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# Laboratory surveillance of *Staphylococcus aureus* bacteraemia in England, Wales and Northern Ireland: 2017

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# Laboratory surveillance of *Staphylococcus aureus* bacteraemia in England, Wales and Northern Ireland: 2017

These analyses are based on data relating to diagnosis of blood stream infections by *Staphylococcus aureus* between 2009 and 2017. Data for England were extracted from the Public Health England (PHE) voluntary surveillance database the Second Generation Surveillance System (SGSS) on the 17 July 2018. Data for Wales and Northern Ireland were extracted separately (DataStore on 6 February 2018 and CoSurv on 2 July 2018, respectively).

In England and Northern Ireland, laboratories are requested to submit data individually to SGSS CDR/CoSurv, with reporting based on clinically significant isolates. Data from Wales is collected by extraction from a single laboratory information system, used by all microbiology laboratories, where all positive blood cultures are recorded, including those not thought to be clinically significant.

Rates of bacteraemia laboratory reports were calculated using mid-year resident population estimates for the respective year and geography with the exception of 2017 rates, which were based on 2016 population estimates as population estimates for 2017 were not available at the time of producing this report [1,2]. Geographical analyses were based on residential postcode, if known – otherwise GP postcode if known; or, failing that, the postcode of the reporting laboratory – with cases in England being assigned to one of nine local PHE Centres (PHECs) formed from administrative local authority boundaries [3].

The report includes analyses on the temporal trends, age and sex distribution, and geographical distribution of cases of MRSA and MSSA bacteraemia cases in England and Northern Ireland. Single-agent antimicrobial susceptibility trends since 2015 are reported for England and Northern Ireland based on SGSS AMR and CoSurv data, respectively. [A web appendix is available featuring the findings of this report including only data submitted to SGSS from laboratories in England.](#)

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.

Data from six laboratories (two in London, one in the South East, one in the North East, one in the North West and one in Yorkshire and Humber) were excluded from the analyses due to concerns about the quality of data submitted to SGSS.

## Key points

- the overall rate of *S. aureus* for England, Wales and Northern Ireland increased for the fifth consecutive year to 19.9 reports per 100,000 population
- in 2017 the rate of *S. aureus* was 19.2 in England, 21.0 in Northern Ireland and 30.2 in Wales
- the rate of MRSA in England and Northern Ireland increased for the first time since 2011 from 1.1 in 2016 to 1.3 reports per 100,000 population in 2017
- the rate of MSSA continued to increase for the third consecutive year
- at the level of the PHE centres (PHECs) the rate of MRSA varied from 0.9 in the East Midlands to 1.7 in the South West
- the rate of MSSA varied across PHECs from 10.1 (London) to 20.9 (North East)
- for both MRSA and MSSA the bacteraemia rate was the highest among  $\geq 75$  years old, 65-74 years old and those below the age of one year
- the bacteraemia rate was higher in males in comparison to females across all age groups for MSSA and MRSA
- between 2015 and 2017 MRSA has had a year on year increase in resistance to gentamicin (7% to 15%), fusidic acid (13% to 22%) and rifampicin (2% to 3%)
- vancomycin, teicoplanin and linezolid have had consistently low rates of resistance reported in MRSA isolates between 2015 and 2017 (0%–<1%)
- the number of MRSA and MSSA bacteraemia reports under voluntary compared to mandatory reporting schemes show broadly similar trends
- in 2017 case ascertainment between voluntary and mandatory schemes was 82.8% for MRSA and 70.1% for MSSA

## Trends

Between 2009 and 2012 there was a decline of 16.5% in the rate of *S. aureus* bacteraemia per 100,000 population in England, Wales and Northern Ireland (figure 1a). Since this point there has been a year on year increase between 2012 and 2017 from 15.7 to 19.9 bacteraemia reports per 100,000 population, an overall increase of 34.4%. The rate of *S. aureus* is at its highest point over the nine year period since 2009.

**Figure 1a. Rates of bacteraemia per 100,000 population (England, Wales and Northern Ireland) caused by *S. aureus*: 2009 to 2017**

