

MAIN STORIES THIS WEEK:

- [!\[\]\(30a147af384f9f71632c2ff17bc706c8_img.jpg\) Possible case of transfusion-associated variant CJD](#)
- [!\[\]\(9b33568d5c136f08ca688ce48be37574_img.jpg\) Laboratory acquired SARS case reported from Taiwan](#)
- [!\[\]\(8c93063dab026f10e159986b27c41c64_img.jpg\) *Clostridium histolyticum* in injecting drug users](#)
- [!\[\]\(8a17676a8da87a4e59299223a765e613_img.jpg\) *Shooting Up: infections among injecting drug users in the United Kingdom 2002*](#)
- [!\[\]\(f7fdc7cc047b770fc5fdd2c2137c07d9_img.jpg\) Revision of the Smallpox Plan released by Department of Health](#)
- [!\[\]\(3ca549f0313858650ddae522dc3cfea6_img.jpg\) European Centre for Disease Control and Prevention to be in Sweden](#)
- [!\[\]\(b6026cac39735f17b6ea8953e5327900_img.jpg\) Legionnaires' disease in Hereford](#)

REPORTS BY INFECTION:

Bacteraemia

- [!\[\]\(49aa2e1da5fe39294864e9598c593810_img.jpg\) *Staphylococcus aureus* bacteraemia: England, Wales, and Northern Ireland: July to September 2003](#)

News

Last updated: 18 December 2003

Next update due: 5 January 2004

- ▾ [Possible case of transfusion-associated variant CJD](#)
- ▾ [Laboratory acquired SARS case reported from Taiwan](#)
- ▾ [Clostridium histolyticum in injecting drug users](#)
- ▾ [Shooting Up: infections among injecting drug users in the United Kingdom 2002](#)
- ▾ [Revision of the Smallpox Plan released by Department of Health](#)
- ▾ [European Centre for Disease Control and Prevention to be in Sweden](#)
- ▾ [Legionnaires' disease in Hereford](#)

Possible case of transfusion-associated variant CJD

The first case of variant Creutzfeldt-Jakob disease (vCJD) thought to have been infected via a blood transfusion may have been seen in the United Kingdom (UK). The case, who died in autumn 2003, received blood during an operation in the first half of 1996. At that time neither the donor nor the recipient showed any signs of illness. The donor became ill in 1999 and subsequently died. The recipient became ill earlier this year, and post mortem tests confirmed the diagnosis of vCJD. Although there is no proven causal link between the two cases, the possibility of the blood transfusion being the route of infection for the second case cannot be ruled out.

The transfusion took place before 1997, when the first of a series of measures to protect against such possibilities took place. Since that time all reports of cases of vCJD are checked against blood donor records, and any stocks from such donors are immediately destroyed. In 1998 a programme was begun to remove white cells from donated blood (leuco-depletion), as they were considered to be a potential source of infection. Also in 1998, the use of UK-sourced plasma in the manufacture of blood products was phased out, a process that was completed at the end of 1999. The National Blood Service and the expert committee on the microbiological safety of blood and tissues for transplantation are to review current procedures in the light of this case.

Up to this point in time, fifteen other people in England and Wales are known to have received blood from donors who subsequently developed vCJD, five of whom received blood after the implementation of leuco-depletion. The earliest transfusion was in 1993, the latest in 2001. These cases are being contacted.

A full transcript of the statement by the Secretary of State for Health to the House of Commons on 17 December 2003 is available at <http://www.doh.gov.uk/cm/vcjdstatement.htm>.

Laboratory acquired SARS case reported from Taiwan

On 17 December 2003, the public health authorities in Taipei, Taiwan, reported a single case of laboratory acquired severe acute respiratory syndrome (SARS) coronavirus infection. The case, a 44 year-old male senior research scientist, who was working on a SARS study, appears to have acquired the infection in a local laboratory. The case had earlier travelled to Singapore and became ill the day he returned to Taiwan. Evidence of SARS-CoV infection has been found in multiple samples submitted to at least two laboratories in Taipei. These results will be verified by an external laboratory in the World Health Organization (WHO) SARS International Reference Laboratory Network to meet the WHO case definition of a confirmed case.

