

Statistical bulletin

# Deaths involving MRSA: England and Wales: 2007 to 2011

Deaths where Meticillin-resistant Staphylococcus aureus (MRSA) was mentioned on the death certificate by sex, age group and whether the death occurred in hospital or elsewhere.



Contact:  
Olugbenga Olatunde  
mortality@ons.gsi.gov.uk

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# 1. Deaths involving MRSA: England and Wales, 2011

- The number of death certificates mentioning MRSA fell by a quarter from 485 in 2010 to 364 in 2011
- For males and females, there was a five-fold decrease in the age-standardised rate for deaths involving MRSA between 2007 and 2011
- In both England and Wales, the age-standardised rate for deaths involving MRSA rose with increasing area deprivation in each period examined
- In England, inequality in deaths involving MRSA between the least and most deprived neighbourhoods increased between the periods 2001–05 and 2006–10
- In the most recent five-year period, 2007–11, the age-specific rate for deaths mentioning MRSA increased with age and was generally higher for males than for females
- In England, the age-standardised rate for deaths involving MRSA was significantly lower in the least deprived areas than in the most deprived in each period examined
- In Wales, the age-standardised rate for deaths involving MRSA was significantly lower in the least deprived neighbourhoods than in the most deprived in each period, except 2005–09

## 2. Summary

Meticillin-resistant *Staphylococcus aureus* (MRSA) is a type of *Staphylococcus* bacteria that is resistant to antibiotics known as beta-lactams. *Staphylococcus aureus* (*S. aureus*) bacteria can cause mild to life threatening disease if there is an opportunity for it to enter the body through broken skin or a procedure requiring the use of an invasive medical device.

This bulletin presents the latest figures for deaths where *Meticillin-resistant Staphylococcus aureus* (MRSA) was mentioned or was identified as the underlying cause of death on death certificates. Data are presented for England and Wales and are broken down by sex, age group and place of death.

Comparisons are made between data for 2011, the latest year, and previously released data from 1993 onwards. Information is given about the context and use of the statistics, and the methods used to produce them. For the first time, inequality in the number of deaths involving *Staphylococcus aureus* and MRSA are examined using the English and Welsh Indices of Multiple Deprivation (IMD 2010 and WIMD 2011) respectively.

Age-specific and age-standardised rates are presented in this bulletin. For both types of rate, mid-year population estimates were used as the denominator. However, as at the time of writing, these estimates were not available for 2011. As a result, mid-year population estimates were used for 1993 to 2010 while population projections were used for 2011.

Therefore, age-specific rates for the period 2007–11 as well as age-standardised rates for 2011 presented here are provisional. Rates for 2002 onwards will be revised in the 2013 bulletin following the release of 2011 Census based mid-year population estimates.

The number of death certificates mentioning *Staphylococcus aureus* fell by 33.6 per cent from 961 in 2010 to 638 in 2011. Similarly, deaths involving MRSA fell by 24.9 per cent from 485 in 2010 to 364 in 2011. Despite these improvements, the number of deaths from MRSA in 2011 is still seven times higher than in 1993 when data were first published (Figure 1).

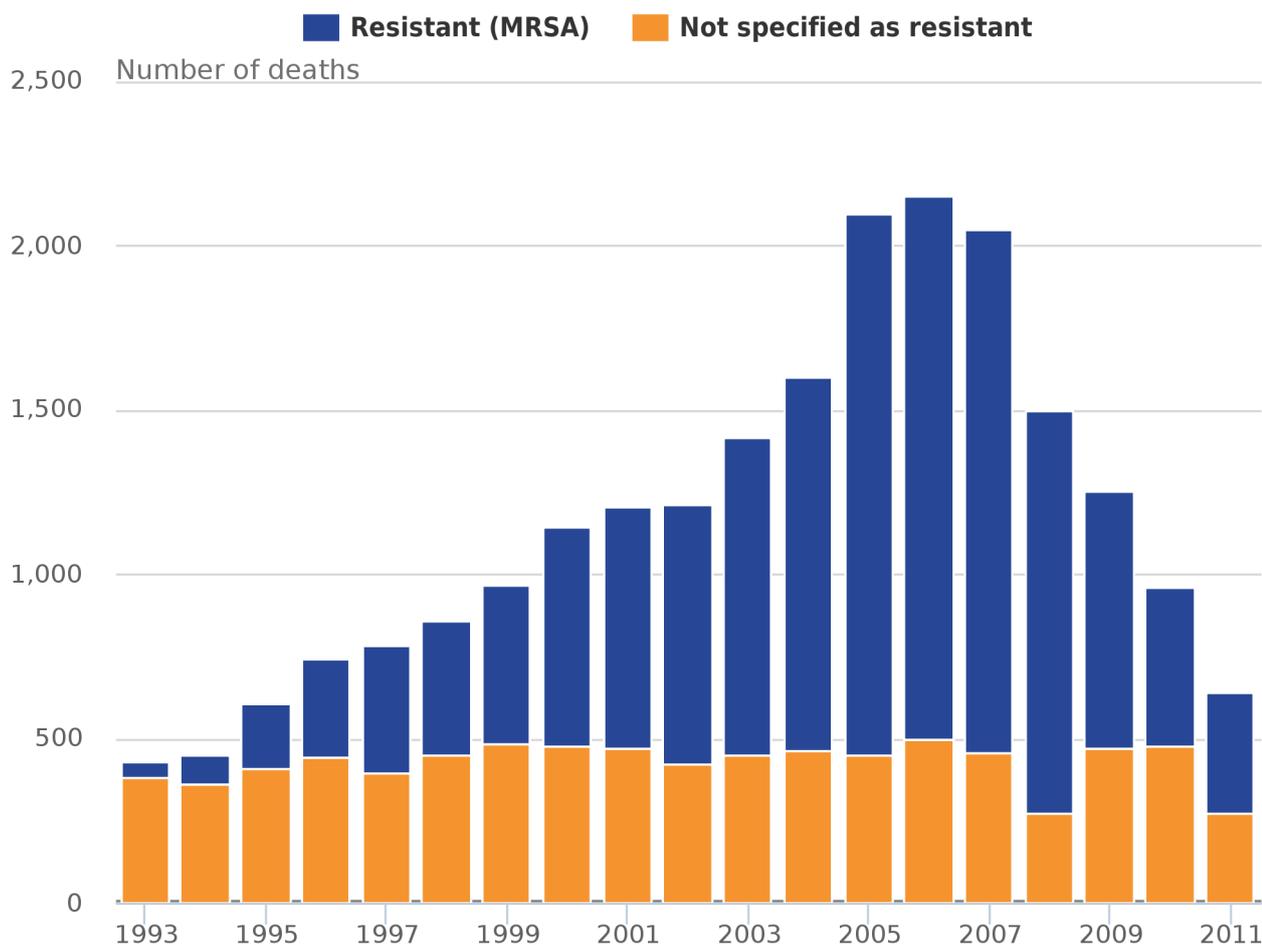
For males, there was a five-fold decrease in the age-standardised rate for deaths involving MRSA from 26.5 deaths per million population in 2007 to 5.4 per million in 2011. For females, there was also a five-fold decrease in rates from 11.9 to 2.4 deaths per million population over these periods.

