

The second year of the Department of Health's mandatory MRSA bacteraemia surveillance scheme in acute NHS Trusts in England: April 2002 – March 2003

Key points:

- Between April 2002 and March 2003, all 177 acute NHS Trusts from the nine English regions participated in the Department of Health's (DoH) mandatory methicillin resistant *Staphylococcus aureus* (MRSA) bacteraemia surveillance scheme.
- The overall MRSA bacteraemia rate for 176 Trusts in England was 0.17 per 1000 bed-days between April 2002 and March 2003, unchanged from the first year of the scheme (one Trust's data were missing from the last quarter).
- The MRSA bacteraemia rate within Trusts ranged from 0 to 0.49/1000 bed-days. Single specialty Trusts had the lowest rates overall (0.10/1000; from 0 to 0.45/1000 bed-days) and specialist Trusts the highest (0.23/1000; from 0.06 to 0.49/1000). General acute Trusts had intermediate rates (0.15/1000; from 0.04 to 0.30/1000).
- MRSA bacteraemia rates within regions were similar to those observed in the first year (April 2001 to March 2002) of the scheme and ranged from 0.13/1000 in the North West to 0.25/1000 in London.
- The total number of *Staphylococcus aureus* bacteraemias increased from 17,876 between April 2001 and March 2002 to 18,403 between April 2002 and March 2003.
- 39.8% of *S. aureus* bacteraemias were reported to be methicillin resistant from April 2002 to March 2003 compared to 40.4% from April 2001 to March 2002.
- A strong association between numbers of MRSA bacteraemias and both positive and total blood culture sets was observed.

Introduction

This report presents the results of the second year of the Department of Health's (DoH's) mandatory methicillin resistant *Staphylococcus aureus* (MRSA) bacteraemia surveillance scheme for all acute NHS Trusts in England. Results pertaining to the first year of the scheme (1-4), and the first three quarters of the second year have already been published (5-7). Unlike the first year's publication, this report does not include named Trust data, although such results will be produced by the Commission for Health Improvement (CHI) as part of their Trust rating scheme (8).

Methods, data collection and analysis

Data were collected quarterly from each acute NHS Trust in England by the Communicable Disease Surveillance Centre (CDSC) regional epidemiology units (now regional health protection teams), and transferred to CDSC Colindale for national analysis. One Trust in the South East region was excluded from the report due to delayed submission of data. All analyses were performed according to the current configuration of Trusts, data from merged Trusts being combined for pre-merger time periods. Regional analysis was performed using the English regional boundaries introduced in April 2002. The latest KH03 overnight bed occupancy data, pertaining to the financial year 2001/2002, were provided by regional epidemiology units for Trusts in the region. These were used to derive the denominators for rate calculations by Trust and by region. Comparisons between the first year

(April 2001 to March 2002) and second year (April 2002 to March 2003) were based on these data.

Regional epidemiologists were asked to provide feedback on the impact on Trusts of the previous year's mandatory MRSA surveillance Trust results (2), as well as regional programmes for action.

Scatter plots (9,10) were used to display Trusts' MRSA bacteraemias by the number of occupied bed-days. These plots were overlaid with a mid-line representing the expected number of MRSA bacteraemias according to the number of occupied bed-days based on the overall or pooled rate(2). Ninety-five per cent confidence limits around this expected number of MRSA bacteraemias were calculated, with adjustment for overdispersion (additional variability in the data expected under a true Poisson distribution). Further details of the construction of these charts can be found in the first year's report (2).

Associations between other variables collected under the surveillance scheme were investigated through graphical display (scatter plots), with strengths of association between the variables determined from the correlation coefficient (r) obtained from linear regression analysis. The correlation coefficient increases in magnitude if the data are tightly concentrated about a straight line, and a coefficient of ± 1 indicating an exact correlation. The coefficient of determination (r^2) can be interpreted as the fraction of the variance that is shared between the two variables, and is always between 0 and 1.

Among the data items explored were the number of blood culture sets examined, which are defined as a sample arising from a single venepuncture, irrespective of the

Table 1 Region-specific comparison of the two years of the mandatory MRSA bacteraemia surveillance scheme, England: April 2001 - March 2003

Regions	Resident population 2001	Acute NHS Trusts		<i>S. aureus</i> bacteraemias April 2001-March 2002		<i>S. aureus</i> bacteraemias April 2002-March 2003		% difference in MRSA between the two years
		Numbers	Annual number of hospital bed-days *	Total number	Methicillin resistant (%)	Total number	Methicillin resistant (%)	
North East	2,516,531	8	2,643,680	931	363 (39.0)	953	380 (39.9)	4.5%
Yorkshire and Humberside	4,967,165	16	4,953,886	2028	714 (35.2)	2088	671 (32.1)	-6.4%
East Midlands	4,175,081	9	2,911,408	1374	543 (39.5)	1349	494 (36.6)	-9.9%
Eastern	5,394,860	18	3,878,955	1652	744 (45.0)	1670	710 (42.5)	-4.8%
London	7,188,006	32	6,707,451	3524	1571 (44.6)	3728	1655 (44.4)	5.1%
South East†	8,006,896	24	5,169,383	2179	967 (44.4)	2293	936 (40.8)	-3.3%
South West	4,934,162	18	4,224,116	1745	696 (39.9)	1756	738 (42.0)	5.7%
West Midlands	5,267,098	21	4,313,968	1863	761 (40.8)	1908	812 (42.6)	6.3%
North West	6,731,540	30	7,445,256	2580	867 (33.6)	2658	934 (35.1)	7.2%
England	49,181,339	176	42,248,102	17,876	7226 (40.4)	18,403	7330 (39.8)	1.4%

* based on average daily number of occupied beds (all wards) in 2001/2 (KH03)

† analysis was based on 24 of 25 trust in this region due to late submission of data from one trust

% difference of MRSA = 1 - (1st year/2nd year) * 100

number of bottles tested, and the total number of positive blood cultures, which represent all positive results for bacterial growth, including repeat specimens and contaminants.

Statistical software* was used to obtain confidence limits scaled according to the over dispersion present within the data, and to estimate correlation coefficients within the linear regression analyses.