A full investigation of the circumstances surrounding the acquisition of infection and the procedures in the laboratory is currently underway. This is the second isolated case of laboratory acquired SARS-CoV infection since SARS was declared eliminated by WHO on July 5 2003.

All contacts in Taipei and Singapore, including passengers who were on the same flight and sat close to the case, are being traced and will be followed up by the health authorities. No secondary transmission has been found.

Further information is available from the WHO website at <http://www.who.int/csr/sars/en/>.



***Clostridium histolyticum* in injecting drug users**

Since 1 December 2003, the Anaerobe Reference Laboratory in Cardiff has diagnosed five cases of *Clostridium histolyticum* – all with cellulitis or abscess formation and all in injecting drug users (IDUs). The organism behaves similarly to *Clostridium novyi* seen in IDUs in 2000 (1).

Further details are awaited but this preliminary note is to alert those involved in clinical care, diagnostic microbiology and infection control to the presence of this organism in IDUs. Any suspect isolates should be sent to the Anaerobe Reference Laboratory at NPHS Microbiology Cardiff, University Hospital of Wales, Heath Park, Cardiff CF14 4XW, tel: 029 2074 6402.

At least two of the cases are known in addition to have tetanus, highlighting the possibility of a common source of *C. tetani* and *C. histolyticum* in soil contamination of drugs prior to, or during, injection. The two tetanus cases are part of a cluster previously reported in *CDR Weekly* (2,3). At least ten cases of tetanus have now been reported in England and Wales, with the latest known date of onset is 5 December 2003. Clinicians need to remain vigilant to diagnose tetanus cases as early as possible and should be aware that mixed infections have occurred.

References

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3. HPA. Cluster of cases of tetanus in injecting drug users in England: update. *Commun Dis Rep CDR Wkly* [serial online] 2003 [cited 18 December 2003]; **13** (47): News. Available at <<http://www.hpa.org.uk/cdr/2003/cdr4803.pdf>>.



Shooting Up: infections among injecting drug users in the United Kingdom 2002.

Data on a range of infections that can affect injecting drug users (IDUs) have been brought together in a new annual report that includes surveillance data from across the United Kingdom (UK), including the national results for 2002 from the Unlinked Anonymous Prevalence Monitoring Programmes (UAPMP) Survey of injecting drug users. The report is available on the HPA website at <http://www.hpa.org.uk/infections/topics_az/injectingdrugusers/shooting_up.htm>.

Infections among injecting drug users (IDUs) in the UK are becoming a growing public health problem. In recent years there have been outbreaks of, among other illnesses, hepatitis A, wound botulism, and most recently tetanus. A key finding is that the prevalence of hepatitis C infection among current injectors participating in the UAPMP survey has increased by a fifth between 2001 and 2002. Between 1998 and 2001 the prevalence among current IDUs in the survey had been stable at around 32%, but it increased to 39% in 2002.

By the end of 2002 there had been around 50,000 laboratory reported cases of hepatitis C in the United Kingdom, the majority amongst injecting drug users. The UAPMP survey of IDUs indicates that in 2002 57% of IDUs with antibodies to hepatitis C were unaware of their HCV status.

Transmission of hepatitis B continues among injectors even though there is an effective vaccine. Although the proportion of injectors participating in the UAPMP survey of injectors reporting vaccination has increased in recent years, only 43% of those participating in 2002 reported receiving one or more doses of the vaccine.

Although overall levels of HIV infection remain stable among injectors in the UK, there is evidence of ongoing transmission. The prevalence of HIV among IDUs participating in the UAPMP survey in London was 3.6% compared to 0.2% elsewhere in England and Wales.

Needle and syringe sharing still continues at a high level with around one in three injectors participating in the UAPMP survey reporting this in 2002. Those that inject and share their equipment remain at increased risk of infection with hepatitis C, hepatitis B, HIV, and other infections such as hepatitis A and wound botulism.