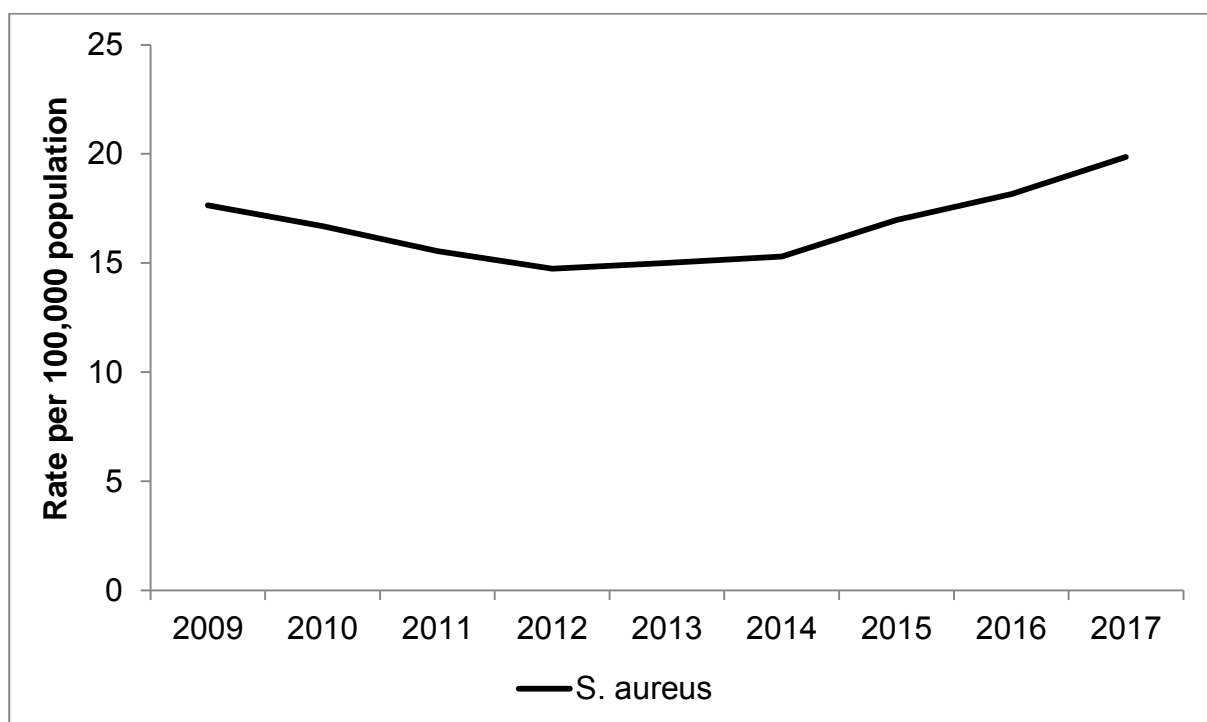


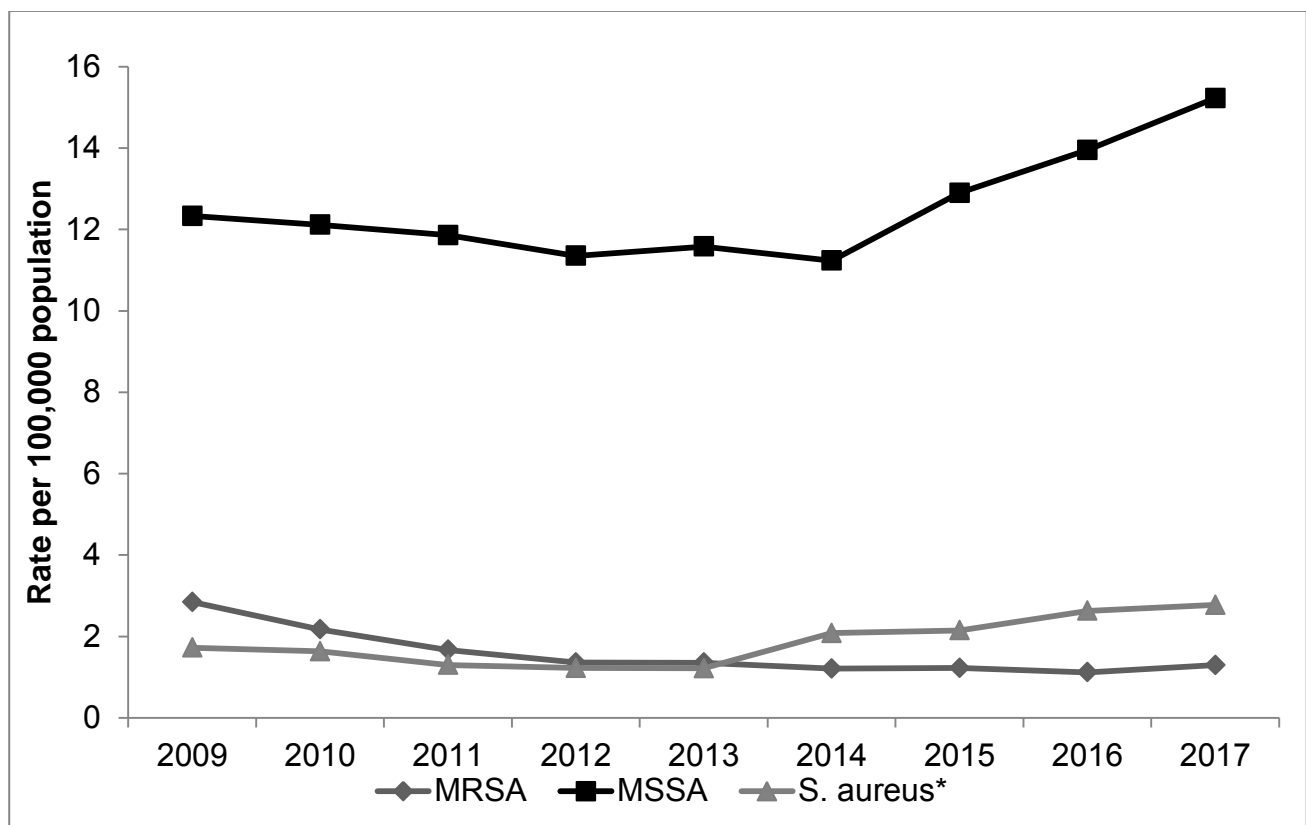
Figure 1b shows the trend in the rate (reports per 100,000 population) of laboratory-reported MRSA (non-susceptibility to meticillin, oxacillin, cloxacillin and/or ceftazidime), MSSA and untested *S. aureus* bacteraemia in England and Northern Ireland between 2009 and 2017.

Between 2009 and 2017, the rate of MRSA decreased by 54.5% in England, and Northern Ireland, with the largest reductions being observed between 2009 and 2012 (49.7%). Since 2011 MRSA has continued to decrease marginally year on year until 2017 when it increased by 15.7% from the rate reported in 2016 (from 1.1 to 1.3 reports per 100,000 population).

The trend in MSSA is characterised by two distinct phases. The first phase between 2009 and 2014 was one in which the rate had a slight decline (8.9%) but was broadly stable. In the second phase there has been an increase year on year between 2014 and 2017 (35.5%).