Further methodological and interpretative information, including a glossary of terms, can be found elsewhere (2,3). The Healthcare Associated Infection Surveillance Steering Group was responsible for developing the dataset for this mandatory surveillance scheme.

Results

During the two years (April 2001 to March 2003) of the mandatory MRSA bacteraemia scheme, eight Trust mergers (14 merged to form 7 Trusts, and four merged to form one new Trust) occurred among acute NHS Trusts in England, decreasing the number of Trusts participating in the scheme from 187 to 177. One hundred and seventy-six of the 177 acute NHS Trusts reported MRSA data for all quarters of the second year (April 2002 to March 2003) of the scheme. The total number of *S. aureus* bacteraemias reported increased from 17,876 in the first year of the scheme, to 18,403 in the following year.

The overall numbers of methicillin resistant

S. aureus were 7226 and 7330 respectively, a 1.4% rise (table 1). The overall MRSA bacteraemia rate in each of the two years of the scheme was 0.17/1000 bed-days. The MRSA bacteraemia rate between Trusts in England, for the April 2002 to March 2003 period, ranged from 0 to 0.49/1000. Although there was a slight increase in the number and rate of MRSA bacteraemias in England (1.4%), the proportion of *S. aureus* bacteraemias that were methicillin resistant decreased slightly from 40.4% to 39.8%.

Trust categorisations

One hundred and fourteen Trusts were categorised as 'general acute', 44 as 'single specialty', and 18 as 'specialist' Trusts (3). MRSA bacteraemia rates varied according to the type of Trust (figures 1 to 3). The lowest overall rate was in single specialty Trusts (0.10/1000 bed-days) ranging from none to 0.45/1000 bed-days. The highest overall rate was among the specialist Trusts (0.23/1000) with a range from 0.06 to 0.49/1000. An intermediate overall rate was seen in general acute Trusts (0.15/1000) with a range of 0.04 to 0.30/1000.

Trusts' results are shown in figures 1 to 3. One Trust fell below the lower 95% control limit with a MRSA bacteraemia rate of 0.04/1000 in the general acute category. Three Trusts were above the 95% control limit in the general acute, two Trusts in the specialist, and one Trust in the single specialty category.

Regional distributions

The number of acute NHS Trusts in each region ranged

Figure 1 Number of MRSA bacteraemias in specialist acute NHS Trusts by bed-days, England: April 2002 to March 2003

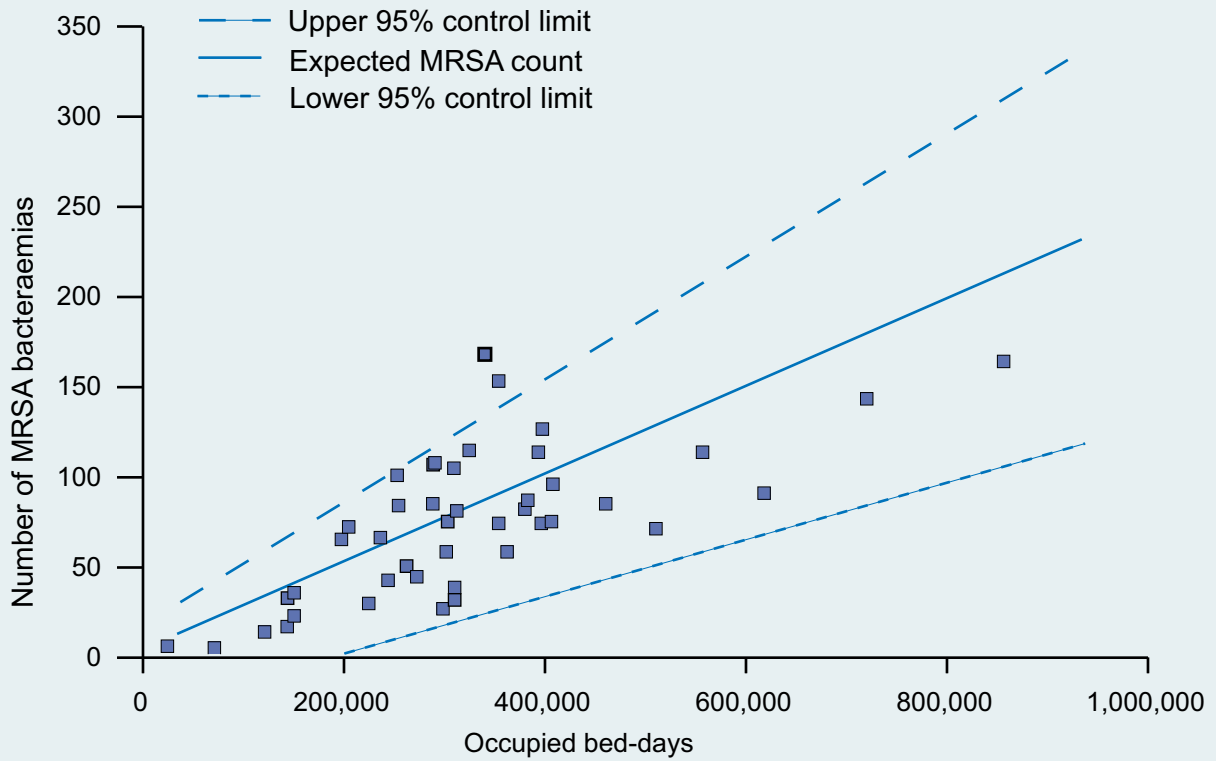


Figure 2 Number of MRSA bacteraemias in general acute NHS Trusts by bed-days, England: April 2002 to March 2003