The report makes a number of recommendations as to priorities for those who commission services:

1. Developing high quality needle exchange services for those unable to stop injecting, this should include:
 - a. the provision of clear information and advice on safer injecting practices, prevention of bloodborne virus transmission, and on the safe disposal of used equipment;
 - b. ensuring that there is adequate service coverage so as to provide access to a new needle and syringe for each injection;
 - c. easy access to other on-site services such as vaccinations, health checks, and diagnostic tests.
2. Considering the provision of injecting-related equipment, other than needles and syringes, through needle exchanges.
3. Ensuring hepatitis B vaccination services are easily accessible, and the development of follow-up strategies for those who have started vaccination courses.
4. Examining the incorporation of hepatitis A vaccination into community and prison vaccination programmes for injecting drug users.
5. Improving access to diagnostic testing for hepatitis C in line with the aims of the Department of Health's consultation document Hepatitis C strategy for England, available at <<http://www.doh.gov.uk/cmo/hcvstrategy/77097dhhepcstrat.pdf>>
6. Ensuring easy access to treatment and support services for all those who wish to cease injecting, or to reduce, or stop, their drug use.

Revision of the Smallpox Plan released by Department of Health

The revised version of the Smallpox Plan was announced by the Minister of State for Health on 15 December. Following wide discussion and comment, the *Interim Guidelines for smallpox response and management in the post-eradication era* (Smallpox Plan) published in December 2002 has been updated. For ease of navigation the plan has been split into two parts. Part one outlines the pre and post-event activities that need to be, or would be undertaken, in response to a smallpox emergency. Part Two (Appendices) provides guidance on the criteria for national, regional and local health professionals and agencies to assist in implementation. The appendices will continue to be updated as experience and discussions proceed. The plan is available on the Department of Health website at <<http://www.doh.gov.uk/smallpox/smallpox.htm>>.

The plan basically remains the same, but apart from easier navigability there is more emphasis on action by alert level. Other changes include: more realistic specifications for smallpox care centres and vaccination centres, an emphasis on regional flexibility, and that the Chief Medical Officer will declare a change to Alert Levels. The main vaccination changes are that ambulance crews will be invited to join the smallpox management and response teams and so a selected group will be vaccinated at alert level 0 and 'Blue light services', who were previously vaccinated at level 2 will now be vaccinated at level 1, at the same time as with healthcare workers.

European Centre for Disease Control and Prevention to be in Sweden

The European Centre for Disease Control and Prevention (ECDC) will be in Sweden, at a location yet to be determined by the Swedish government. The European Food Safety Agency (EFSA), will be situated in Parma, Italy, and The European Chemicals Agency will be located in Helsinki, Finland. These decisions were taken at a meeting of the European Council, made up of heads of state or government, which took place on 13 December 2003 (1).

The EFSA has been operational since June 2003, and has been given a temporary office in Brussels. It is expected that legislation to set up the ECDC will be finalised early in 2004, with the intention of the centre becoming operational in early 2005 (2).

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Legionnaires' disease in Hereford



The outbreak of legionnaires' disease in Hereford previously reported in *CDR Weekly* (1,2) was declared closed by the outbreak control team on 8 December 2003. Twenty-eight cases of legionnaires' disease were identified during the outbreak with two deaths. Dates of onset ranged from 8 October to 20 November. All cases either lived in, or travelled through, Hereford between October and mid-November. Ages ranged from 36 to 91 years (the median age was 57.5 years) with an approximate male to female ratio of 3:1.

Detailed case finding, including a retrospective review of pneumonia admissions to Hereford hospital, identified no cases prior to the presumed index case. All cases were *Legionella pneumophila* urinary antigen positive and *L. pneumophila* serogroup 1 was isolated from three.

