

1. Introduction

Reporting of MRSA bacteraemia rates by acute division was initiated by HDL (2001) 57 and has been ongoing since March 2002, with twelve reports now in the public domain.

In order to obtain robust and comparable national data, surveillance in Scotland is conducted according to the SSHAIP MRSA Bacteraemia Surveillance Protocol (http://www.show.scot.nhs.uk/scieh/infectious/hai/SSHAIP/pdf/Protocol_for_National_Reporting_of_MRSA_Bacteraemias.pdf). Data collected at division level are transferred to HPS for national reporting. These rates are fed into the Performance Assessment Framework and are utilised by the Scottish Executive in order to evaluate the performance of individual Health Boards. It is therefore imperative that the data collected are accurate and complete to ensure valid national reporting.

All 35 laboratories in Scotland report to HPS on a weekly basis, including the 26 laboratories responsible for conducting blood tests, all positive microbiological samples are sent on a paper form to HPS on a weekly basis. These results are then entered onto a database by clerical staff (see figure 1) and a print-off of the results checked by a clinician to detect any obvious errors.

From these data all bacteraemias are extracted electronically and emailed to the SSHAIP team Epidemiologist, who identifies duplicate reports according to the definition of an “episode” in the SSHAIP MRSA reporting protocol. The individual reports are then returned to the reporting laboratory in order to allow identification of inaccurate reports. The data are then amalgamated to divisional level, converted to rates using Acute Occupied Bed Days (AOBDs), obtained from ISD, as the denominator and the quarterly MRSA bacteraemia report produced for publication.

Data are presented in statistical process control (SPC) charts. It is intended that acute divisions who have MRSA bacteraemia rates per 1000 AOBDs consistently above the control limit are asked to investigate the local reasons for this and identify interventions to reduce their rate. Prior to this it is essential that both HPS and the reporting laboratories are confident that the figures represent an accurate report of MRSA bacteraemias within hospitals.