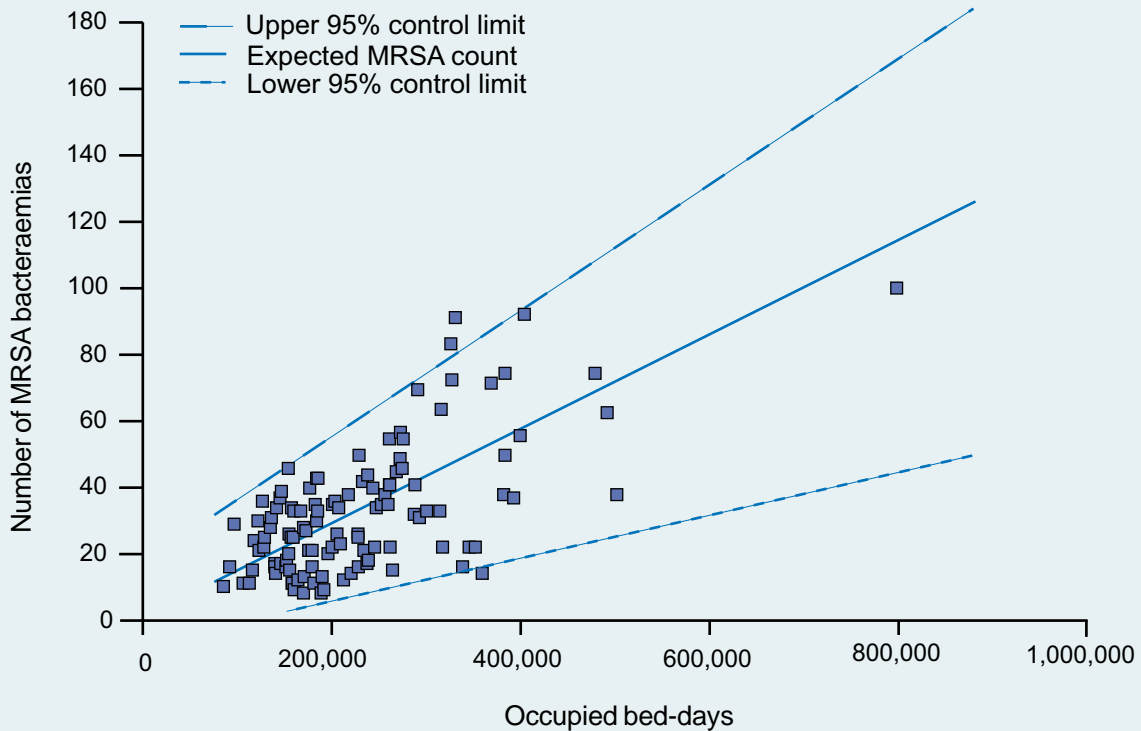
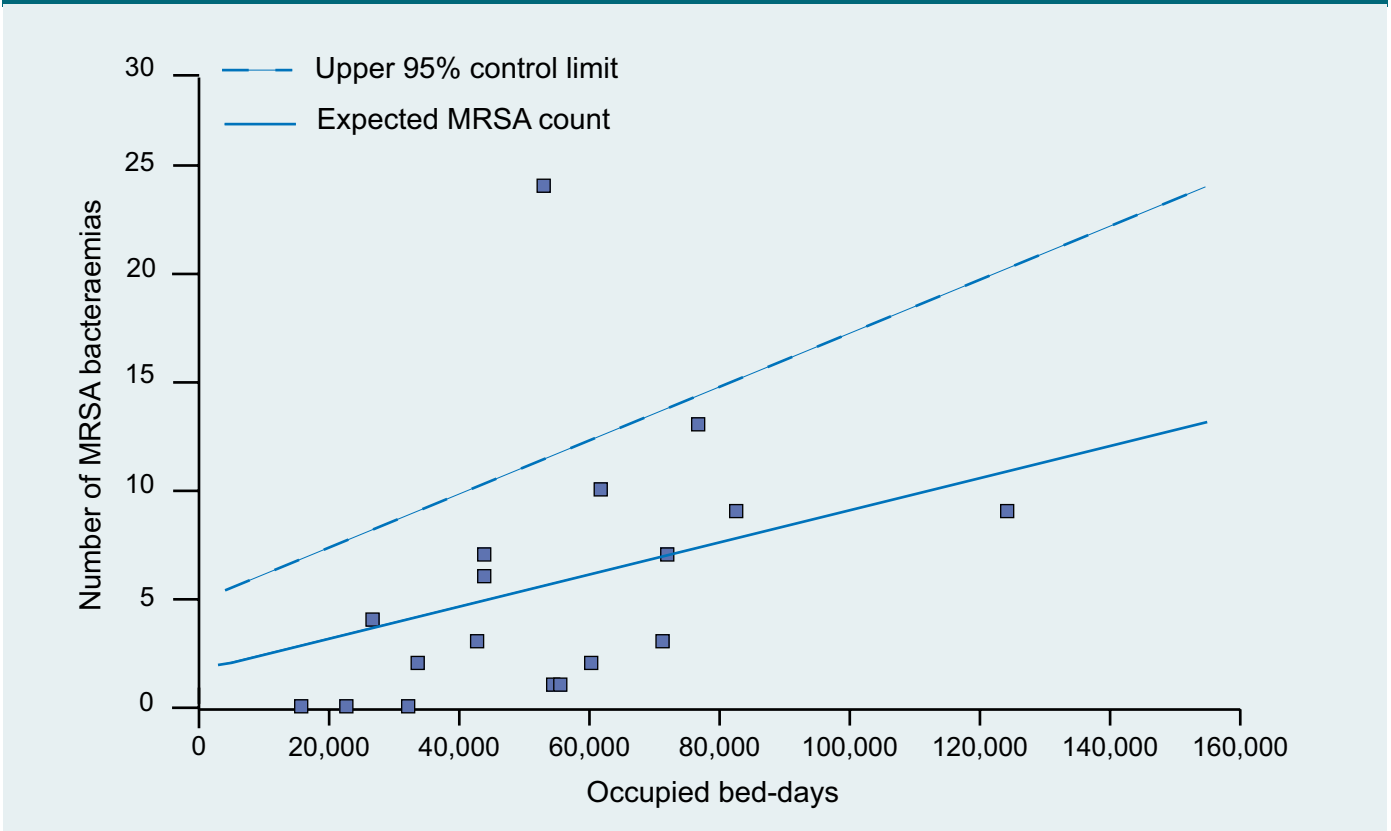


Figure 3 Number of MRSA bacteraemias in single specialty acute NHS Trusts by bed-days, England: April 2002 to March 2003

Data points below the expected MRSA count lie within the lower 95% confidence limit (line not shown).

from eight in the North East to 32 in London (table 1). The highest resident population for 2001 was the South East (8,006,896) and the lowest was in the North East region (2,516,531). The annual number of occupied bed-days in all wards in acute NHS Trusts in the April 2001 to March 2002 year (based on the KH03 data) was lowest in the North East (2,643,680) and highest in the North West region (7,445,256). London had the highest number of Trusts, and the second largest resident population (7,188,006).