Caution should be used when interpreting these figures as there has been a 128.2% increase in rates of *S. aureus* bacteraemia without susceptibility test results since 2013 (from 1.1 per 100,00 population in 2013 to 2.8 in 2017). The bacteraemia rate of unspecified *S. aureus* has exceeded the rate MRSA since 2014.

**Figure 1b. Rates of bacteraemia per 100,000 population (England and Northern Ireland) caused by MRSA, MSSA and *S. aureus* where susceptibility to methicillin was not reported: 2009 to 2017**



\**S. aureus* where susceptibility to methicillin was not reported

## Geographic distribution: MRSA

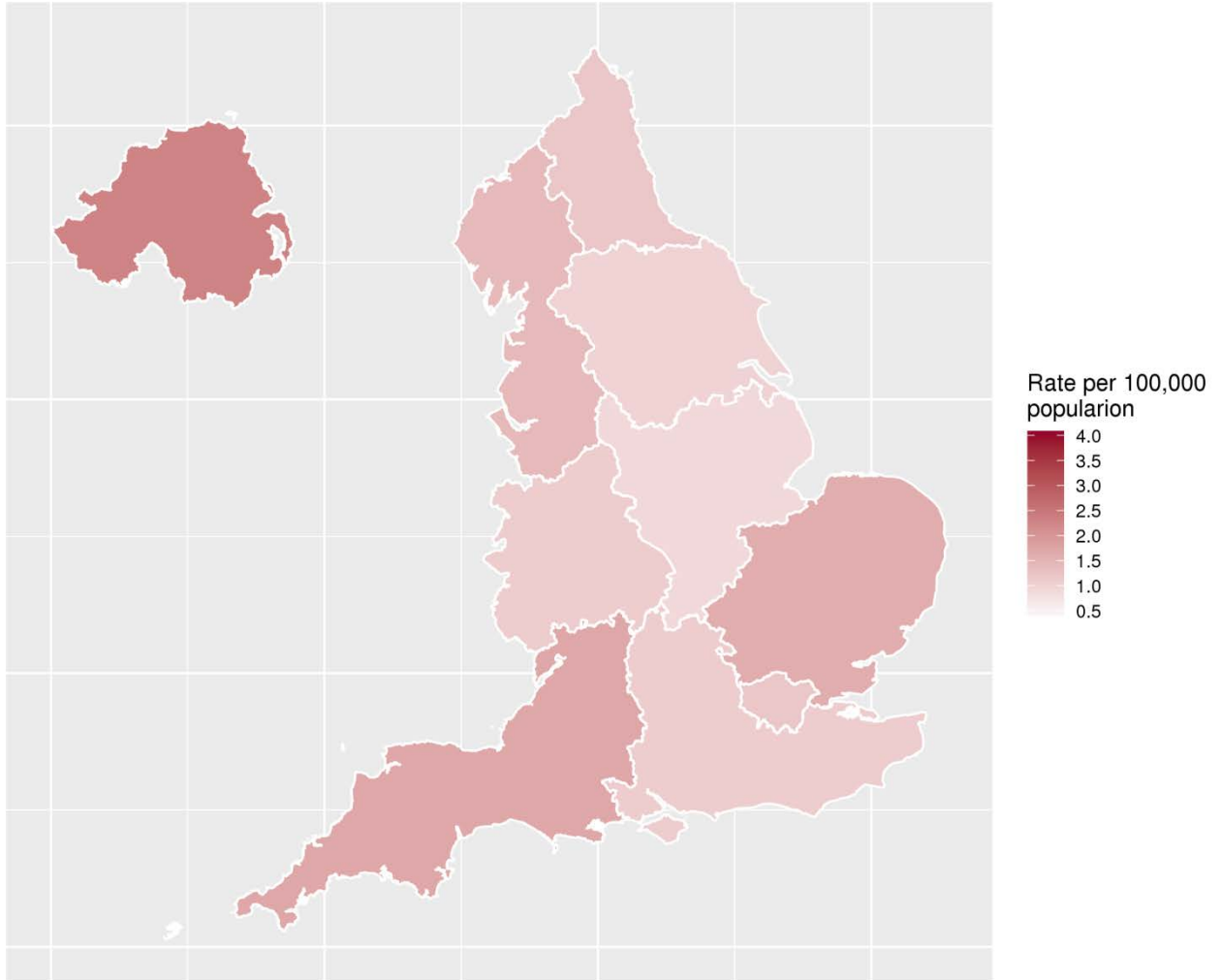
The combined rate of bacteraemia due to MRSA in England and Northern Ireland was 1.3 per 100,000 population in 2017; the rates were 1.3 and 2.3 reports per 100,000 population in England and Northern Ireland, respectively.

While the rate of MRSA in England decreased by 17.2% (1.3 to 1.0 reports per 100,000 population) between 2013 and 2016, an increase was observed between 2016 and 2017 (20.1%). The rate of MRSA bacteraemia in Northern Ireland fluctuated considerably over the same time period, rising from 3.9 to 4.3 reports per 100,000 population between 2013 and 2015 (9.8%) this was followed by a decline of 46.8% in the rate between 2015 and 2017.

At the level of the PHE centres (PHECs) the rate varied from 0.9 in the East Midlands to 1.7 in the South West (Figure 2a) (Table 1a). No PHEC has consistently had the highest or lowest rate of MRSA over the five year period between 2013 and 2017.

Only the North East PHEC had a decline in the rate of MRSA bacteraemia between 2016 and 2017 (8.6%), all other PHEC had an increase in 2017 compared to 2016. The biggest increase was observed in the South East PHEC where the rate increased from 0.7 to 1.1 (67.3%) reports per 100,000 population, although caution is required in this interpretation as the South East had the joint lowest rate reported in 2016. The South West, East Midland and London PHEC all had relatively large increase in the rate of MRSA in 2017 compared to 2016 at 33.7% 23.0% and 18.2% respectively.