In both England and Wales, the age-standardised rate for deaths involving *S. aureus* and MRSA increased with increasing area deprivation in each period examined. In addition, the inequality in these rates between the least and most deprived neighbourhoods increased between the periods 2001–05 and 2006–10.

In the most recent five-year period, 2007–11, the age-specific rate for deaths mentioning *S. aureus* and MRSA increased with age and was generally higher for males than for females.

**Figure 1. Number of death certificates mentioning *Staphylococcus aureus*: by meticillin resistance, England and Wales, 1993 to 2011**

**England and Wales**



**Source: Office for National Statistics**

**Notes:**

1. Figures for England and Wales combined include deaths of non-residents. When presented separately, data for each country exclude non-residents.
2. Figures are for deaths registered in each calendar year.

### 3. Background

Staphylococcus aureus (*S. aureus*) is an opportunistic bacterial pathogen associated with the colonisation of the skin and mucosal surfaces of humans without causing any harm ([World Health Organization, 2012](#)). About a third of the population are colonised (known as carriers) with *S. aureus* ([London Health Observatory, 2012](#)).

It can cause disease if there is an opportunity for it to enter the body through broken skin or a procedure requiring the use of an invasive medical device ([Health Protection Agency, 2012a](#)). If the bacteria enter the body, mild to life-threatening illnesses may then develop.

These include skin and wound infections, infected eczema, abscesses or joint infections and pneumonia. It also has the potential to induce infection of the bone (osteomyelitis), infections of the heart valves (endocarditis) and bacteraemia (blood stream infection), leading to infections in any of the major organs of the body ([Health Protection Agency, 2012a](#); [World Health Organisation, 2012](#)).

*S. aureus* is also responsible for many serious community- and hospital- acquired infections, being the most frequently isolated bacterial pathogen from patients with hospital-acquired infections, especially those with implants or prosthetic devices ([World Health Organisation, 2012](#)).

Most strains of *S. aureus* are sensitive to the more commonly used antibiotics, and infections can be effectively treated. Some are however more resistant and often require different types of antibiotics to treat them ([Health Protection Agency, 2012a](#)).

Meticillin-resistant Staphylococcus aureus (MRSA) is a type of Staphylococcus bacteria that is resistant to antibiotics known as beta-lactams. This group of antibiotics include meticillin and other more common antibiotics such as oxacillin, penicillin and amoxicillin ([Centre for Disease Control, 2010](#)).

The concern about MRSA is in part due to the fact that it shows a higher degree of drug resistance than other types of *S. aureus* and also because it has become particularly associated with hospital acquired infections ([Public Health Wales, 2011a](#)).

There is also growing concern about community-acquired MRSA in some parts of the world, with studies ([Herold et al., 1998](#); [Salmenlinna S, Lyytikäinen O and Vuopio-Varkila, 2002](#)) suggesting that this type of MRSA can be found in otherwise healthy people with no previous contact with healthcare facilities or hospitalised persons.

### 4. Use of MRSA data

Incidence and mortality data for *S. aureus* and MRSA infections in England and Wales are used by various organisations, including the Department of Health (DH), Health Protection Agency (HPA), and Public Health Wales to highlight the burden of MRSA and to monitor and evaluate intervention programs aimed at reducing this burden. They are also used by primary care organisations (PCOs), local health boards (LHBs) and individual healthcare establishments.

In England, the Operating Framework for the NHS is the document which sets out the planning, performance and financial requirements for NHS organisations and the basis on which they will be held to account.

To reflect NHS's increased focus on controlling healthcare associated infections, the 2012/13 Framework ([DH, 2011](#)) highlights, 'Treating and caring for people in a safe environment and protecting them from avoidable deaths,' as one of the important dimensions of quality used in monitoring and assessing performance. Reducing the incidence of MRSA is seen as one of three key drivers of this dimension.

Of particular interest is the reduction of MRSA bloodstream infections as these are more common in healthcare settings and are more likely to be associated with undesirable outcomes. In 2001, the Health Protection Agency (HPA) developed a Mandatory MRSA surveillance scheme on behalf of the Department of Health (DH) to monitor trends and enable epidemiological analyses of MRSA bloodstream infections data.

Data gathered from the surveillance scheme showed that since its peak in 2003/04, there have been large reductions in the reports of MRSA bloodstream infections ([HPA 2012b](#)). For example, between April 2011 and March 2012 there were 1,114 MRSA bloodstream infection reports made; a 24.8 per cent reduction compared to the number of reports between April 2010 and March 2011 at 1,481 ([HPA, 2012b](#)). A report by HPA suggests that the improved trend is likely due to initial interventions which were targeted at hospital-based infection control practices ([HPA, 2012c](#)).