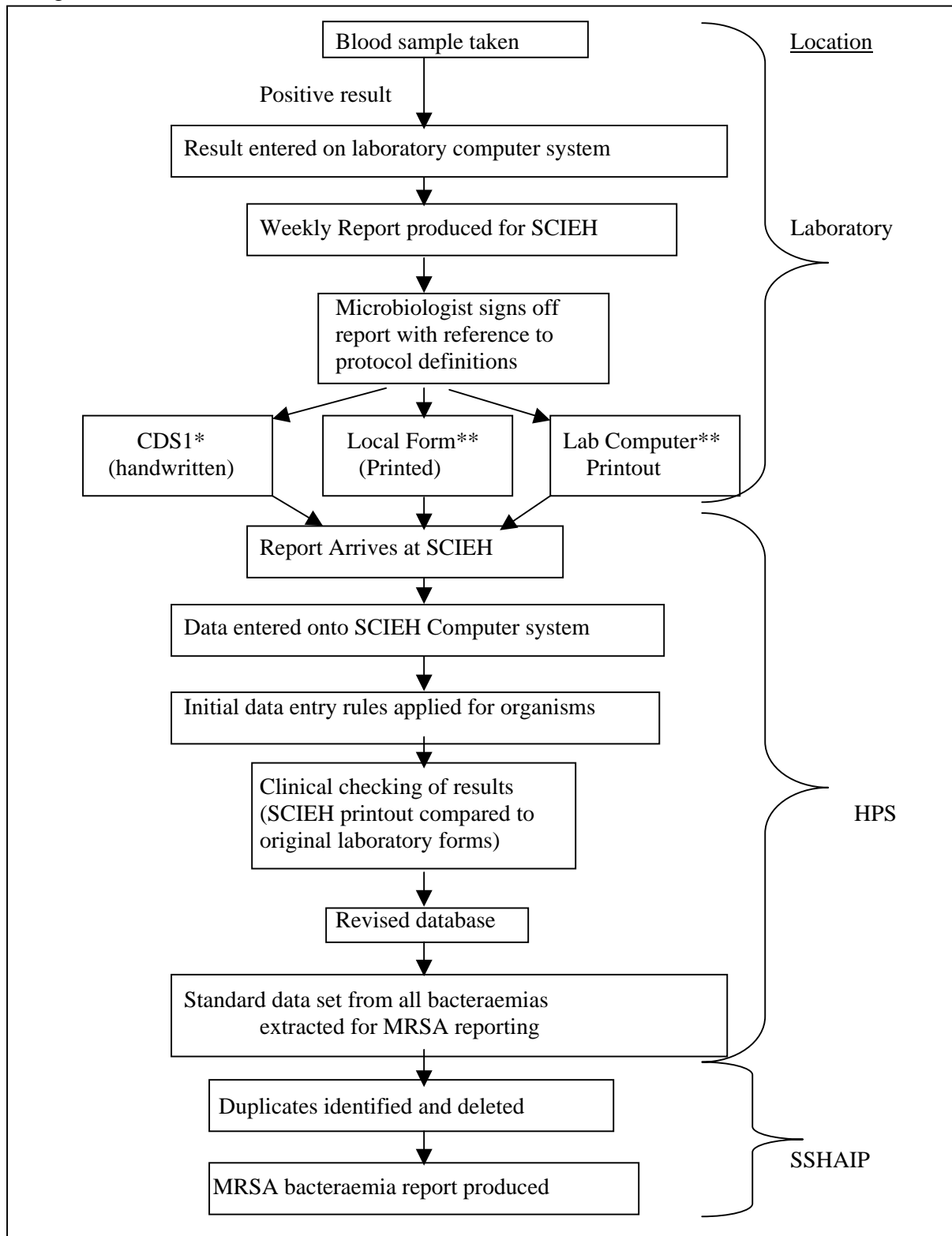
2. Background

The literature states that the accuracy with which nosocomial infections are identified varies considerably and that experience, qualifications, training and awareness of staff involved in surveillance effects the accuracy of infection reporting¹. This emphasises the need for staff to have good working knowledge of a standard set of data definitions that are simple and easy to interpret.

However, it has been demonstrated that despite highly trained staff and the use of specific criteria, that identification of nosocomial infections can vary considerably between investigators¹. This reflects the scope for subjectivity of decision making when identifying infections, therefore validation of surveillance data is necessary to ensure its scientific credibility and to help identify methodological problems within

the surveillance programme. Validation can also help to increase compliance and participation in the surveillance programme and identify local problems and issues².

Figure 1: Data Flow for MRSA bacteraemias



* CDS1 is a HPS form with the fields Infecting agent/pathogen, Diagnosis, Laboratory findings, Nature of specimen, Patients Name, Sex/Age and Any additional information of interest.

** The format and fields contained in local forms and laboratory printouts varies between acute divisions.

3. Aims

The primary aim of this study was to determine the accuracy and completeness of MRSA bacteraemia reporting. All elements of the process of gathering and reporting this information were evaluated including the completeness of the reporting from local sites and the accuracy and completeness of data entry within HPS.

4. Objectives

1. To obtain a detailed description of the structure for producing weekly reports and the processes used in reporting laboratories.
2. To determine the compliance of the reporting process with the definitions in the MRSA bacteraemia surveillance protocol. This will determine the proportion of “false positive” reports to HPS, i.e. those patients reported as having an MRSA bacteraemia when they did not, and estimate the number of “false negatives”, i.e. those not reported to HPS or reported incorrectly.
3. To determine the accuracy of MRSA bacteraemia data recorded in HPS.
4. To determine the accuracy of reporting for the quarterly MRSA bacteraemia report.

5. Methods

The validation approach adopted within this study described the structures and processes used for MRSA reporting and evaluated the outcomes of these processes.

5.1 Structure

The individuals involved and their knowledge of definitions defined in the MRSA bacteraemia protocol were described by means of a standardised telephone interview schedule.

5.2 Process

The way in which the data was collected and reported to HPS was evaluated. Components of process were evaluated by telephone structured interview schedule with all personnel involved in reporting to HPS at each site.

Components of process evaluated:

1. Data collection methods
2. Identification and reporting of MRSA bacteraemias
3. Data collation and transfer
4. Degree of adherence to data definitions and protocol

Within each laboratory the Consultant Microbiologist used as a contact for MRSA reporting was telephoned and questioned about the structure and processes of reporting MRSA bacteraemias to HPS, utilising a standard interview schedule (appendix I), and asked to identify all individuals involved in this process.

5.3 Outcome

Data held within HPS were compared to data held for the EARSS database and a list of blood samples positive for MRSA extracted from each laboratory's computer system.

The completeness of the reporting was evaluated. This determined whether all episodes of MRSA bacteraemia were reported to HPS.