**Figure 2a. Geographical distribution of MRSA bacteraemia rates per 100,000 population (England and Northern Ireland): 2017**



**Table 1a: Rate of MRSA bacteraemia reports per 100,000 population by PHE Centre (England and Northern Ireland): 2013 to 2017**

Region	PHE Centre	Rate per 100,000 population				
		2013	2014	2015	2016	2017
North of England	North East	1.3	0.7	1.1	1.4	1.2
	North West	1.5	1.1	1.1	1.2	1.4
	Yorkshire and Humber	1.0	0.7	1.0	1.0	1.0
Midlands and East of England	East Midlands	1.1	1.1	1.2	0.7	0.9
	East of England	1.2	1.8	1.4	1.4	1.6
	West Midlands	1.3	1.3	1.7	1.0	1.1
London	London	1.4	1.1	1.0	1.0	1.2
South of England	South East	1.4	1.0	0.8	0.7	1.1
	South West	1.0	1.4	1.1	1.3	1.7
England		1.3	1.2	1.1	1.0	1.3
Northern Ireland		3.9	2.9	4.3	3.2	2.3
England and Northern Ireland		1.4	1.2	1.2	1.1	1.3

### Geographic distribution: MSSA

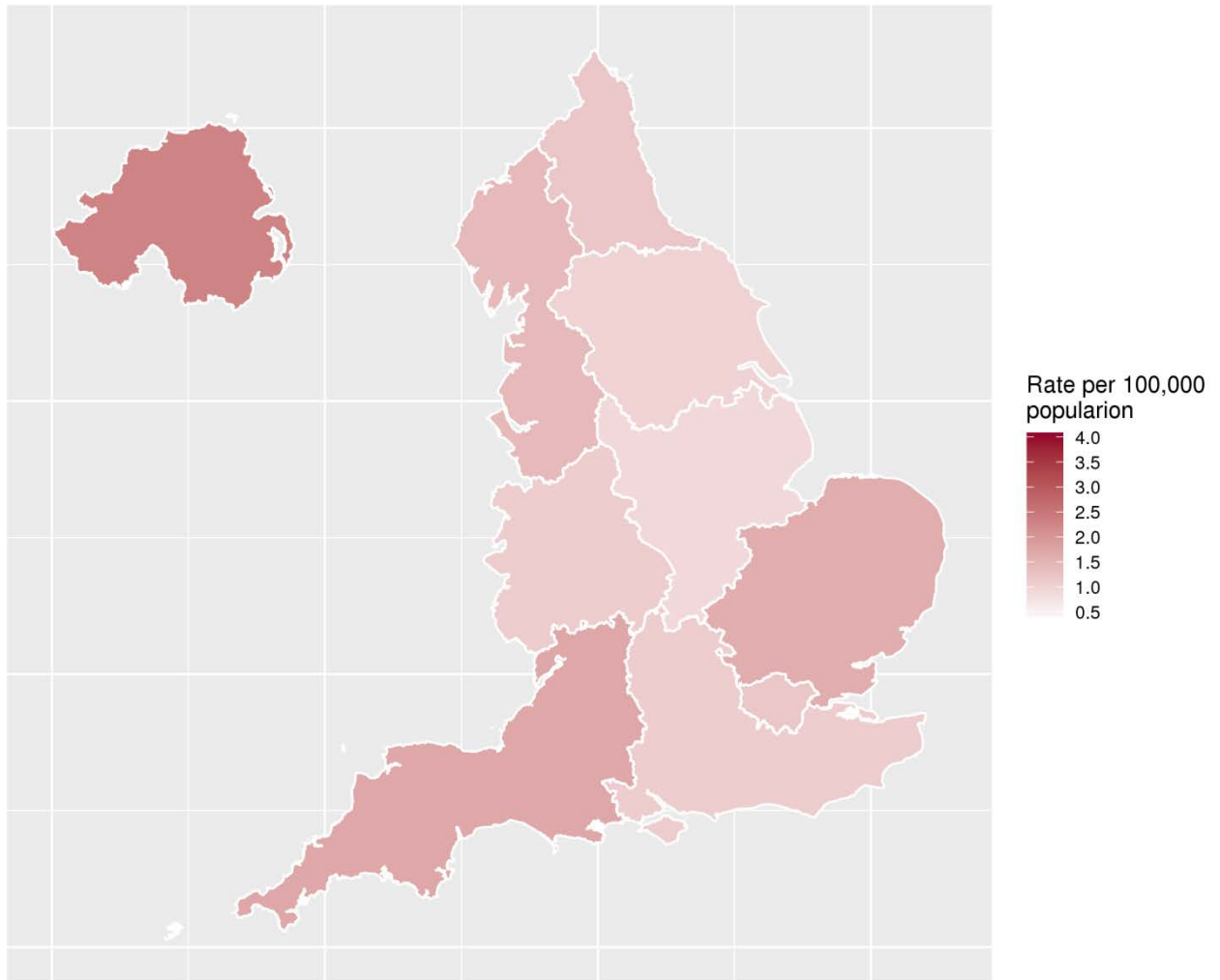
The combined rate of bacteraemia due to MSSA in England and Northern Ireland was 15.2 reports per 100,000 population in 2017; this was a third consecutive increase since 2014. Individually, the rates of laboratory-reported bacteraemia were 15.1 and 18.5 per 100,000 population in England and Northern Ireland respectively (table 1b). In 2017, compared to 2013 both England (32.0%) and Northern Ireland (21.3%) had an increase in the rate of MSSA bacteraemia.