Environmental investigations by Hereford Council identified a likely source in a cider factory near the city centre. The site included two cooling towers associated with a plant that opened in the late autumn each year to process apples from the year's harvest. Subsequent testing confirmed the presence of significant colonisation with *L. pneumophila* serogroup 1. Epidemiological typing by both monoclonal antibody subgrouping and sequence-based typing was used to characterise the strain of legionella involved (3). This confirmed that the legionella in the tower were indistinguishable from the clinical isolates from two cases.

The towers were cleansed and finally closed on 12 November. There were no cases with an onset date more than eight days after the towers were closed.

This investigation highlighted the benefits of collaboration across the Health Protection Agency (HPA) and partner agencies. In addition to the local and regional HPA teams, the Hereford laboratory, the HPA London Food and Water Laboratory, the HPA SRMD Water and Environmental Microbiology Reference Unit, the SRMD Respiratory and Systemic Infection Laboratory, and the HPA Communicable Disease Surveillance Centre were involved. Collaboration with Hereford Council and HPA Porton Down enabled detailed travel histories to be mapped for each case and overlaid with modelling of potential plume spread from known sources of water vapour in Hereford. This proved to be a very valuable part of the outbreak investigation. Support for managing the outbreak and the intense media interest came from the West Midlands South Strategic Health Authority.

A full outbreak report is being prepared.

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Bacteraemia

Last updated: 18 December 2003

Next update due: 15 January 2004

 [Staphylococcus aureus bacteraemia: England, Wales, and Northern Ireland: July to September 2003](#)

Staphylococcus aureus bacteraemia: England, Wales, and Northern Ireland: July to September 2003

Key points:

- Laboratories in England reported 3899 *Staphylococcus aureus* bacteraemia isolates between July and September 2003 through the voluntary reporting scheme*. A further 1000 *S. aureus* reports (4899) were made via the mandatory reporting scheme†. The trends in mandatory and voluntary reporting of *S. aureus* are considered in the discussion.
- Over the same period there were 203 and 121 voluntary reports of *S. aureus* bacteraemia isolates from laboratories in Wales and Northern Ireland respectively.
- Ninety-two per cent of voluntary reports contained information on susceptibility to methicillin. Methicillin resistance in Wales and Northern Ireland (voluntary reporting) was noted in 47% and 41% of *S. aureus* bacteraemia reports respectively. In England, 39% of *S. aureus* bacteraemias were due to methicillin resistant *Staphylococcus aureus* (MRSA) under both the voluntary and mandatory schemes.
- No reports of vancomycin or linezolid resistance in *S. aureus* bacteraemias were received during this period, and there were just two reports of teicoplanin resistance.
- These data do not distinguish between hospital-acquired and community-acquired infections, in which healthcare setting they may have been acquired, or whether they were acquired in the UK.

* Voluntary reporting: undertaken by most laboratories in England, Wales, and Northern Ireland for many years. Laboratories report individual clinically significant infections on a regular basis, usually weekly.

† Mandatory reporting: established in England in April 2001. Acute NHS Trusts send quarterly aggregate reports of total numbers of *S. aureus*

bacteraemias, including MRSA.

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Staphylococcus aureus bacteraemia: England, Wales, and Northern Ireland: July to September 2003

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Introduction

This report covers *Staphylococcus aureus* bacteraemia reports made during the third quarter of 2003 (July to September) under the voluntary (routine communicable disease reporting by laboratories) and mandatory bacteraemia reporting schemes. These bacteria were isolated from blood cultures with or without cerebrospinal fluid, by laboratories across England, Wales, and Northern Ireland. Wales and Northern Ireland do not participate in this mandatory *S. aureus* surveillance scheme. Rates were calculated using 2002 mid-year resident population estimate denominators for each region. Regional analyses were performed using the English regional boundaries introduced in April 2002.

Staphylococcus aureus

In the three month period July to September 2003, 3899 reports of *S. aureus* bacteraemia were received through the voluntary reporting scheme in England, Wales, and Northern Ireland (3575, 203, 121 respectively) (table 1 and figure 1). Under the mandatory surveillance scheme, there were 4899 *S. aureus* bacteraemia reports from England. Wales and Northern Ireland do not participate in the mandatory methicillin resistant *Staphylococcus aureus* (MRSA) surveillance scheme.