In Wales, surveillance of MRSA is managed by the Welsh Healthcare Associated Infection Programme (WHAIP), which is part of Public Health Wales. As in England, in recent years there has been a decrease in the number of cases in Wales. For example, figures for April 2010 to March 2011 (2010/11) show that there were 218 cases of MRSA bloodstream infection reported.

This represents a reduction of 20.4 per cent on the 274 cases reported in 2009/10. Similarly the number of *S. aureus* bloodstream infection cases fell by 8.5 per cent from 958 to 877 over the same periods ([Public Health Wales, 2011b](#)).

Deaths involving *S. aureus* and MRSA statistics have been produced by the Office for National Statistics (ONS) for each year since 1993. Figures for recent years show a large decrease in the number and age-standardised rate of deaths where *S. aureus* and MRSA were the underlying cause of death or were mentioned anywhere on the death certificate.

This trend is consistent with the decreases in incidence as reported by the HPA and Public Health Wales. The decreases may in part be due to the actions taken to reduce healthcare associated infections described above. It is however noteworthy that the English and Welsh surveillance reports only focus on bloodstream infections and not other types of infections associated with MSRA. Conversely, the figures presented in this report are for deaths from all MRSA related infections.

## 5. Results

Results presented here are for England and Wales combined (with the exception of area deprivation), while the tables accompanying the commentary contain results for both countries separately. In addition, while data for 1993 onwards are compared in this section, the accompanying tables contain data for the last five years or latest five-year period for ease of presentation. The reference table accompanying this bulletin contains data from 1993 onwards.

### **Number of deaths where Staphylococcus aureus or MRSA were mentioned on the death certificate**

The number of death certificates mentioning *S. aureus* (including those resistant to meticillin) increased from 430 in 1993, when these data were first published, to 638 in 2011. Within this period, there was an initial steady rise in these deaths until 2006 when the numbers were five times those recorded in 1993 at 2,150.

The numbers have since fallen to date. Latest figures show that in 2011, there were 638 mentions of *S. aureus*; a 33.6 per cent decrease compared to the number of mentions in 2010 at 961.

A similar trend was observed with MRSA. The number of deaths increased from 51 in 1993 to a peak of 1,652 in 2006 before falling. Latest figures also show that the number of mentions of MRSA fell by 24.9 per cent from 485 in 2010 to 364 in 2011.

The proportion of *S. aureus* mentions that were MRSA stood at 12 per cent in 1993. Over time this proportion has fluctuated substantially, peaking at 82 per cent in 2008. In 2011, fifty-seven per cent of all *S. aureus* mentions were MRSA, representing an increase of 7 percentage points on the previous year.

In 1993, of the 430 death certificates mentioning *S. aureus*, 36 per cent also attributed the underlying cause of death to this bacterial agent. For MRSA, this was lower at 29 per cent. By 2011 the percentage of *S. aureus* and MRSA mentions where these bacterial agents were also recorded as the underlying cause of death had fallen to 24 per cent and 18 per cent respectively.

Although there have been fluctuations in these figures since 1993, the most notable change occurred in 2008 when there was a decrease of at least 10 percentage points on the previous year for *S. aureus* and MRSA. There has been little or no change since then (see Table 1).

**Table 1: Number of deaths where *Staphylococcus aureus* or MRSA was mentioned on the death certificate, 2007–2011**

England and Wales

	Numbers, %				
	2007	2008	2009	2010	2011
England and Wales					
Mentions					
Staphylococcus aureus	2,052	1,500	1,253	961	638
MRSA	1,593	1,230	781	485	364
Percentage of <i>S. aureus</i> mentions that were MRSA	78	82	62	50	57
Underlying cause					
Staphylococcus aureus	630	305	294	229	153
MRSA	460	228	147	82	65
Percentage of mentions selected as underlying cause					
Staphylococcus aureus	31	20	23	24	24
MRSA	29	19	19	17	18
England					
Mentions					
Staphylococcus aureus	1,941	1,395	1,165	887	576
MRSA	1,517	1,137	718	437	325
Percentage of <i>S. aureus</i> mentions that were MRSA	78	82	62	49	56
Underlying cause					
Staphylococcus aureus	596	273	275	208	135
MRSA	439	200	133	68	56
Percentage of mentions selected as underlying cause					
Staphylococcus aureus	31	20	24	23	23
MRSA	29	18	19	16	17
Wales					
Mentions					
Staphylococcus aureus	103	101	87	72	43
MRSA	73	90	63	47	31

Percentage of <i>S. aureus</i> mentions that were MRSA	71	89	72	65	72
Underlying cause					
Staphylococcus aureus	30	31	19	20	13
MRSA	20	27	14	14	8
Percentage of mentions selected as underlying cause					
Staphylococcus aureus	29	31	22	28	30
MRSA	27	30	22	30	26

Source: Office for National Statistics

Notes:

1. Figures for England and Wales include deaths of non-residents. Data for England and Wales separately exclude deaths of non-residents.
2. Figures are for deaths registered in each calendar year.

## Age-specific mortality rate for deaths mentioning *Staphylococcus aureus* and MRSA

In each year, the number of deaths mentioning *S. aureus* and MRSA broken down by age and sex are small and are therefore subject to random variation. To minimise the effect of this variation on age-specific rates, five years of data were pooled to ensure sufficient number of deaths.

In the period 2007–11, the age-specific rate for deaths mentioning *S. aureus* and MRSA increased with age and was generally higher for males than for females.

For males, rates for *S. aureus* and MRSA were lowest among those under 45 years of age at 2.3 and 0.7 deaths per million population respectively. For females, the corresponding rates were 1.7 and 0.5 deaths per million population respectively.

The highest rates were observed among males and females aged 85 years and over. For males at this age, the rate for deaths involving *S. aureus* was 233 times greater than the rate for those aged under 45 years of age at 524.5 deaths per million.

The disparity was even greater for MRSA with the rate among those aged 85 years and over almost 600 times greater than the rate for those under 45 years at 411.2 deaths per million. For females the rate for deaths involving *S. aureus* and MRSA were 256.6 and 197.5 deaths per million respectively for those aged 85 years and over. As with males, these rates were substantially greater than for those under 45 years.