At the level of the PHEC the rate varied from 10.1 in the London to 20.9 in the North East (figure 2b, table 1b). No PHEC has consistently had the highest or lowest rate of MSSA over the five year period between 2013 and 2017.

Between 2013 and 2017 the rate of MSSA bacteraemia increased among all PHECs. Over the same period the largest increases were observed in PHECs of Yorkshire and Humber (76.4%; 8.7 to 15.3 per 100,000), East Midlands (56.7%; 11.1 to 17.4 per 100,000) and South West (50.3%; 13.2 to 19.8 per 100,000). Furthermore all PHECs reported an increase in MSSA bacteraemia between 2016 and 2017 with the exception of the South East and the North East, although the North East had reported the highest rate during 2016.



**Figure 2b. Geographical distribution of MSSA bacteraemia rates per 100,000 population (England, Wales and Northern Ireland): 2017**



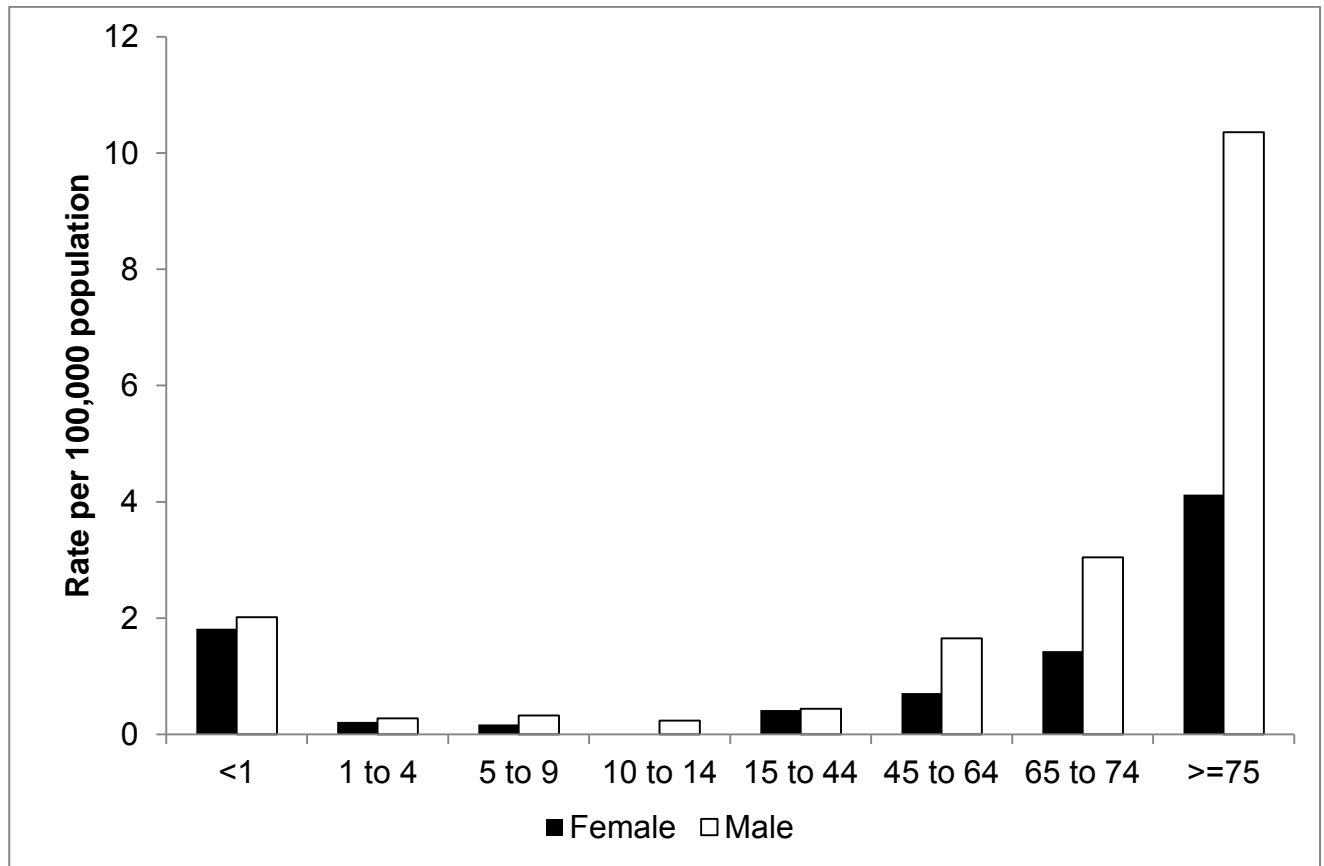
**Table 1b: Rate of MSSA bacteraemia reports per 100,000 population by PHE Centre (England, Wales and Northern Ireland): 2012 to 2016**

Region	PHE Centre	Rate per 100,000 population				
		2013	2014	2015	2016	2017
North of England	North East	15.3	13.5	19.7	22.3	20.9
	North West	12.6	11.4	12.8	11.1	14.2
	Yorkshire and Humber	8.7	9.4	14.4	14.4	15.3
Midlands and East of England	East Midlands	11.1	11.5	15.7	17.1	17.4
	East of England	11.6	12.5	13.9	15.1	16.4
	West Midlands	14.0	13.8	15.2	17.5	19.0
London	London	9.6	7.9	7.7	7.5	10.1
South of England	South East	10.1	9.6	9.4	11.7	11.3
	South West	13.2	13.8	15.0	17.8	19.8
England		11.5	11.1	12.8	13.8	15.1
Northern Ireland		15.2	15.3	16.5	18.8	18.5
England and NI		11.6	11.2	12.9	14.0	15.2

### Age and sex distribution: MRSA

Figure 3a depicts MRSA bacteraemia rates per 100,000 population amongst men and women across different age groups in England and Northern Ireland in 2017. The bacteraemia rate was the highest in the  $\geq 75$  years, 65-74 years and  $< 1$  year age groups. The rate of bacteraemia per 100,000 population in these age groups was markedly higher amongst males in comparison to females ( $\geq 75$  years: 10.4 vs. 4.1, 65-74 years: 3.0 vs. 1.4 and  $< 1$  year: 1.9 vs 1.0 per 100,000 population). This pattern was broadly similar to previously reported data [2].