Among the English regions, the West Midlands had

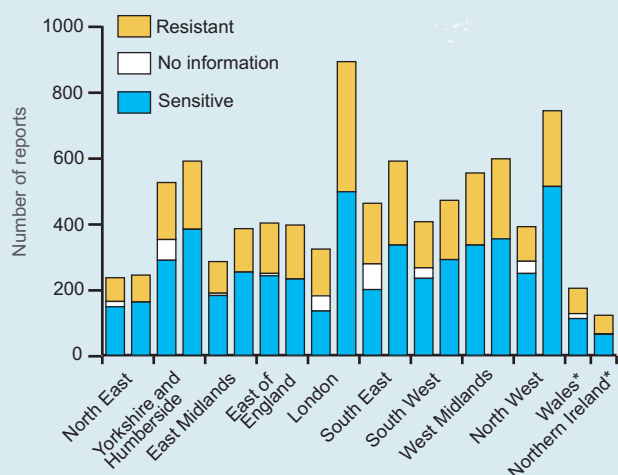
the highest number of reports under the voluntary scheme (553) and London had the highest number of reports under the mandatory scheme (891). The lowest number of reports under both schemes were received from the North East (235 for the voluntary and 243 for the mandatory scheme). London had the greatest discrepancy in MRSA reports made under the voluntary and mandatory schemes, with 253 more reports under the mandatory scheme, and East of England region had the smallest, with 11 more MRSA reports made under the mandatory scheme.

The overall reporting rate of *S. aureus* bacteraemia for England, Wales, and Northern Ireland was 7.2 per 100,000 for the three month period, based on voluntary reporting (figure 2). England had the highest rate (7.2 per 100,000 population) followed by Northern Ireland (7.1/100,000) and Wales (7.0/100,000). Reporting rates within England ranged from 4.4/100,000 in London to 10.5/100,000 in Yorkshire and Humberside.

Antimicrobial susceptibility

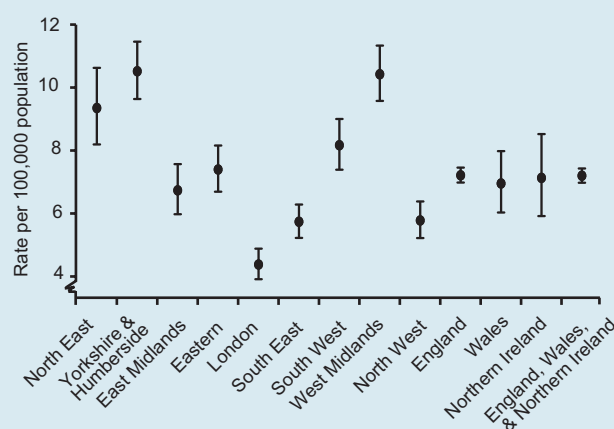
All reports made under the mandatory surveillance scheme include methicillin susceptibility data, whereas 92% of voluntary reports included this information (table 1 and figure 3). There was little variation in the proportion of *S. aureus* bacteraemia isolates resistant to methicillin between the two schemes in the South West (0%), West Midlands (1%), North West (1%), East Midlands (1%), and North East regions (1%). In London,

Figure 1 *Staphylococcus aureus* bacteraemia reports and methicillin susceptibility data, England, Wales, and Northern Ireland: July to September 2003*



*rates calculated using 2002 mid-year resident population estimates

Figure 2 *Staphylococcus aureus* bacteraemia voluntary reporting rates* per 100,000 population (95% confidence intervals): England, Wales, and Northern Ireland, July to September 2003



*rates calculated using 2002 mid-year resident population estimates

Table 1 *Staphylococcus aureus* bacteraemia reports and methicillin susceptibility data*, England, Wales, and Northern Ireland: July to September 2003