Sick people in healthcare facilities are at increased risk of contracting MRSA. Older people are particularly vulnerable because the immune system weakens with age and they are more likely than younger people to have other underlying health problems.

It is therefore expected that the rate of deaths involving MRSA and *S. aureus* will increase with age. It is important to monitor these rates by age as there is evidence ([McMullen, Warren and Woeltje, 2009](#)) suggesting that the median age of hospital patients with MRSA in some countries may be falling.

**Table 2: Age-specific mortality rates for deaths mentioning *Staphylococcus aureus* and MRSA by age, 2007–2011**

England and Wales

Rate per million population

Age group	Males		Females	
	S. aureus	MRSA	S.aureus	MRSA
England and Wales <sup>1</sup>				
Under 45	2.3	0.7	1.7	0.5
45–54	7.9	4.3	5.0	2.8
55–64	20.7	12.4	10.7	6.1
65–74	60.5	43.9	31.6	19.7
75–84	185.4	137.3	105.1	72.0
85 and over	524.5	411.2	256.6	197.5
England				
Under 45	2.1	0.6	1.8	0.5
45–54	7.8	4.1	4.9	2.8
55–64	20.6	12.2	10.3	5.7
65–74	58.8	42.0	31.6	20.1
75–84	182.4	135.3	103.9	71.1
85 and over	527.3	413.2	257.1	197.2
Wales				
Under 45	3.1	1.7	1.2	:
45–54	9.2	7.1	2.9	2.9
55–64	18.9	13.6	16.2	10.1
65–74	80.7	67.7	29.3	14.7
75–84	221.8	166.4	118.6	86.6
85 and over	445.9	361.7	237.2	193.7

Source: Office for National Statistics

Notes:

1. Rates for 2007–11 are provisional because the denominators are based on mid-year population estimates for 2007 to 2010 and population projections for 2011.
2. Figures for England and Wales combined include deaths of non-residents. When presented separately, data for each country exclude non-residents.
3. Figures are for deaths registered in each calendar year.
4. Rates were not calculated where there were fewer than 3 deaths in a cell denoted by ':'.  
:
5. Rates calculated from fewer than 20 deaths are shown in italics.

### Age-standardised mortality rate for deaths mentioning *Staphylococcus aureus* and MRSA

The age-standardised rates for deaths mentioning *S. aureus* and MRSA increased between 1993 and 2011 and were substantially greater for males than for females.

For males, the rate for deaths mentioning *S. aureus* was 8.8 per million population in 1993 and 9.8 deaths per million population in 2011. However, these figures mask the variation in rates within this period which show an initial increase in each year to a peak of 35.7 deaths per million in 2006 before falling. It is noteworthy that for the first time since 1994, the age-standardised rate is no longer significantly higher than it was in 1993.

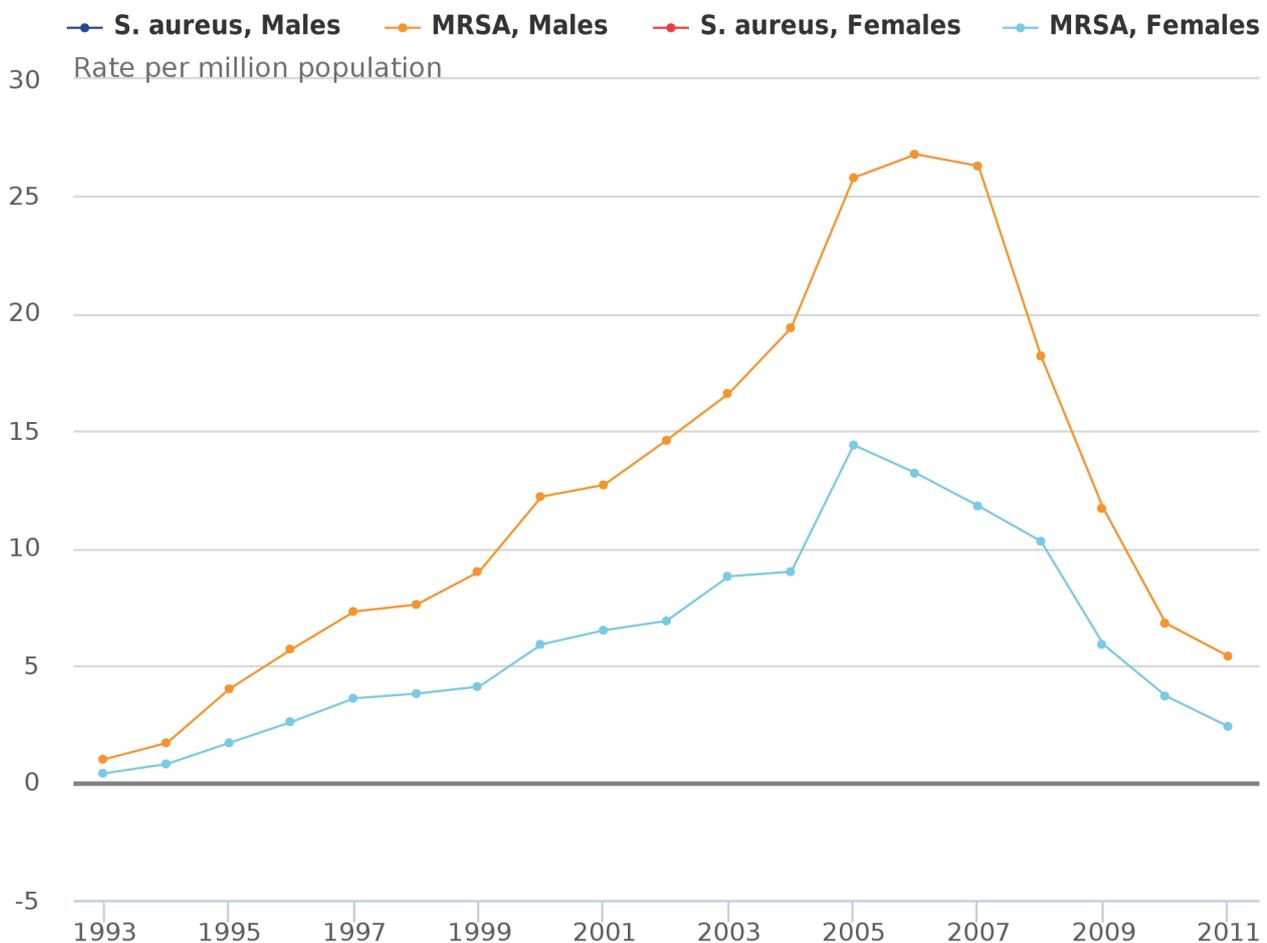
For females, the picture was similar with rates rising up to 2005 before falling gradually since then. The latest figure shows that for the first time the rate for deaths mentioning *S. aureus* was lower than when records began; 4.8 deaths per million in 2011 compared with 5.1 deaths per million in 1993. However, the difference between these two rates was not statistically significant.