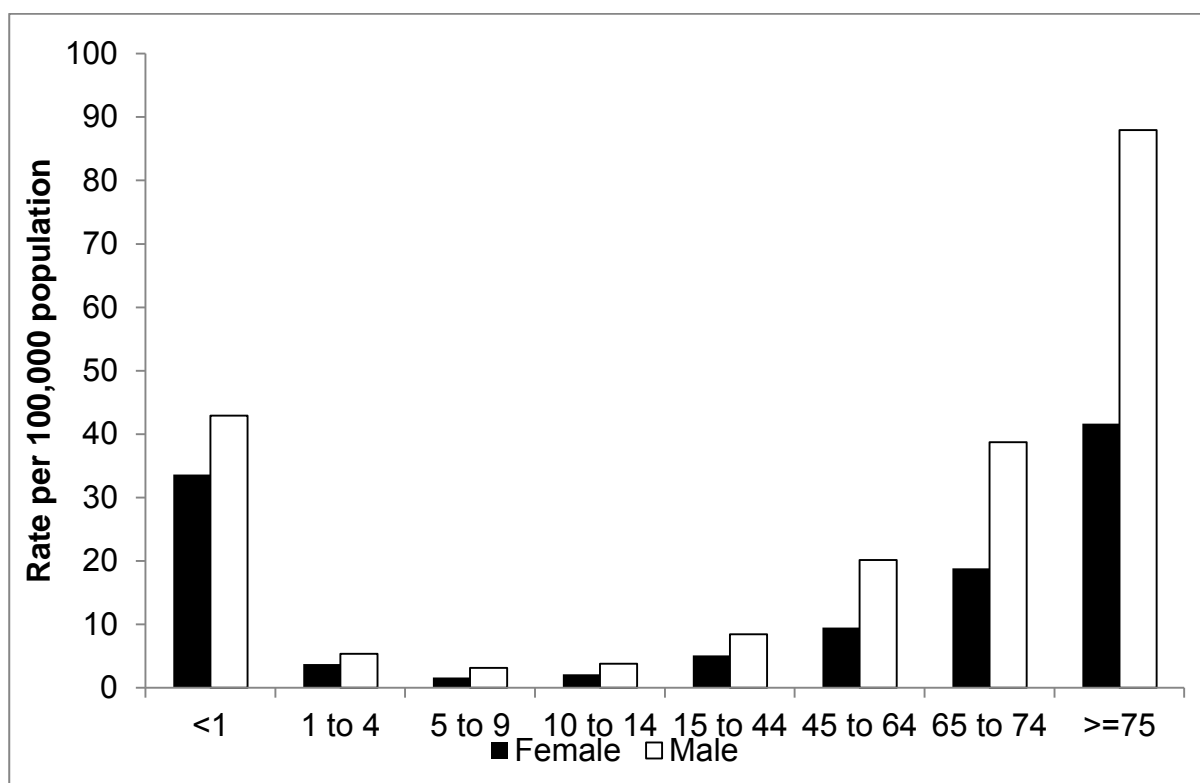
**Figure 3a. MRSA bacteraemia rates per 100,000 population by age and sex (England and Northern Ireland): 2017**



## Age and sex distribution: MSSA

Figure 3b shows that the rate of MSSA bacteraemia had similar distribution patterns across age and sex as MRSA bacteraemia. The highest combined bacteraemia rate was observed in those aged 75 years and older (61.3 reports per 100,000 population), in the under 1 year-olds (38.5 reports per 100,000 population) and in the 65-74 year-olds (28.4 reports per 100,000 population). The bacteraemia rate was higher in males in comparison to females across all age groups, with men having double the rate of females in the  $\geq 75$ , 65-74 and 45-64 years age groups (87.9 vs. 41.7, 38.7 vs. 18.8 and 20.2 vs 9.5 per 100,000 population, respectively).

**Figure 3b. MSSA bacteraemia rates per 100,000 population by age and sex (England and Northern Ireland): 2017**



## Antimicrobial resistance: England and Northern Ireland

Tables 2a and 2b show trends in susceptibility to key antibiotic agents for MRSA and MSSA between 2015 and 2017 for England and Northern Ireland.

Since 2015 there has been a sharp increase in proportion of MRSA isolates that are resistant to gentamicin (7% to 15%). Over the same period there has been a similar increase reported for isolates tested against fusidic acid (13% to 22%). Resistance to rifampicin, while relatively low, has also increased from 2% in 2015 to 3% in 2017. A slight increase has been reported in isolates reporting resistance to mupirocin from 3.8% in 2015 to 4.2% in 2017. Vancomycin, teicoplanin and linezolid all have had consistently low rates of resistance reported between 2015 and 2017 (0%–<1%), a further point being no isolates have displayed high level (van-mediated) resistance to vancomycin. Rates of resistance reported in isolates to ciprofloxacin and erythromycin have consistently been high over the three year period and remained so in 2017 at 66% and 55% respectively.

There was a markedly different response to first line treatments among tests that were performed on MSSA isolates, for which resistance was comparably much lower.

Resistance to erythromycin has increased between 2015 and 2017 from 14% to 17%. The number of isolates with resistance to gentamicin increased in 2017 compared to 2016 from 1% to 2%, although the rate in 2016 was slightly lower than in 2015. Resistance to ciprofloxacin remained stable at 6% when compared to the two previous years.