Substantial regional variations in MRSA bacteraemia rates (according to occupied bed-days) were observed in April 2002 to March 2003, with the highest rates in London (0.25/1000 bed-days) and the lowest rates in the North West region (0.13/1000). There was overlap of the 95% confidence intervals around the MRSA bacteraemia rates for all the regions except London (figure 4).

Comparisons of MRSA bacteraemia rates by region for the two years of the mandatory MRSA scheme are shown in table 1 and figures 5 and 6. The northern regions (North East, Yorkshire and Humberside, and the North West) reported the lowest and London the highest MRSA bacteraemia rates in each of the two years of the scheme (figures 5 and 6). Although the proportion of total *S. aureus* bacteraemias that were methicillin resistant did not vary significantly by region, some differences were observed between the two years.

The largest decrease in the number and the rate of MRSA bacteraemias was observed for the East Midlands with a 9.9% decrease in MRSA between the two years, followed by Yorkshire and Humberside (6.4% decrease) and Eastern region (4.8% decrease). The biggest increase in the number

of MRSA bacteraemias was observed in the North West region (7.2%) which, despite this, still remained the region with the lowest MRSA rate (0.13/1000 bed-days). The next highest increase was in the West Midlands region (6.3%).

Blood culture sets

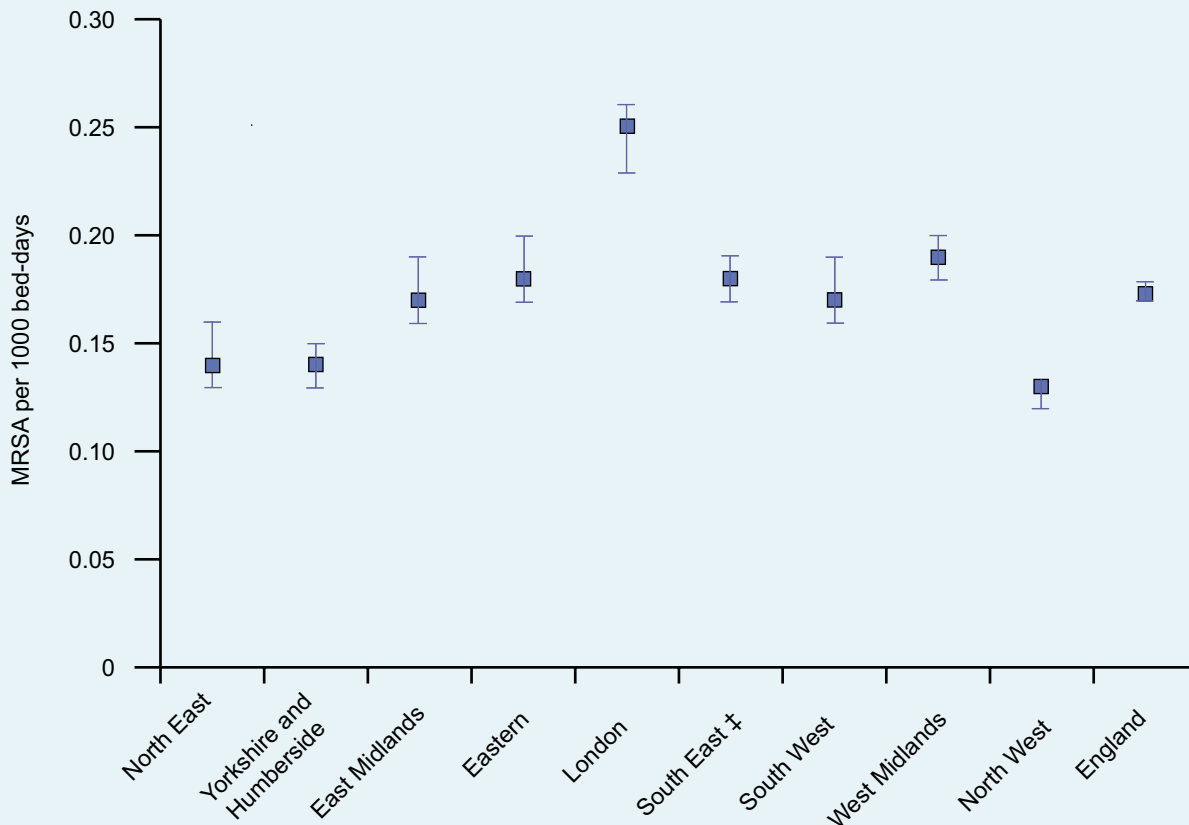
The number of MRSA bacteraemias within Trusts (April 2002 to March 2003) was closely associated with both total number of blood culture sets examined ($r = 0.84$) and the number of positive blood cultures ($r = 0.86$) (figures 7 and 8) giving coefficients of determination of $r^2 = 0.71$ and $r^2 = 0.74$ respectively.

An even stronger association was noted between positive blood cultures and total blood culture sets, with a correlation coefficient $r=0.97$ ($r^2=0.94$) where an almost 1:5 ratio was observed, *ie* for every five blood culture sets taken one will be positive for bacteria (figure 9). The number of blood culture sets taken and the number of occupied bed-days were closely associated ($r=0.81$ and $r^2=0.66$) (figure 10).

Regional activity

The **North East region** has put in place a review process involving the feedback of MRSA surveillance results to Trust level. The findings from the review are then published along with recommendations. Future plans include an audit of the reporting process to inform the change from aggregate data collection to routine, timely electronic transmission of data. In addition, there is consideration of the use of statistical control charts for the feedback of MRSA bacteraemia rates to clinicians.