Region	Reporting scheme	Resistant	(%†)	Sensitive	No information	(%)	Total
North East	Voluntary	72	33	147	16	7	235
	Mandatory	82	34	161	–	–	243
Yorkshire & Humberside	Voluntary	173	38	288	63	12	524
	Mandatory	207	35	382	–	–	589
East Midlands	Voluntary	96	35	181	7	2	284
	Mandatory	132	34	252	–	–	384
East of England	Voluntary	153	39	241	7	2	401
	Mandatory	164	42	231	–	–	395
London	Voluntary	142	51	134	46	14	322
	Mandatory	395	44	496	–	–	891
South East	Voluntary	184	48	199	78	17	461
	Mandatory	255	43	334	–	–	589
South West	Voluntary	140	38	233	32	8	405
	Mandatory	180	38	290	–	–	470
West Midlands	Voluntary	219	40	334	–	–	553
	Mandatory	243	41	353	–	–	596
North West	Voluntary	105	30	248	37	9	390
	Mandatory	230	31	512	–	–	742
England	Voluntary	1284	39	2005	286	8	3575
	Mandatory	1888	39	3011	–	–	4899
Wales‡	Voluntary	77	41	111	15	7	203
Northern Ireland‡	Voluntary	56	47	63	2	2	121
England, Wales, & Northern Ireland	Voluntary	1417	39	2179	303	8	3899

* provisional data; †R as a percentage of R+S; ‡ Wales and Northern Ireland have separate mandatory surveillance schemes

however, voluntary reporting a 7% higher rate of methicillin resistance than mandatory reporting.

The proportion of *S. aureus* reports without methicillin susceptibility information was highest in reports from the South East (17%), London (14%), and Yorkshire and Humberside regions (12%). Only the West Midlands had complete information on methicillin susceptibility for the July to September 2003 quarter under the voluntary scheme.

Thirty-nine per cent of reports of isolates with methicillin susceptibility information made under the voluntary laboratory reporting scheme for England were resistant to methicillin. This compares to 41% of reports from Wales (77/188) and 47% of reports from Northern Ireland (56/119) (table 1). Of the 4899 reports made via the mandatory scheme in England, 1888 (39%) isolates were reported as resistant to methicillin.

London had the highest percentage of methicillin resistant *S. aureus* (MRSA) isolates (51% voluntary and 44% mandatory) in England (table 1). The North West (30% voluntary and 31% mandatory) and North East regions (33% voluntary and 34% mandatory) had the lowest proportion of methicillin resistant isolates.

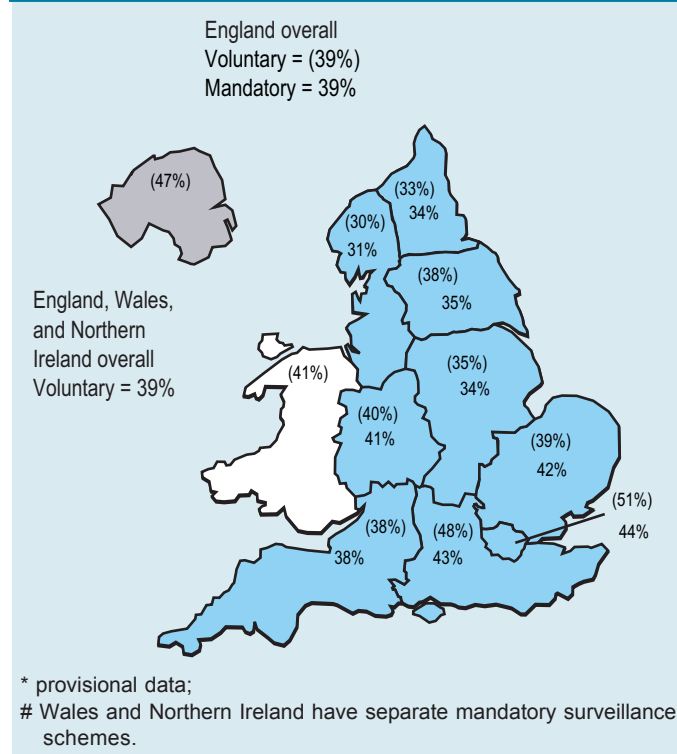
Of the reports that included susceptibility data for other antimicrobials, 51% of isolates were reported as resistant to ciprofloxacin, and 37% as resistant to erythromycin. Less than 10% resistance was reported for the remaining antibiotics listed in table 2. No reports of vancomycin or linezolid resistance in *S. aureus* bacteraemias were received during this period and there were just two reports of teicoplanin resistance.