A list of all blood samples positive for MRSA but not reported to HPS was produced and the Consultant Microbiologist was asked the reasons for these not having been reported.

This study therefore compared the MRSA bacteraemia data held on the following systems:

5.4 **Sources of Data**

Laboratory computer systems.

Each reporting laboratory enters data from each positive microbiological sample on a dedicated database. There are currently four main systems used. A report of all MRSA positive blood samples was extracted from each system and after application of the definitions defined in the MRSA bacteraemia protocol a list of MRSA bacteraemias was compared with other data sources.

HPS Weekly Reports

On a weekly basis each laboratory produces a list of all positive microbiological samples for reporting to SCIEH. These were utilised to identify reports missed during HPS's data entry/quality assurance processes.

HPS Database

The above paper reports are entered onto a database (DATAEASE) by dedicated data entry staff and quality checked by medical staff. On a quarterly basis all bacteraemias are extracted from this database and form the basis of the SHHAIP database. Data from this database were extracted for comparison with data from other sources.

SSHAIP Database

Data extracted from the HPS database are imported into a dedicated database on a quarterly basis. After deletion of duplicate reports, quality assurance and feedback to participating laboratories, these data form the basis of the quarterly MRSA bacteraemia report.

EARSS Database

The European Antimicrobial Resistance Surveillance System (EARSS) was launched in Scotland in July 2002. All laboratories processing blood samples in Scotland are now participating in this scheme which requires a sample from all blood samples found to be positive for MRSA to be sent to the MRSA reference laboratory. Data on these samples is then entered into a dedicated database held by the Antimicrobial Resistance Team in HPS. Data held on this independent system were utilised to identify MRSA bacteraemias not known to the other data sources.

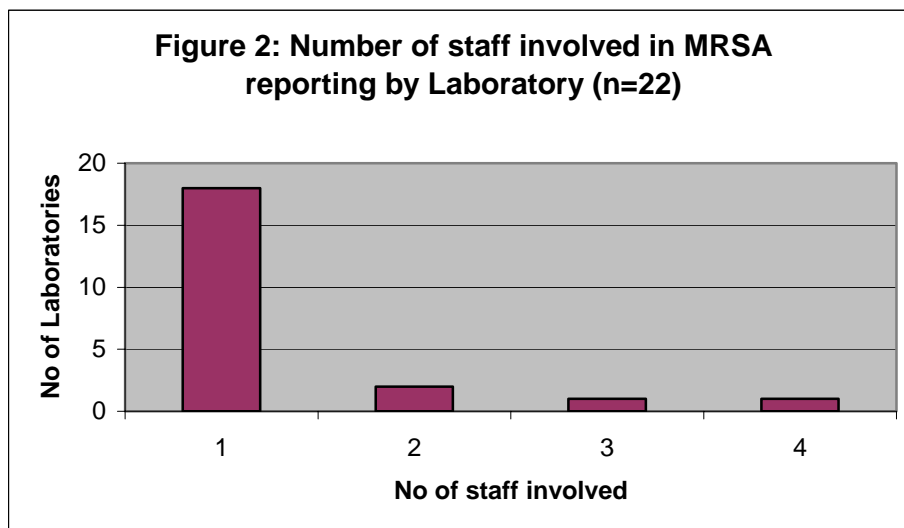
6. Results

The telephone interviews were conducted between June and October 2004 and 22 laboratories agreed to participate, three laboratories were excluded as they had not reported any MRSA bacteraemias during the period of surveillance (i.e. from January 2001 to March 2004) and two laboratories had recently merged and their data was considered as one. In total, 22 Microbiologists were interviewed and 238 MRSA bacteraemia were verified.