Figure 4 MRSA bacteraemia rates with 95% confidence intervals*, by region†, England: April 2002 to March 2003



* Based on average number of occupied beds (all wards) in 2001/2

† Acute NHS Trusts

‡ Analysis was based on 24 of 25 Trust in this region due to late submission of data from one Trust

Figure 5 Methicillin resistance in *Staphylococcus aureus* bacteraemia reports by region*, April 2001 - March 2002

MRSA/1000 Bed-days

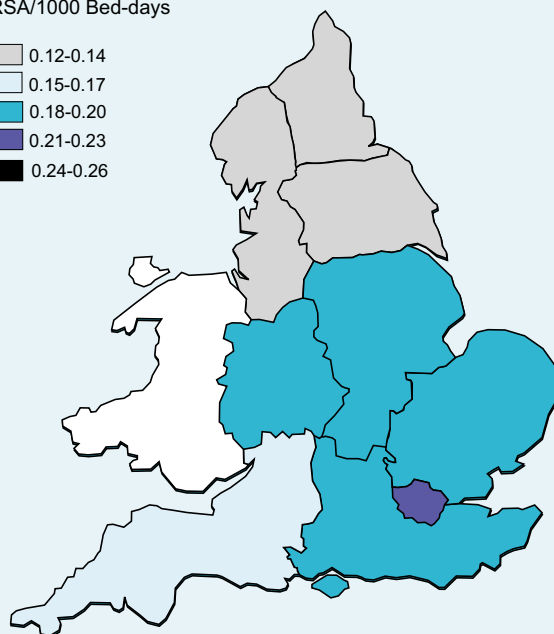
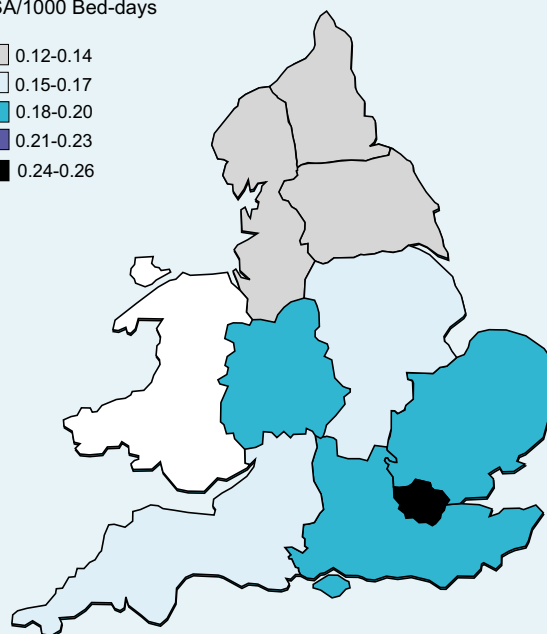
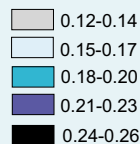


Figure 6 Methicillin resistance in *Staphylococcus aureus* bacteraemia reports by region*, April 2002 - March 2003

MRSA/1000 Bed-days



* analysis was based on 176 of 177 Trusts data due to late submission of data from one Trust

Figure 7 Number of MRSA bacteraemias by total blood culture sets examined in all acute NHS Trusts, England: April 2002 to March 2003