Vancomycin, teicoplanin and linezolid have had consistently low rates of resistance reported between 2015 and 2017 (0% to <1%). Resistance to rifampicin, mupirocin and fusidic acid decreased in 2017 compared to 2015 but remain broadly stable at <1%, <1% 12% respectively.

Individuals diagnosed with MRSA are more likely to have bacteraemia that also has resistance to additional first line treatments. Treatment options for patients infected with MRSA resistant to multiple antimicrobials are more limited; such individuals will more likely suffer premature mortality, thus highlighting the increasing concern over antimicrobial resistance [4,5].

**Table 2a. Antimicrobial susceptibility\* for MRSA bacteraemia (England and Northern Ireland): 2015 to 2017**

Antimicrobial agent	2015			2016			2017		
	S (%)	I (%)	R (%)	S (%)	I (%)	R (%)	S (%)	I (%)	R (%)
Gentamicin	93	0	7	89	0	11	84	<1	15
Ciprofloxacin	21	<1	78	32	<1	67	32	2	66
Vancomycin	100	0	<1	100	0	0	100	<1	0
Teicoplanin	100	0	<1	99	0	<1	99	<1	<1
Linezolid	100	0	<1	100	0	0	100	0	<1
Erythromycin	40	<1	60	44	1	56	45	<1	55
Rifampicin	97	<1	2	96	1	3	97	<1	3
Mupiricin	94	2	4	94	2	4	94	2	4
Fusidic Acid	85	2	13	80	<1	20	78	<1	22

\*S = susceptible; I = intermediate (reduced susceptibility); R = resistant

**Table 2b. Antimicrobial susceptibility\* for MSSA bacteraemia (England and Northern Ireland): 2015 to 2017**

Antimicrobial agent	2015			2016			2017		
	S (%)	I (%)	R (%)	S (%)	I (%)	R (%)	S (%)	I (%)	R (%)
Gentamicin	99	<1	1	99	0	1	98	0	2
Ciprofloxacin	93	1	6	93	<1	6	93	1	6
Vancomycin	100	0	<1	100	0	0	100	0	0
Teicoplanin	100	0	<1	100	<1	<1	100	0	<1
Linezolid	100	0	<1	100	0	0	100	0	<1
Erythromycin	86	<1	14	84	<1	15	83	<1	17
Rifampicin	98	1	1	98	1	<1	99	<1	<1
Mupiricin	99	<1	<1	99	<1	<1	99	<1	<1
Fusidic Acid	86	<1	13	87	<1	13	87	<1	12

\*S = susceptible; I = intermediate (reduced susceptibility); R = resistant

## **Ascertainment: Comparison of MRSA and MSSA positive specimens from the voluntary laboratory reporting scheme versus MRSA and MSSA infections from the mandatory surveillance scheme in England**

The following data compare MRSA and MSSA bacteraemias reported to the voluntary laboratory surveillance scheme with those reported to the mandatory surveillance scheme. All voluntary bacteraemia reports were limited to those from England only (Wales and Northern Ireland do not take part in the English mandatory surveillance scheme); data from six laboratories (two in London, one in the South East, one in the North East, one in the North West and one in Yorkshire and Humber) were excluded due to concerns about the quality of data submitted to SGSS.

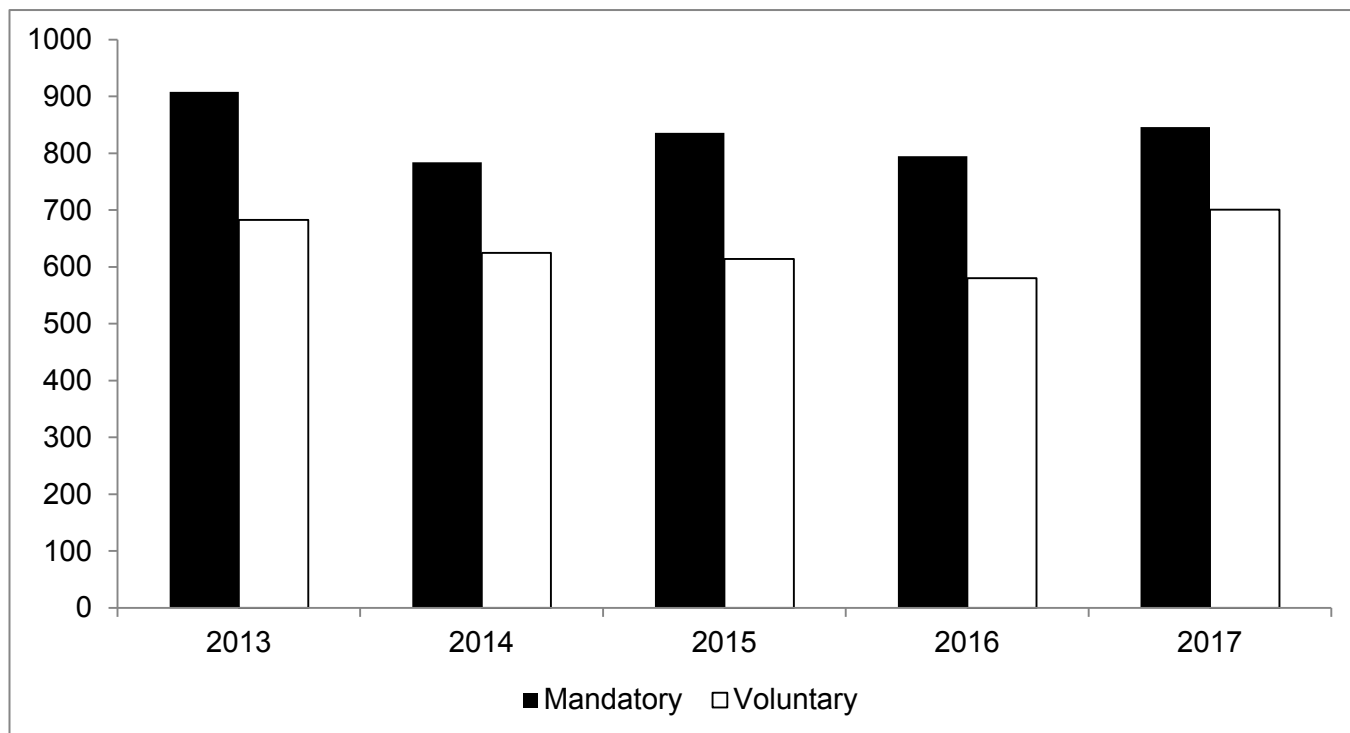
The number of MRSA bacteraemia reports under voluntary and mandatory reporting schemes shows a broadly similar trend (figure 4a), although the number that are reported through voluntary surveillance is lower than through the mandatory scheme.