For males, these rates were highest in 2007 at 33.9 and 26.5 deaths per million for *S. aureus* and MRSA respectively. By 2011, the rate for *S. aureus* mentions was 3.5 times lower than in 2007 at 9.8 deaths per million and for MRSA five times lower at 5.4 deaths per million.

For females, rates were also highest in 2007 at 16.8 and 11.9 deaths per million for *S. aureus* and MRSA respectively. As with males, there was a 3.5 to 5 fold decrease in the rate for *S. aureus* and MRSA to 4.8 and 2.4 deaths per million respectively, between 2007 and 2011.

**Figure 2. Age-standardised mortality rates for deaths mentioning *Staphylococcus aureus* and MRSA, England and Wales, 1993 to 2011**

**England and Wales**



**Source:** Office for National Statistics

**Notes:**

1. Figures for England and Wales combined include deaths of non-residents. When presented separately, data for each country exclude non-residents.
2. Figures are for deaths registered in each calendar year.
3. Rates per million population standardised to the European Standard Population.

**Table 3: Age-standardised mortality rates for deaths mentioning Staphylococcus aureus and MRSA by sex, 2007–2011**

England and Wales

	Rate per million population				
	2007	2008	2009	2010	2011
England and Wales					
Staphylococcus aureus, males	33.7	22.3	19.1	13.8	9.8
Staphylococcus aureus, females	16.6	13.2	10.8	8.2	4.8
MRSA, males	26.3	18.1	11.7	6.8	5.4
MRSA, females	11.8	10.3	5.9	3.7	2.4
England					
Staphylococcus aureus, males	33.8	21.9	19.0	13.4	9.2
Staphylococcus aureus, females	16.7	13.2	10.7	8.1	4.7
MRSA, males	26.6	17.7	11.4	6.4	4.9
MRSA, females	11.9	10.1	5.7	3.5	2.4
Wales					
Staphylococcus aureus, males	30.3	26.3	20.6	19.3	13.4
Staphylococcus aureus, females	12.6	13.2	13.1	10.5	4.0
MRSA, males	21.4	23.9	15.9	12.7	9.9
MRSA, females	8.0	11.5	8.5	5.5	3.0

Source: Office for National Statistics

Notes:

1. Rates for 2011 are provisional because they are based on population projections rather than mid-year population estimates as the denominator.
2. Figures for England and Wales combined include deaths of non-residents. When presented separately, data for each country exclude non-residents.
3. Figures are for deaths registered in each calendar year.
4. Rates per million population, standardised to the European Standard Population.

## 6. Place of death

For the period 2007–11, deaths involving *S. aureus* and MRSA accounted for 0.3 per cent and 0.2 per cent, respectively, of all deaths in England and Wales.

A breakdown by place of death shows that at least 9 out of 10 deaths (90.1 per cent) involving *S. aureus* occurred in NHS hospitals across England and Wales. Similarly, 87.4 per cent of deaths involving MRSA occurred in NHS hospitals. These represent 0.4 per cent and 0.3 per cent of all deaths that occurred in NHS hospitals respectively.

As the majority of deaths in England and Wales occur in NHS hospitals, it is expected that the percentage of deaths involving *S. aureus* and MRSA in these establishments would be comparatively higher than that in other establishment types.

Non-local authority care homes accounted for 6.4 per cent and 8.8 per cent of deaths involving *S. aureus* and MRSA respectively. Both figures represent 0.1 per cent of all deaths in this type of care establishment.

Compared with these figures, the number and percentage of deaths involving *S. aureus* and MRSA in local authority care homes were much lower (see Table 4 in the reference table section). This reflects the fact that majority of all deaths in care homes occur in the non-local authority establishment type.

Inequality in number of deaths involving MRSA and *S. aureus* by area deprivation

Poor hygiene and crowded living conditions are some of the factors that have been associated with the spread of MRSA. People living in places where these factors are more common may be at greater risk of contracting MRSA.

There is also evidence in some countries suggesting that low socioeconomic status is associated with MRSA infections, and that the proportion of MRSA patients categorised as having low socioeconomic status is increasing ([Groom et al., 2001](#); [McMullen, Warren and Woeltje, 2008](#)).

However, while low socioeconomic status can be an important predictor of health, the difficulty in accurately recording occupation and/or employment status at death registration for some groups of people and the absence of mid-year population estimates by socio-economic status may pose limitations to such analyses.

To overcome the limitations of carrying out analyses of mortality data by socio-economic position, small area deprivation indices can be used as alternative indicators to measure health inequality. In this bulletin, relative area deprivation was used as proxy for socioeconomic status to examine the gradient in deaths involving *S. aureus* and MRSA in England and in Wales.

The IMD and WIMD, take into account both compositional (individual) and contextual (physical and social environment) characteristics in producing a summary measure of the deprivation of an area of residence.

The indicators used in constructing the English Index of Multiple Deprivation 2010 and Welsh Index of Multiple Deprivation 2011 are different and relate to different time periods. As such, results for these two countries are not comparable.