Table 2 *Staphylococcus aureus* bacteraemia reports (voluntary reporting*) and susceptibility data: England, Wales, and Northern Ireland: July to September 2003

	Resistant	(%)†	Sensitive	No information	(%)‡
Ciprofloxacin	657	51	620	2622	67
Erythromycin	1095	37	1852	952	24
Fusidic acid	237	9	2309	1353	35
Gentamicin	159	6	2582	1158	30
Mupirocin	85	6	1345	2469	63
Rifampicin	85	6	1345	2469	63
Vancomycin	–	–	1582	2317	59
Teicoplanin	2	0.2	1226	2671	69
Linezolid	–	–	160	3739	96

* This information is not available under the mandatory surveillance scheme
 † as a percentage of reports with susceptibility information
 ‡ reports with no susceptibility information as a percentage of total voluntary *S. aureus* reports

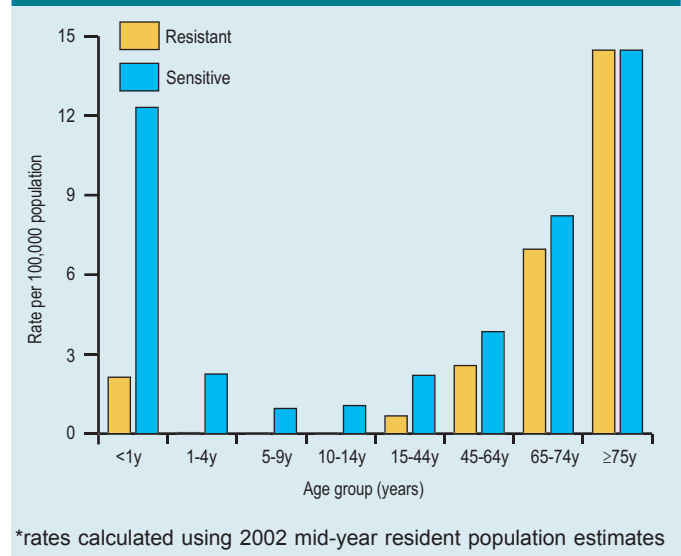
Figure 3 Methicillin resistance in *Staphylococcus aureus* bacteraemia reports*, England, Wales, and Northern Ireland: July to September 2003. MRSA as a percentage of isolates whose susceptibilities were reported



Age distribution

The age-specific rate of MRSA (figure 4) was highest in the 75 years and over age group (14.47 per 100,000 population), followed by the 65 to 74 years and 45 to 64 age groups. This is the same distribution as that reported for the second quarter of 2003. This information is only obtainable from the voluntary reporting scheme and is not included in the mandatory dataset. The proportion of methicillin sensitive *S. aureus* (MSSA) was higher than MRSA for all age groups except the over 75 years age group, where it was equal.

Figure 4 Age-specific *Staphylococcus aureus* bacteraemia rates* and methicillin susceptibility per 100,000 population: England, Wales, and Northern Ireland: July to September 2003 (voluntary reporting)



Discussion

S. aureus bacteraemia reports made from July to September 2003, from both the voluntary and mandatory reporting schemes, are presented here to allow comparison with earlier reports. Caution should be exercised when interpreting data from a short time period such as three months. The data obtained under both schemes (voluntary and mandatory) have been analysed here as the voluntary scheme includes additional information such as age and gender. No distinction is made between community- and hospital-acquired bacteraemias in this analysis, nor is there data to identify the location that the infection was acquired.