The number of MSSA bacteraemia reports increased in both the mandatory and voluntary surveillance schemes between 2013 and 2017, albeit numbers reported voluntarily were much lower.

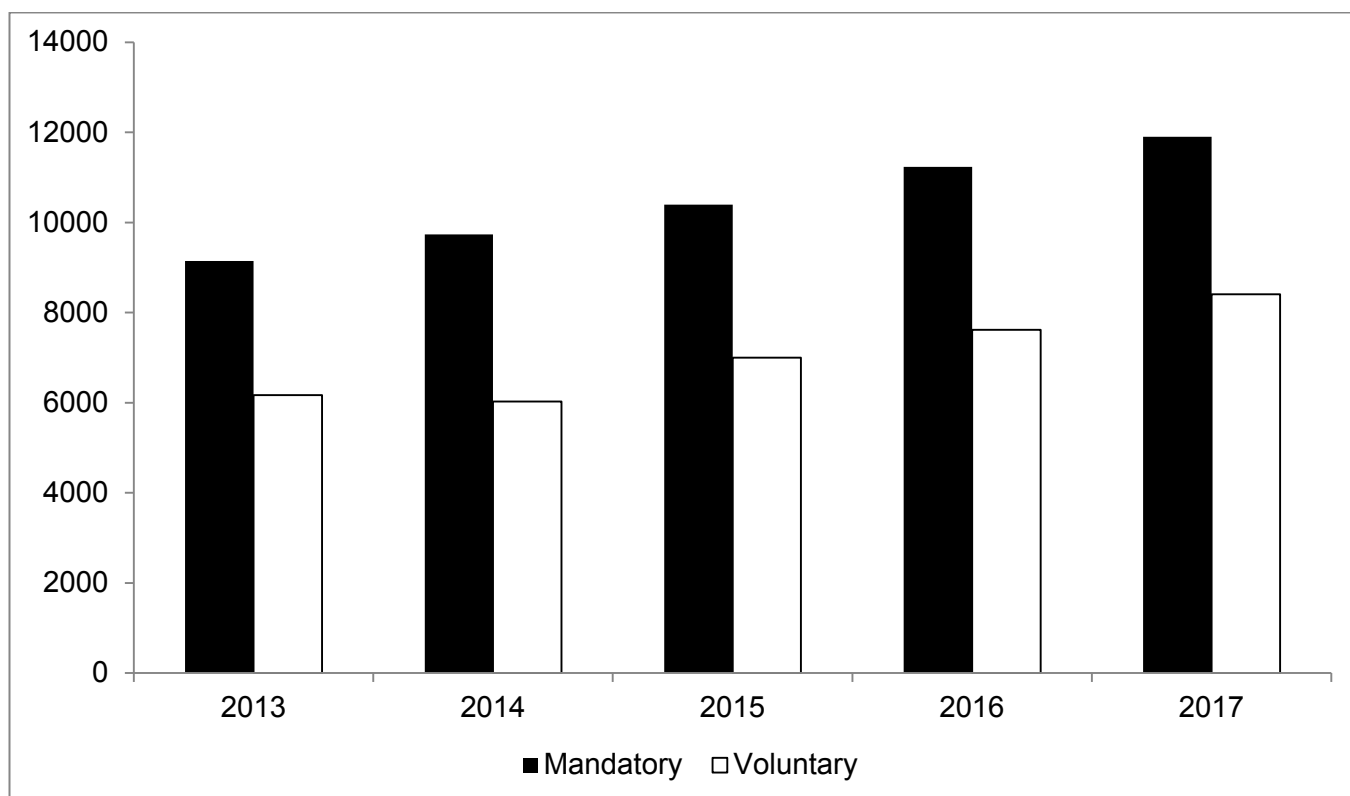
The case ascertainment of MRSA bacteraemia reports to the voluntary scheme fluctuated between 2012 and 2016, reaching its highest at 83% in 2017. The number of MSSA reported to the voluntary compared to the mandatory scheme was stable at approximately 65%-70% between 2013 and 2017, with the exception of 2014, when it decreased to 62 %.



**Figure 4a. Ascertainment of MRSA bacteraemia data for the mandatory and voluntary reporting schemes in England: 2013-2017**



**Figure 4b. Ascertainment of MSSA bacteraemia data for the mandatory and voluntary reporting schemes in England: 2013-2017**



## 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. The support from colleagues within Public Health England, Public Health Wales and Public Health Agency, Northern Ireland and the PHE Reference Unit, in particular, is valued in the preparation of this report. Feedback and specific queries about this report are welcome and can be sent to:

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