Further details of the methodology used to analyse deaths involving *S. aureus* and MRSA by area deprivation are presented below. This analysis is new for 2012. If you have any comments about the value (or otherwise) of these results, we would welcome your feedback (see background notes 7 and 8 below for details of how to send feedback).

## England

The age-standardised rates (per 100,000 population) for deaths involving *S. aureus* or MRSA increased as area deprivation increased.

In 2001–05, there were 9.9 fewer deaths per 100,000 population involving *S. aureus* among those living in the least deprived neighbourhoods than in the most deprived; 14.7 compared with 24.7 deaths per 100,000. In relative terms, this means the rate in the most deprived neighbourhoods was 1.68 times higher than the rate in the least deprived.

In 2006–10 the rate difference between these two area groupings was 11.6 deaths per 100,000 population; 13.7 compared with 25.3 deaths per 100,000 respectively. In relative terms, the rate in the most deprived neighbourhoods was 1.84 times higher than in the least deprived neighbourhoods.

The picture was similar for MRSA. In the period 2001–05, the rate for deaths involving MRSA was lower in the least deprived neighbourhoods in England than in the most deprived; 9.7 deaths per 100,000 population compared with 16.4 deaths per 100,000.

In relative terms, this means the rate in the most deprived neighbourhoods was 1.68 times higher than the rate in the least deprived. By 2006–10, the rate in the least deprived neighbourhoods was slightly lower than in 2001–05 at 9.6 deaths per 100,000 population while it increased in the most deprived to 17.6 deaths per 100,000. In relative terms, this means the rate in the most deprived neighbourhoods in this period was 1.84 times higher than the rate in the least deprived.

For both MRSA and *S. aureus*, the difference in death rates between the least and most deprived neighbourhoods as well as the increase in this difference between 2001–05 and 2006–10 were statistically significant.

The slope index of inequality (SII) and relative index of inequality (RII) are sophisticated measures of absolute and relative inequality, respectively, that take into account the deprivation across all quintiles not just the extremes.

They therefore use all available data in producing a summary measure of inequality (see methods section for further details). The SII and RII both showed substantial differences between the least and most deprived neighbourhoods. For *S. aureus* the SII increased from 12.5 deaths per 100,000 in 2001–05 to 13.9 deaths per 100,000 2006–10.

For MRSA, the SII increased from 8.8 deaths per 100,000 in 2001–05 to 9.7 deaths per 100,000 in 2006–10. The RII also highlighted substantial inequality in *S. aureus* and MRSA deaths in each period (see table 5).

**Table 5: Inequality in the number of deaths involving *Staphylococcus aureus* and MRSA by area deprivation; England, 2001–05 and 2006–10**

	Period	Range	95 per cent CI	Slope Index	Rate per 100,000 population	
					Relative Index	Ratio
S. aureus	2001–05	9.9	(9.4–10.5)	12.5	1.90	1.68
	2006–10	11.6	(11.0–12.1)	13.9	2.09	1.84
MRSA	2001–05	6.7	(6.2–7.1)	8.8	1.96	1.68
	2006–10	8.0	(7.6–8.5)	9.7	2.10	1.84

Source: Office for National Statistics

Notes:

1. Deaths were assigned to fifths (quintiles) of relative deprivation using the Index of Multiple Deprivation, 2010 in England.
2. Figures are for deaths registered in each calendar year.
3. Rates per 100,000 population, standardised to the European Standard Population.

## Wales

In each period, the age-standardised rate (per 100,000 population) for deaths involving *S. aureus* and MRSA increased with increasing area deprivation.

In 2001–05, there were 15.5 and 23.2 deaths per 100,000 population involving *S. aureus* in the least and most deprived neighbourhoods respectively. However, the difference between these rates was not statistically significant. By 2006–10, the rate in the least deprived neighbourhoods was significantly lower than in the most deprived; 14.3 deaths per 100,000 compared with 27.1 deaths per 100,000 respectively.

The increase in inequality from 7.7 deaths per 100,000 in 2001–05 to 12.8 deaths per 100,000 in 2006–10 was statistically significant.

In the period 2001–05, there were 7.5 fewer deaths per 100,000 involving MRSA in the least deprived areas than in the most deprived; 11.0 compared with 18.5 deaths per 100,000. By 2006–10, the rate was 10.8 deaths per 100,000 in the least deprived neighbourhoods and 19.5 deaths per 100,000 in the most deprived.

Although difference in rates between the least and most deprived neighbourhoods in both periods was significant there was no significant increase in this difference over time.

Despite the death rates for each quintile having fairly wide margins of error, the confidence intervals surrounding them still enabled detection of statistically significant differences between the least and most deprived neighbourhoods.

When deprivation across all areas, not just the extremes, was taken into account, the SII and RII showed that in both periods, there were substantial inequalities in deaths involving *S. aureus* and MRSA across all neighbourhoods. For *S. aureus* the SII was 11.3 per 100,000 in 2001–05 and 14.6 deaths per 100,000 in 2006–10.

For MRSA these figures were 9.6 per 100,000 and 10.0 deaths per 100,000 respectively. The RII also highlighted substantial inequality in *S. aureus* and MRSA deaths in each period (see table 6).

**Table 6: Inequality in the number of deaths involving *Staphylococcus aureus* and MRSA by area deprivation; Wales, 2001–05 and 2006–10**

Wales

	Period	Range	95 per cent CI	Slope Index	Rate per 100,000 population	
					Relative Index	Ratio
<i>S. aureus</i>	2001–2005	7.7	(5.4–9.9)	11.3	1.79	1.49
	2006–2010	12.8	(10.4–15.1)	14.6	2.11	1.89
MRSA	2001–2005	7.5	(5.5–9.5)	9.6	1.93	1.68
	2006–2010	8.7	(6.7–10.7)	10.0	1.99	1.81

Source: Office for National Statistics

Notes:

1. Deaths were assigned to fifths (quintiles) of relative deprivation using the Welsh Index of Multiple Deprivation, 2011.
2. Figures are for deaths registered in each calendar year.
3. Rates per 100,000 population, standardised to the European Standard Population.