Where voluntary and mandatory reporting from England are compared, there is a deficit of 1324 reports. There were, however, no differences in the overall proportion (39%) of *S. aureus* bacteraemias due to MRSA in England under the two schemes. It is noteworthy that the number of reports made under the voluntary scheme has risen by over 30%, while during the same period the number of mandatory reports has risen by less than 10% (1). This would suggest an improvement in the reporting of bacteraemias under the voluntary scheme.

In England, Wales, and Northern Ireland, 92%, 93% and 98% respectively of voluntary *S. aureus* reports included data on methicillin susceptibility. Ninety-two per cent of voluntary reports contained methicillin susceptibility information, which compares to 91% for the same period of 2002 (1) and 93% for the preceding quarter of 2003 (2). All mandatory reports included methicillin susceptibility data.

The proportion of *S. aureus* reports identified as methicillin resistant was very similar when compared to data from the previous report (2), where methicillin resistance of 39% and 40% from the mandatory and voluntary schemes respectively was reported. These results compare well with other surveys such as those produced by the British Society for Antimicrobial Chemotherapy (BSAC) (3) and the European Antimicrobial Resistance Surveillance System (EARSS) (4) and this strengthens the observation made in the previous quarter's report on MRSA (2) that the proportion of *S. aureus* due to MRSA appears to have stabilised at approximately 40%.

There is a wide range in the regional reporting rate for the voluntary reporting scheme (from 4.9 to 10.5 per 100,000 population). This may be due to a number of factors, including regional differences in rates of MRSA and methodological differences in reporting. For example, the rate in the West Midlands is one of the higher rates 10.4 per 100,000 population, which may be due to the fact that this region has complete electronic reporting of both voluntary and mandatory *S. aureus* bacteraemias.

It is interesting to note that the rate has increased from an overall rate of 6.2 per 100,000 population from England, Wales, and Northern Ireland to 7.2/100,000. This increase in the rate may be due, in part, to the use of 2002 mid-year population estimates in this latest quarterly analysis.

The rate of mandatory *S. aureus* reports is 9.9 per

100,000 population for England. This rate is considerably higher than the rate of voluntary reports, suggesting under-reporting of *S. aureus* bacteraemias under the voluntary scheme.

Although 92% of voluntary *S. aureus* reports included data on methicillin susceptibility, only 36% of these reports included ciprofloxacin susceptibility data and 81% included susceptibility data for erythromycin. Thirty-nine per cent of MRSA reports were accompanied by reports of resistance to ciprofloxacin and 65% of MRSA reports included erythromycin resistance. Thirty-one per cent of MRSA isolates were reported with concomitant resistance to ciprofloxacin and erythromycin and only 1% of MSSA reports were reported with this resistance pattern. The higher percentage ciprofloxacin and erythromycin resistance in MRSA isolates compared to MSSA isolates, is consistent with the MRSA isolates belonging to EMRSA-15 and EMRSA-16 strains, which account for the majority of MRSA isolates in England (Livermore DM, Personal communication, 16 December 2003) and which differ in their antimicrobial susceptibilities and treatment options (2,5).

Susceptibility data for other antimicrobials was weak as there was a lack of information on more than 50% of the isolates. These data are similar to those for the previous quarter although the incomplete information makes comparisons with previous data and analyses difficult. There were no reports of vancomycin- or linezolid-resistant bacteraemias and only two reports of teicoplanin resistant bacteraemias.

Laboratories are asked to send any isolates suspected to have full or intermediate glycopeptide resistance or resistance to newer anti-staphylococcal agents, such as linezolid, to the Health Protection Agency (HPA) Antibiotic Resistance Monitoring Reference Laboratory (ARMRL). Suspect isolates will also be typed at the HPA Laboratory of Healthcare Associated Infection (LHCAI) to explore the evolution and spread of new strains.

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