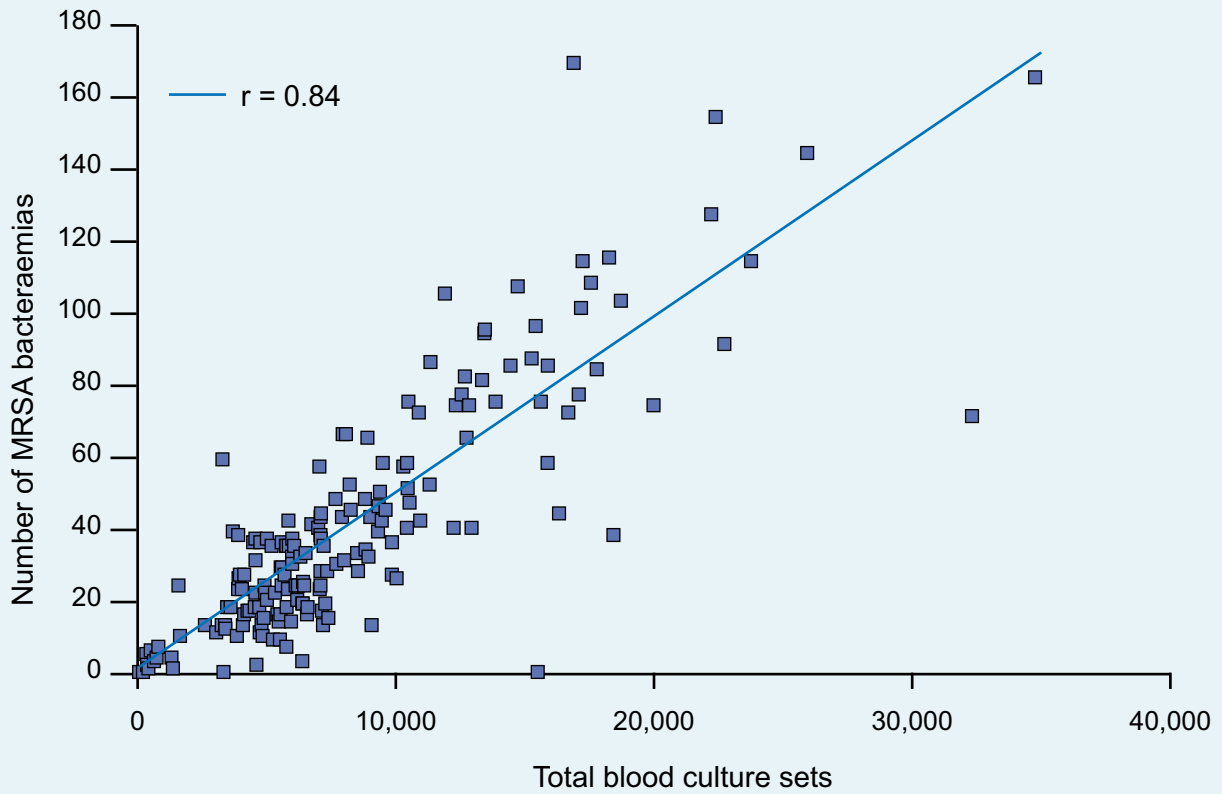
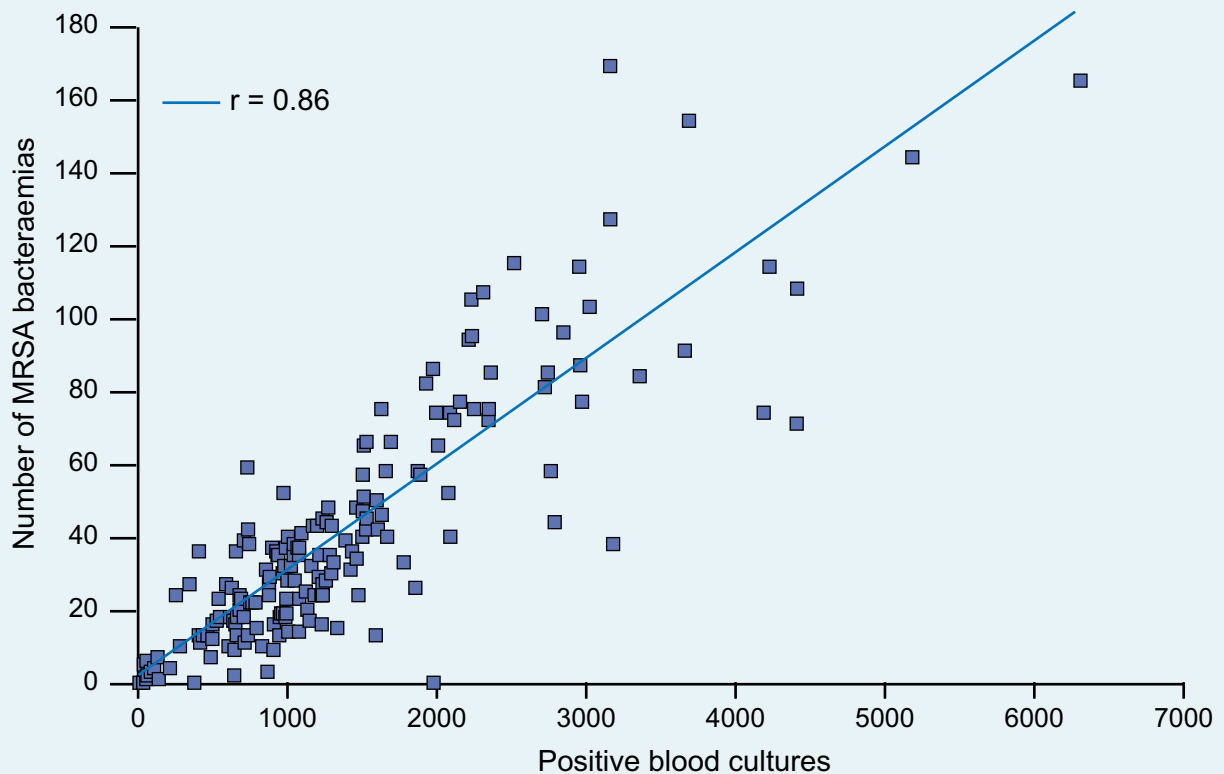


Figure 8 Number of MRSA bacteraemias by total positive blood cultures* examined in all acute NHS Trusts, England: April 2002 to March 2003



*includes repeat specimens and contaminants

Figure 9 Number of positive blood cultures* by total blood culture sets examined in all acute NHS Trusts, England: March 2002 to April 2003