## 7. Methods

## Data source

The information used in this bulletin is based on the details collected when deaths are certified and registered. All deaths are coded by ONS according to the International Classification of Diseases (ICD) produced by the World Health Organisation (WHO).

Since 1993, ONS has stored the text of death certificates on a database, along with all the ICD coding related to causes identified on the death certificate. The Tenth Revision of ICD (ICD-10) has been used to code deaths in England and Wales since 2001.

## Approach used in selecting deaths

The text on death certificates were used in combination with ICD-10 codes to identify those mentioning *S. aureus* and MRSA in a two step process.

A number of infections are specifically related to *Staphylococcus aureus* or other staphylococcal species. First, all deaths were extracted where any of these infections was mentioned on the death certificates.

These deaths were extracted using the ICD-10 codes given in Box 1 in reference table 1. The text of these death certificates was then searched, both electronically and manually, to identify MRSA.

Conversely, some infections have different causative organisms and may be caused by *Staphylococcus* species or other pathogens. The second step therefore involved extracting all deaths which had these non-specific infections mentioned on the death certificate.

The codes used to identify these infections are given in Box 2 (see reference table 1). The text of these death certificates was then searched manually to identify *S. aureus* and MRSA.

Deaths with an underlying cause of *S. aureus* were identified by selecting those deaths with a mention of *S. aureus* that also had as the underlying cause one of the infections listed in Box 1 or Box 2. The same procedure was followed in order to identify deaths with MRSA as the underlying cause.

As in previous MRSA reports (ONS, 2010a) where MRSA was mentioned on the death certificate, the code A41.9 (septicaemia, unspecified) was taken to indicate that MRSA was also the underlying cause of death. This is because this code is sometimes selected as the underlying cause of death when MRSA septicaemia is mentioned on the death certificate.

Since 1986, ONS has used the internationally recommended death certificate for neonatal deaths (infants under 28 days old). This certificate was only designed to record all conditions found at death.

This means that neonates cannot be assigned an underlying cause of death. However, as the data were based on deaths where *S. aureus* and MRSA were mentioned on the death certificate, neonates have been included. Neonatal deaths were extracted in the same way as described above for post-neonatal deaths.

## Area deprivation

Inequality in MRSA and *S. aureus* deaths by relative area deprivation was examined using the English Index of Multiple Deprivation (IMD 2010) and the Welsh Index of Multiple Deprivation (WIMD 2011) respectively.

IMD 2010 combines seven distinct domains of deprivation while WIMD combines eight domains to produce a single measure of relative deprivation for each Lower Super Output Area (LSOA) in England and Wales respectively.

LSOAs are relatively homogenous in terms of population size and structure; each has approximately 1,500 residents. The LSOAs in England and in Wales can be ranked according to their multiple deprivation score and grouped into quintiles (fifths) or deciles (tenths) for subsequent analyses.

Analysis by area deprivation was carried out to examine the inequality in MRSA and *S. aureus* deaths across England and Wales (separately). Deaths were assigned to deprivation quintiles using a two-step process.

First, the postcode of usual residence of the deceased was mapped to an LSOA. The LSOA was then used to map each death record to a quintile of deprivation using the LSOA/IMD or LSOA/WIMD quintile lookup table as appropriate.

The unavailability of 2011 mid-year population estimates for LSOAs at the time of producing this bulletin meant that inequality in the period 2007–11 could not be examined. In addition, analyses do not extend to the periods between 1993 and 2000 because the indicators used in IMD 2010 and in WIMD 2011 are based on data from 2001 onwards.

## Outcome measures

Age-specific rates were calculated using deaths and population data pooled over a five-year period. Data were pooled to minimise the effect of random variation in the number of deaths registered annually on rates. The trend in these rates was then examined by age group and sex.

Age-standardised rates were also calculated for each year since 1993 and the change in these rates was examined over time and by sex.

For both types of rates, mid-year population estimates were used as the denominator. However, as at the time of writing this bulletin, estimates were not available for 2011. As a result mid-year population estimates were used for 1993 to 2010 while population projections were used for 2011.

Two measures were used to assess the absolute inequality in the number of deaths involving MRSA and *S. aureus*; the range and the Slope Index of Inequality (SII). While the range (difference between the least and most deprived areas) is simple to calculate and understand, this measure ignores what goes on in intermediate groups.

In addition, the range does not take into account the size of the groups being compared and this may be crucial if the population size of groups vary substantially over time. The SII on the other hand takes into account deprivation across all groupings rather than just focusing on the extreme ones.

It is a measure of the total impact of deprivation on health and can be interpreted as the difference in health related events between the least and most deprived areas, taking into account the deprivation across all area groupings. It is also sensitive to the distribution of the population across deprivation groups.

The method described in Mackenbach and Kunst (1997) was adopted and used to calculate the slope index of inequality as follows:

Quintiles were ordered by decreasing area deprivation, that is, from the most to the least deprived. The fraction of the total population in each quintile ( $f$ ) was calculated. The cumulative frequency ( $c_i$ ), that is the cumulative sum of the population in successively less deprived quintiles, was also obtained and the relative deprivation rank ( $x$ ) for each quintile was calculated as:

$$x = c_{i-1} + (0.5 \times f)$$

The SII (slope of the regression line) was then estimated by carrying out a regression of the number of deaths in each quintile against the relative deprivation rank (x), weighted by the population in each quintile.

The relative index of inequality (RII) is the relative version of the SII. To obtain the RII, the rate (y) for the least deprived grouping of areas, taking into account its relative deprivation rank, was estimated using a linear regression model.