6.1 Validation of Process

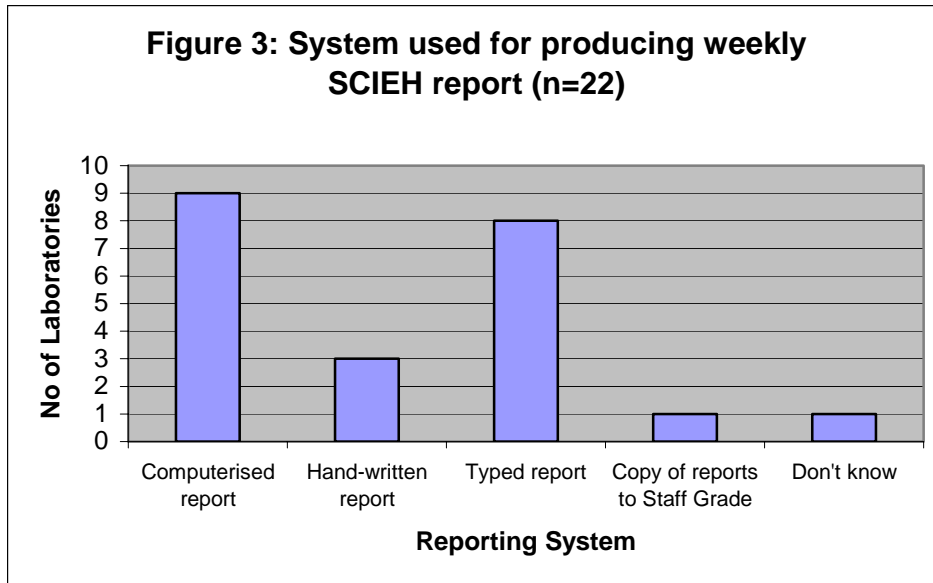
6.1a Staff involved in reporting

The number of people involved in the reporting process within each laboratory is shown in figure 2. For most laboratories only one staff member was involved in producing the MRSA report for HPS, usually the Consultant Microbiologist.



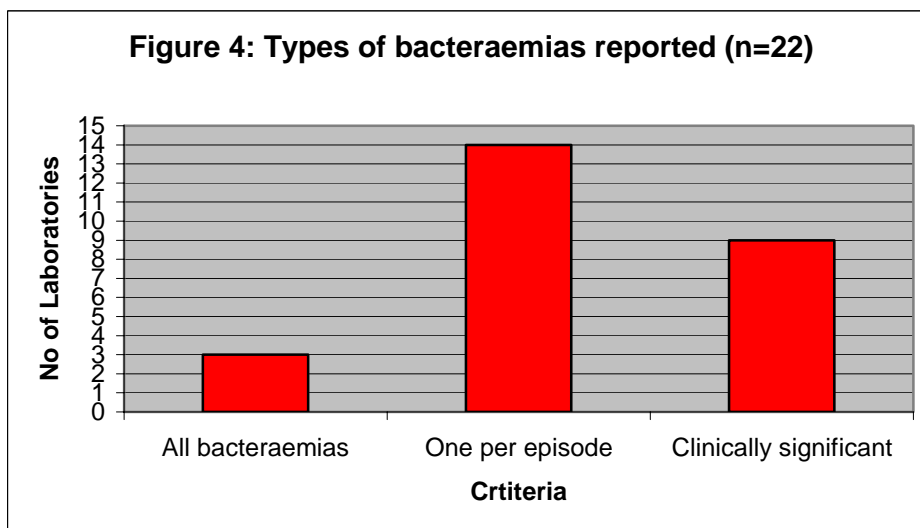
6.1b Systems for reporting

The system used to report MRSA bacteraemias to HPS are shown in figure 3. The majority of laboratories used computer generated reporting systems or produced a typed list of reports for return to HPS.