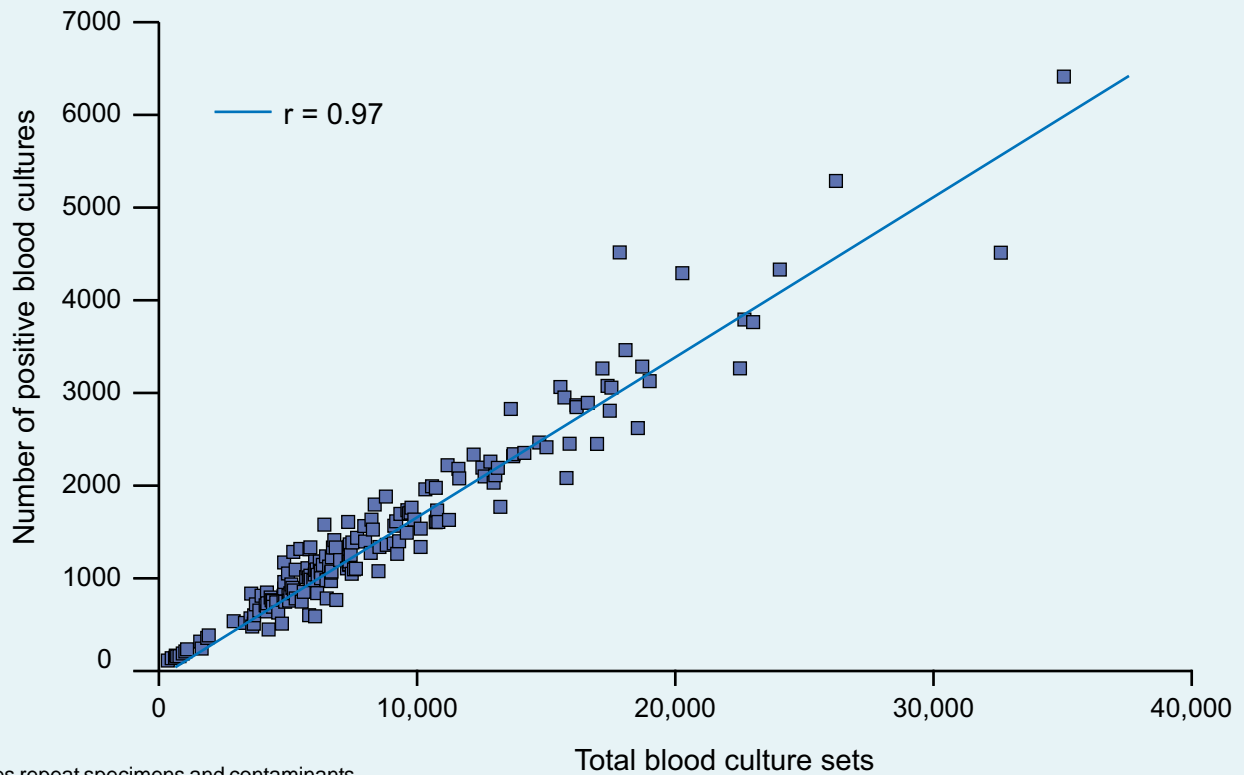
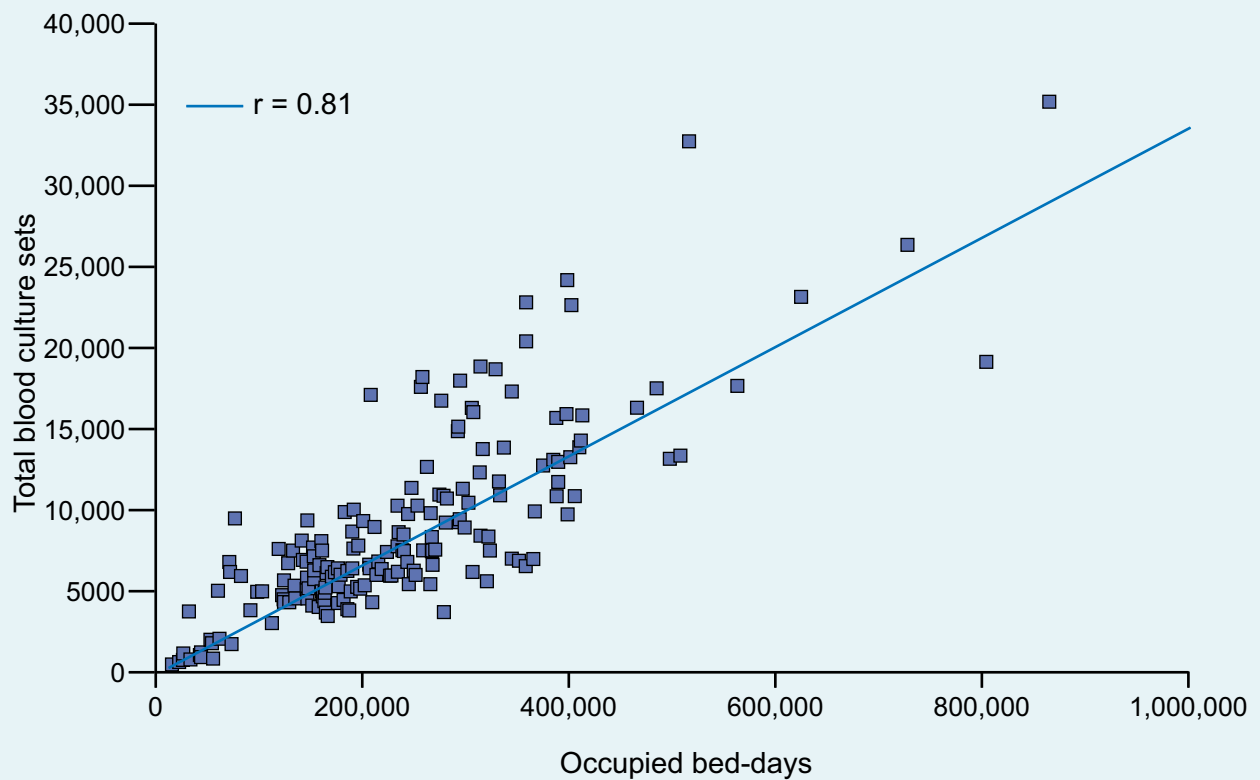


Figure 10 Number of blood culture sets examined by occupied bed-days in all acute NHS Trusts, England: April 2002 to March 2003



During the two-year mandatory surveillance period, there has been a decline in the bacteraemia rate in the **Yorkshire and Humberside region**. There has been a mixed response to the mandatory surveillance system in the region with concerns over the resource required to extract and report data. Some favourable effects were noted, including the development of joint working between Trusts' infection control teams and the regional Health Protection Agency. These plans include an educational programme directed at improving techniques for central venous catheter insertion and care, enhanced bacteraemia surveillance, and a review of antimicrobial prescribing policy and implementation.

There has been a decrease in MRSA rates in the **East Midlands region** since the start of the surveillance scheme. Some Trusts commented that publication of the figures has had little impact, while one Trust reported that it had changed its antibiotic policy in response to the increasing MRSA bacteraemia rate.

Since the first year of the scheme, the **Eastern region** has successfully implemented a Trust peer review process, whereby Trust and regional staff meet to discuss the MRSA rates, implications of the data, and infection control issues. The meetings are informal and generate significant discussion, resulting in agreed action points. These are incorporated into Trust action plans, which are submitted to the regional director of public health. Trusts within the region feel that publication of rates by named trusts has been particularly constructive, helping to assess their position nationally and also in responding to complaints and queries.

London region no longer has a regional infection control nurse to visit and review infection control services within Trusts. Responses to the impact of the scheme include using it as a benchmark for comparison with other hospitals, and 'good MRSA rates' inducing complacency among staff. There was also concern that due to the 'league table system', managers were more focused on MRSA infections at the expense of the overall hospital infection control picture, and that data from blood cultures taken in accident and emergency departments confound the true in-patient MRSA bacteraemia rates.

Trusts in the **South East region** reported little impact of the MRSA surveillance scheme. Responses included, considering how to use the information in a 'more constructive way', and encouraging senior management and clinicians to take an interest in infection control issues, MRSA in particular. The majority of Trusts that gave feedback reported that the MRSA rates had no effect on their management of infection control, as standards were already high. The reported negative effects of the scheme include the demoralization of staff in wards with high MRSA rates and the time consuming nature of reporting *S. aureus* bacteraemias. Concern was voiced about the quality of patient care, understaffing and resource shortages.