The quotient of the SII and the predicted rate was obtained, (SII / y). The result represents the ratio of the mortality rate of the most deprived areas to that of the least deprived. For ease of interpretation, this was expressed as a rate ratio by adding 1 to it, giving the modified RII.

$$\text{Modified RII} = 1 + (\text{SII} / y)$$

## 8. Background notes

1. Figures are for deaths registered in each calendar year while rates are based on mid-year population estimates as the denominator. However, as at the time of writing, these estimates were not available for 2011. As a result, mid-year population estimates were used for 1993 to 2010 while population projections were used for 2011. Therefore, age-specific rates for the period 2007–11 as well as age-standardised rates for 2011 presented here are provisional. Rates for 2002 onwards will be revised in the 2013 bulletin following the release of 2011 Census based mid-year population estimates.
2. Information about the underlying mortality data, including details on how the data are collected and coded, is available in the [mortality metadata \(2.7 Mb Pdf\)](#).
3. The number of deaths due to MRSA is difficult to estimate. Trends in mortality are usually monitored using the underlying cause of death (the disease which initiated the train of events leading directly to death). However, MRSA (and other healthcare associated infections) are often not the underlying cause of death. Those who die with MRSA are usually patients who were already very ill, and it is their existing illness, rather than MRSA, which is often designated as the underlying cause of death. There is therefore an interest in the number of deaths where MRSA contributed to the death – only conditions which contribute directly to the death should be recorded on the death certificate. Results presented in this bulletin identify deaths where the underlying cause was MRSA and also where MRSA was mentioned as the underlying cause or as a contributory factor in the death.
4. Although MRSA is commonly referred to as a healthcare associated infection, it is not possible to state from the information on a death certificate where the infection was acquired, nor can assumptions be made about quality of care. People are often transferred between hospitals, care homes and other establishments, and may acquire infections in a different place from where they died.
5. Guidance on death certification, with specific reference to healthcare associated infections, was issued to doctors in May 2005 (revised in 2010) (Office for National Statistics, 2010b). This was followed by a [message](#) from the Chief Medical Officer to all doctors reminding them of their responsibilities with respect to death certification and drawing their attention to the guidance (DH, 2005).
6. There are two types of rates reported in this bulletin; age-specific and age-standardised. Age-specific rates may be calculated for given age groups and are defined as the number of deaths in the age group per million (or thousand) population in the same age group. While these rates can be compared between times, places, and sub-populations, the tables containing them are usually large and may be difficult to assimilate. In addition, where there are very few deaths these rates will be imprecise and may be difficult to interpret. Age-standardised rates make allowances for differences in the age structure of the population, over time and between sexes. The rates presented here have been age-standardised using the direct method of standardisation. The age-standardised rate for a particular disease is that which would have occurred if the observed age-specific rates for the disease had applied in a given standard population. In this bulletin, the European standard population has been used. This is a hypothetical population standard, which is the same for both males and females, allowing standardised rates to be compared over time and between sexes.

7. Rates were not calculated where there were fewer than three deaths in a cell, denoted by ‘.’. It is ONS practice not to calculate rates where there are fewer than three deaths in a cell, as rates based on such low numbers are susceptible to inaccurate interpretation. Rates which were calculated from fewer than 20 deaths are distinguished by italic type as a warning to the user that their reliability as a measure may be affected by the small number of events.
8. Within this bulletin, a difference which is described as ‘statistically significant’ has been assessed using confidence intervals. Confidence intervals (CIs) are a measure of the statistical precision of an estimate and show the range of uncertainty around it. Calculations based on small numbers of events are often subject to random fluctuations. Significance is assigned on the basis of non-overlapping CIs. While more formalised and accurate methods of significance testing are available, the non-overlapping CI method is used because it is both simple to calculate and easily understood. As a general rule, if the confidence interval around an estimate overlaps with the interval around another, there is no significant difference between the two estimates.
9. Special extracts and tabulations of deaths involving MRSA data for England and Wales are available to order for a charge (subject to legal frameworks, disclosure control, resources and agreement of costs, where appropriate). Such requests or enquiries should be made to:  
  
Mortality Analysis Team, Health and Life Events Division Office for National Statistics Government Buildings Cardiff Road Newport Gwent NP10 8XG Tel: +44 (0)1633 456491 E-mail: [mortality@ons.gsi.gov.uk](mailto:mortality@ons.gsi.gov.uk)  
[uk](http://ons.gov.uk)  
  
The ONS charging policy is available on the ONS website.
10. As a valued user of our statistics, we would welcome feedback on this release. In particular, the content, format and structure. We have introduced further analysis based on inequality in MRSA and *S. aureus* deaths by area deprivation and would welcome feedback about its usefulness. This is in line with the [Health and Life Events user engagement strategy](#). Please send feedback to the postal or e-mail address above.
11. Details of the policy governing the release of new data are available from the Media Relations Office.
12. National Statistics are produced to high professional standards set out in the Code of Practice for Official Statistics. They undergo regular quality assurance reviews to ensure that they meet customer needs. They are produced free from any political interference.
13. Summary Quality Reports are overview notes which pull together key qualitative information on the various dimensions of quality as well as providing a summary of methods used to compile the output. Updated editions from April 2011 are published as [Quality and Methodology Information notes](#) (QMI).
14. ONS produces statistics for MRSA for England and Wales. The [National Records of Scotland](#) (NRS), formerly the General Register Office for Scotland (GROS) produces statistics for Scotland, and the [Northern Ireland Statistics and Research Agency](#) (NISRA) produces statistics for Northern Ireland.
15. A list of the names of those given pre-publication access to the statistics and written commentary is available in [pre-release access \(29.6 Kb Pdf\)](#) list to deaths involving MRSA. The rules and principles which govern pre-release access are featured within the [Pre-release Access to Official Statistics Order 2008](#).

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18. Media contact:

Tel: Media Relations Office +44 (0) 845 6041858

Emergency on-call +44 (0) 7867 906553

Email: [media.relations@ons.gsi.gov.uk](mailto:media.relations@ons.gsi.gov.uk)

Follow ONS on [Twitter](#) and [Facebook](#)

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[psi@nationalarchives.gsi.gov.uk](mailto:psi@nationalarchives.gsi.gov.uk)

20. Details of the policy governing the release of new data are available by visiting [www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html](http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html) or from the Media Relations Office email: [media.relations@ons.gsi.gov.uk](mailto:media.relations@ons.gsi.gov.uk)