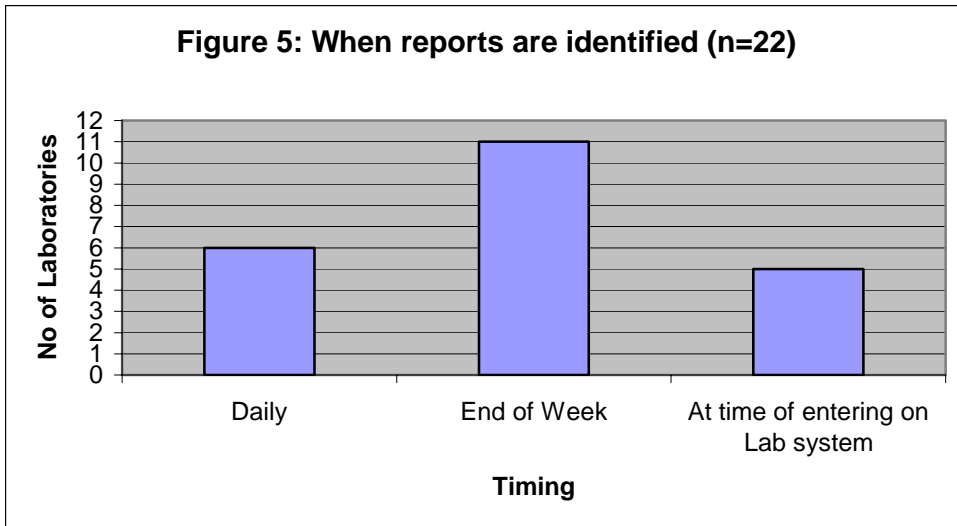
6.1c Type of bacteraemias reported

The bacteraemias reported by the laboratories are illustrated in figure 4. It can be seen that three laboratories sent all reports to HPS, 14 sent only the first isolate for each episode of MRSA bacteraemia and nine labs removed reports thought not to be clinically significant, i.e. the positive sample was the result of a contaminant. Laboratories were allowed to give more than one response to this question, e.g. a laboratory may indicate that sent one report for each clinically significant episode.



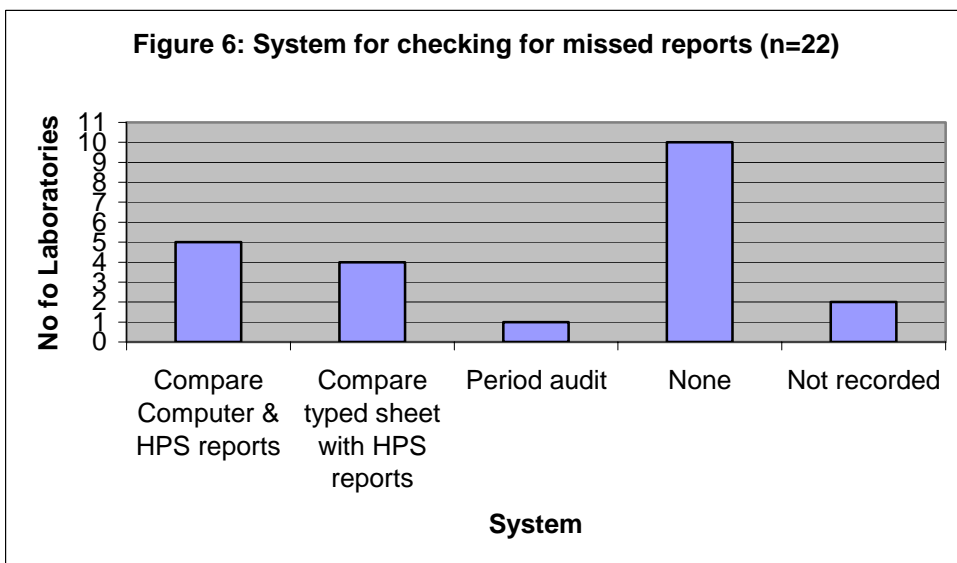
6.1d Timing of bacteraemia identification

The time at which bacteraemias were identified for reporting are illustrated in figure 5. Six laboratories identified reports on a daily basis, 11 produced a weekly report and five laboratories identified the reports as part of the process of entering data on to their laboratory computer system.



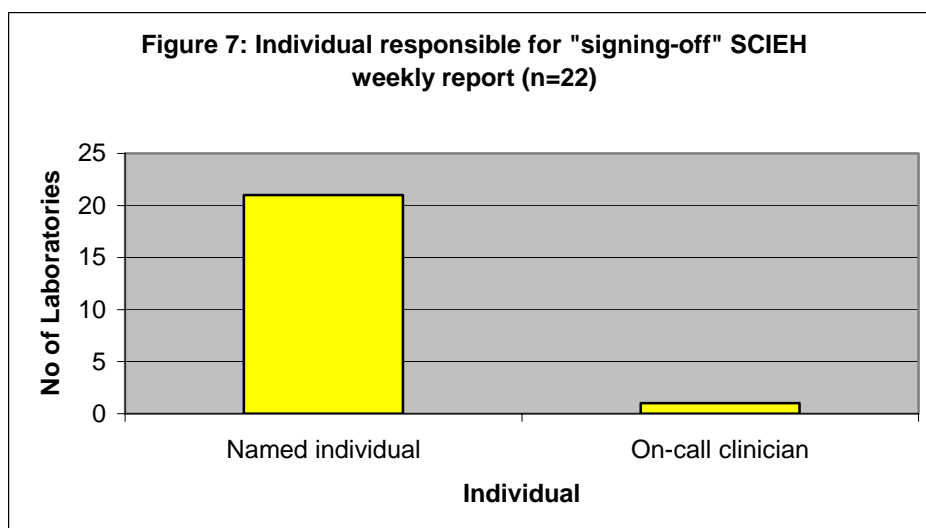
6.1e System for identifying missed reports

The systems used to check that no reports had been missed are shown in figure 6 below. Only ten sites (45%) had a system for checking their data with ten sites not performing any form of quality assurance and two not giving a response to this question.