The **South West region** has carried on in its efforts to reduce hospital acquired infection. This includes appointment of an infection control nurse and epidemiological scientist to work closely with Trusts to bring about reductions in MRSA rates. One Trust reported that if MRSA rates are found to be high, their

practice is audited and feedback of findings is given to clinicians to raise awareness and to help generate an action plan. In addition to this are other ongoing efforts within Trusts, with a particular focus on renal units.

In the **West Midlands region** attention has been focused on the Trust with the highest national rate of MRSA bacteraemias. Agreed initiatives with the Trust include educational measures for staff, enhancement of the prominence of infection control in the clinical governance processes, an increase in number of infection control staff, and increased staff time devoted to hospital epidemiological studies. One other large Trust has published work on MRSA in renal units and the use of intravenous catheters, and the high profile of the published mandatory data was considered to have enhanced the emphasis given to this work. Other consultant microbiologists have found their services in demand for presenting and commenting upon their hospitals' data, although some have noted a managerial view that the need for urgent action is confined to high "outliers".

The **North West region** distributes a quarterly publication to microbiologists, which is used to facilitate further discussion on actions taken and progress at meetings.

Discussion

The results of the second year of the mandatory MRSA bacteraemia surveillance scheme show that the overall rate of methicillin resistant *S. aureus* bacteraemias has remained stable at 0.17/1000 bed-days (2), with rates ranging from 0 to 0.49/1000 across acute NHS Trusts in England. Regional comparisons showed similarities to the first year of the scheme, with lower MRSA rates in the north of England and the highest rates in London.

The Scottish Centre for Infection and Environmental Health (SCIEH) has recently published data on MRSA bacteraemias in its 18 acute Trusts for the period January to December 2002 (11). The overall MRSA bacteraemia rate in Scotland was 0.17/1000 bed-days (11), is the same as in England (0.17/1000) for the period April 2002 to March 2003, but higher than that found in the neighbouring northern regions of England.

Comparing the two years of the MRSA surveillance scheme by Trust category, there was a slight increase in the overall MRSA bacteraemia rate from 0.14 to 0.15/1000 bed-days in general acute Trusts, a similar increase in the rate in single specialty Trusts from 0.08 to 0.10/1000, while a small decrease was seen for specialist Trusts from 0.24 to 0.23/1000 bed-days (2). The range of MRSA rates in the three categories of Trusts decreased between the two years from 0.02 to 0.39 to 0.04 to 0.30 for general acute Trusts, 0.08 to 0.66 to 0.06 to 0.49 in specialist Trusts, and increased from 0 to 0.23 to 0 to 0.45 in single specialty Trusts (2).

A strong association was seen between the number of MRSA bacteraemias and both the number of culture positive and the total number of blood culture sets examined. Correlation analysis suggests a variability of 74% in the number of MRSA bacteraemias associated with positive blood culture sets. Similarly, 71% of the variability in the number of MRSA bacteraemias was associated with the total number of blood culture sets examined, the

remaining 29% of the variance being explained by other factors or by measurement error. Further investigations of these variables needs to be undertaken to increase our understanding any possible associations.

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References

1. PHLS. *Staphylococcus aureus* bacteraemia: England and Wales, 2001. *Commun Dis Rep CDR Wkly* [serial online] 2002 [cited 17 June 2003]; **12**(12): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2002/1202mrsa.pdf>>.
2. PHLS. The first year of the Department of Health's mandatory MRSA bacteraemia surveillance scheme in acute NHS Trusts in England: April 2001 - March 2002. *Commun Dis Rep CDR Wkly* [serial online] 2002 [cited 17 June 2003]; **12**(25): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2002/MRSA2502.pdf>>.
3. PHLS. First report of the Department of Health's mandatory MRSA bacteraemia surveillance scheme in acute NHS Trusts in England: April to September 2001. *Commun Dis Rep CDR Wkly* [serial online] 2002 [cited 17 June 2003]; **12**(6): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2002/MRSA0602.pdf>>.
4. PHLS. *Staphylococcus aureus* bacteraemia: England and Wales July to September 2001. *Commun Dis Rep CDR Wkly* [serial online] 2001 [cited 17 June 2003]; **11**(46): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2001/cdr4601.pdf>>.
5. PHLS. *Staphylococcus aureus* bacteraemia: England, Wales and Northern Ireland, January to December 2002. *Commun Dis Rep CDR Wkly* [serial online] 2003 [cited 17 June 2003]; **13**(12): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2003/cdr1203.pdf>>.
6. PHLS. *Staphylococcus aureus* bacteraemia: England and Wales, first six months of 2002. *Commun Dis Rep CDR Wkly* [serial online] 2002 [cited 17 June 2003]; **12**(38): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2002/cdr3802.pdf>>.
7. PHLS. *Staphylococcus aureus* bacteraemia: England, Wales and Northern Ireland, July to September 2002. *Commun Dis Rep CDR Wkly* [serial online] 2002 [cited 17 June 2003]; **12**(51): bacteraemia. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2002/cdr5102.pdf>>.
8. PHLS. NHS performance indicators and key targets for 2002/03: new infection control indicators. *Commun Dis Rep CDR Wkly* [serial online] 2002 [cited 17 June 2003]; **12**(50):news. Available at <<http://www.phls.org.uk/publications/cdr/PDFfiles/2002/cdr5002.pdf>>.
9. Adab P, Rouse A, Mohammed MA, Marshall T. Performance league tables: the NHS deserves better. *BMJ* 2002; **324**: 95-8.
10. Mohammed MA, Cheng KK, Rouse A, Marshall T. Bristol, Shipman, and clinical governance: Shewhart's forgotten lessons. *Lancet* 2001; **357**:463-7.
11. Scottish Centre for Infection and Environmental Health. *Report on methicillin-resistant Staphylococcus aureus bacteraemia in Scotland, January 2002 to December 2002*. Glasgow: SCIEH, April 2003. Available at <<http://www.show.scot.nhs.uk/scieh>>.