6.1f Individual responsible for “signing-off” reports

Individuals responsible for “signing-off” the weekly report prior to sending to HPS fell into two main categories, In all but one laboratory a named individual was responsible for signing the report. In the remaining laboratory the on-call clinician was given this responsibility (figure 7).



6.2 Validation of Outcome

Laboratories produced a list from their laboratory computer system of all blood cultures between 1st January 2004 and 31st March 2004. The criteria for reporting MRSA bacteraemias were applied to this list of reports to identify episodes of bacteraemia and this list compared to the data held at HPS.

Of the 26 laboratories who report MRSA bacteraemias to HPS, the three island sites were excluded as they had no bacteraemias in the period under review, two labs were unable to supply the list required before the deadline, three labs did not supply the data requested and two laboratories had merged prior to study beginning and were treated as one site. Therefore these reports are based on 17 laboratories (Table 1).

Table 1: MRSA Validation Results for period 1/1/2004 to 31/3/2004

Lab	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
No of MRSA Episodes – Lab Printout	15	35	41	13	25	2	6	3	10	27	5	5	9	16	8	0	18	238
No of MRSA Episodes – HPS Database	17	29	38	10	26	3	6	2	10	14	2	2	9	13	7	0	20	208
No reported and correctly recorded	14	18	41	12	20	2	6	2	9	12	2	2	6	13	6	0	15	180
No of reports running into next quarter	1	2	9	3	4	0	0	1	1	3	2	0	1	6	0	0	3	36
No of reports running over from previous quarter	3	10	6	1	7	1	0	0	1	1	0	0	3	5	1	0	1	40
No on line listings but not recorded on HPS database	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
No not reported to HPS on line listings	0	14	0	1	2	0	0	0	0	12	1	3	2	2	2	0	0	39
No on line listing but not on Laboratory printout	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4	5
No falsely entered by HPS as MRSA bacteraemias	4*	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6

* A problem with the reporting and interpretation of the line listings from laboratory 1 was identified in early 2004 and missed MRSA bacteraemias shown above would have been identified through the new rules of interpretation.

Table 1 shows that the HPS reporting system has an overall sensitivity of 81% (193 of 238 bacteraemias) and a positive predictive value of 94.5% (188 of 199 reports held by HPS), when the two sites identified as having particular problems are excluded the sensitivity of the surveillance rises to 90.3% (159 of 176 bacteraemias), while the positive predictive value increases to 97.8%.

7. Discussion

The main objectives of this study were :

To obtain a detailed description of the structure for producing weekly reports and the processes used in reporting laboratories.

To determine the compliance of the reporting process with the definitions in the MRSA bacteraemia surveillance protocol. This will determine the proportion of “false positive” reports to HPS, i.e. those patients reported as having an MRSA bacteraemia when they did not, and estimate the number of “false negatives”, i.e. those not reported to HPS or reported incorrectly.

To determine the accuracy of MRSA bacteraemia data recorded in HPS.

To determine the accuracy of reporting for the quarterly MRSA bacteraemia report.

Each of these will be discussed in turn.

7.1 Detailed description of the structure for producing weekly reports

A variety of systems are used in laboratories to produce the weekly reports. The majority of laboratories have one individual responsible for producing the reports and this individual is responsible for “signing-off” the reports to HPS, however the systems used to produce the report vary from a computer generated list to hand-written reports produced from copies of individual laboratory reports. Only a minority of laboratories had a regular system for checking that no reports had been missed.

7.2 Determine the compliance of the reporting process with the definitions in the MRSA bacteraemia surveillance protocol

According to the MRSA reporting protocol laboratories should only make one report per episode of MRSA bacteraemia and only where it is a clinically significant bacteraemia. Although nine labs remove reports thought not to be clinically significant, the majority of these sites suggested that this was a rare occurrence. This could introduce an element of inconsistency in the reporting at specific sites and may be responsible for the under-reporting in two of the laboratories.

7.3 Determine the accuracy of MRSA bacteraemia data recorded in HPS.

The results for the 17 labs supplying data (two laboratories had merged their MRSA reporting and the results were considered as one) suggest that the recording of MRSA bacteraemias within HPS now accurately represents the results reported by the laboratories, with only 6 of 238 (2.5%) reports missed and only six records (2.5%) falsely entered as MRSA bacteraemias. The reporting from the laboratories was less consistent with 39 reports sent to HPS, however this appears to be a local problem with two labs accounting for 67% (26/39) of all missed reports, with these laboratories excluded the consistency of reporting appears to be good with only 13 of 143 reports (9%) missed.

The accuracy of data held at HPS was found to be high, with only six reports not correctly recorded on the HPS database suggesting that the recording of information within HPS is of a high standard.

7.4 Determine the accuracy of reporting for the quarterly MRSA bacteraemia report.

A substantial influence on the number of episodes of MRSA bacteraemia reported is the number occurring in the previous quarter that are recorded in the current quarter and similarly the number of episodes occurring in the current quarter that are reported as happening in the subsequent quarter. Although, in theory these two inconsistencies should balance out, during certain periods of the year, e.g. Christmas holidays, the numbers slipping into the following quarter will be higher than during other period and this may falsely suggest a seasonality to the data, where none exists.

Although 39 bacteraemias were not reported to HPS, the majority of these (26) were from two laboratories, suggesting that there is a special situation within these two laboratories.

8. Interventions

Where a site was shown to be reporting poorly, the following interventions were initiated:

1. Support the site to improve/optimize reporting. This will include identifying individual responsible for the completeness of the data and providing reference material and training, where appropriate.
2. Update the data retrospectively. All corrected data were fed into the MRSA bacteraemia reporting system and updated on HPS's "line listings" database to improve future reporting.
3. Repeat validation study. Where corrective action was taken a repeat of the validation exercise will be conducted within one year in order to identify improvements and maintain the quality of the data.

9. Conclusions

Overall the results show that in the majority of cases reporting of MRSA bacteraemias to HPS is sensitive and specific with only two laboratories having a large number of episodes unreported. Further investigation will be made to identify the reasons for this apparent underreporting.

10. Limitations of Study

The limitations of this study included the narrow timescale covered by the analysis, however a longer timescale would have substantially increased the time needed to conduct the research and would have been prohibitive.

Details of the systems in place within each laboratory were self reported, however there was little incentive for laboratories to misreport these systems when the outcomes, i.e. the reports produced, were to be assessed.

11. Recommendations and Further Action

Action has been taken in order to improve the reporting from sites which were found to be under-reporting and further validation will take place at a later date. As a result of this validation study one laboratory has initiated a new system for reporting MRSA bacteraemias to HPS in order to improve their accuracy of reporting, several laboratories have put in place systems of checking for missed reports and the National HAI Steering Group have decided to modify the MRSA bacteraemia surveillance protocol definition to remove the term “clinically significant”. The results of this study demonstrate that the performance of the SSHAIP MRSA bacteraemia surveillance scheme is satisfactory, however eradication of reporting problems specific to two reporting laboratories would substantially increase the sensitivity and positive predictive value of the reporting.

Future versions of the MRSA bacteraemia surveillance protocol may include recommendations for systems of data checking.

References:

1. Gastmeier P, Kampf G *et al.* Experience with two validation methods in a prevalence survey on nosocomial infection. September 1998, *Infect Cont and Hosp Epidemiology*
2. Scientific Institute of Public Health Epidemiology Unit, Belgian Society of Intensive Care Medicine and Emergency Medicine. Data validation study of the National surveillance of nosocomial infections in intensive care units (SIZ-IPH). *October 2000.*

Appendix I

MRSA Data Validation Questionnaire

Laboratory:

Consultant Microbiologist:

Staff involved in reporting bacteraemias to SCIEH:

Name:	Designation:	Telephone No
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

How are bacteraemias reported to SCIEH ?

Computerised report

Do you report ?

- All bacteraemias
- One report per episode
- Only "clinically significant" bacteraemias
- Other _____

When are reports identified:

- Daily
- End of week
- On entering into lab computer system
- Ad-hoc
- Other _____

How do you check that no reports are missed ?

Who is responsible for ensuring no reports are missed ? _____

Who signs off the SCIEH weekly return ? _____