CONTROL OF MRSA – CAN SCOTLAND WIN?

Introduction

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There is genuine fear that MRSA is out of control in this country and its prevalence in many of our hospitals and nursing homes appears to be extending into the community at large. The conference held on October 30 2002 was intended to discuss how to address the problem of MRSA in Scotland. The question being asked in the second part of the above title, which could appear as a headline in the sports pages of our newspapers, may not be so unlikely as it would be in soccer terms!

With the appearance of glycopeptide intermediate-resistant *S.aureus* (GISA) in the world, and in two instances, the proven transfer of the vancomycin resistance determinant (vanA) from *Enterococcus faecalis* to *S.aureus* (VRSA), we are rightly concerned about the spread (or lack of control) of this pathogen. The Scottish Centre for Infection and Environmental Health (SCIEH), supported by the Scottish MRSA Reference Laboratory, recently invited all Scottish Microbiology laboratories to participate in the European Antimicrobial Resistance Surveillance Survey (EARSS). This will facilitate the collection of good data about the occurrence of serious MRSA infections. Since its inception in April 1997, the MRSA Reference Laboratory has typed over 25,000 strains of MRSA and has thereby gained a closer understanding of the molecular changes which may affect the survival, carriage and infection risk posed by this organism.

Guidelines have been written in the UK and elsewhere, for the control of MRSA in our hospitals but often what’s good in theory is not so good in practice. The first part of the meeting was devoted to setting out the current ground rules for MRSA control – the second part allowed participants from throughout Scotland a chance to show how they have coped with the rising incidence of MRSA in their hospitals and communities. Although the validity of the guidelines may have changed, it was useful to rehearse the issues as they affect the current healthcare system. Delegates participated in a far-reaching debate designed to determine whether we are winning the game but losing the plot in the eyes of the public, the healthcare managers and the politicians in Scotland.

It is noteworthy that the Department of Health (England and Wales) has recently recommended that working parties be established to develop new guidelines for the treatment and control of MRSA infection. Scotland, too, has initiated a Hospital-Acquired Infection Task Force, which will address current infection control policies, including basic cleaning, in our hospitals.

We would like to acknowledge the financial support of our sponsors, Pharmacia Limited, Biomerieux Limited, Adams Healthcare and Deb Limited, for making the conference possible. Thanks are also due to the organisational team at SCIEH, particularly Mrs Rebecca Flanagan, and all delegates, especially those who presented their work on the day and contributed towards this supplement. Dr Ahilya Noone, Consultant Epidemiologist at SCIEH, provided the catalyst for the conference. The SCIEH Weekly Report team kindly published the supplement.

It is hoped that the proceedings of this conference will inform how these projects are taken forward.
MRSA – changing epidemiology and new threats

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Introduction
In the last few years several major developments have occurred regarding methicillin-resistant *Staphylococcus aureus* (MRSA). These include the increasing prevalence of the organism in Scotland, clonal characteristics, evolution, nomenclature and the appearance of novel community strains. These will be discussed as follows.

Increasing prevalence
From 1991 to 1995, approximately 500 MRSA infections were reported to SCIEH each year. This rose steadily to 12,203 in 2001. A similar increase over the same period was also observed in MRSA reported from blood cultures (70 to 696). Referrals to the Scottish MRSA Reference Laboratory (SMRSA), established in 1997, also rose rapidly during this period. The prevalence of MRSA compared with all *Staphylococcus aureus* rose to 40% in 2001, which is equivalent to the figures reported for England and Wales. Despite the emphasis placed on infection control in the UK and with the HIS Working Party MRSA Guidelines now in its third edition, it is of concern to find that the UK have come out in the worst category (>30% MRSA) in recent data from the European Antimicrobial Resistance Surveillance Scheme (EARSS <http://www.earss.rivm.nl>). Several European countries including the Netherlands, Denmark and Sweden, report levels of <1% - which would appear to indicate that MRSA control is possible. MRSA is a worldwide problem and figures of >30% have also been reported from the USA, Africa, India and Australia. The Far East appear to have even greater problems, with figures of 63%, 74% and 80% reported from Singapore, Japan and Hong Kong, respectively.

MRSA clone characteristics
Data collected by the SMRSA since 1997 has shown that two clones predominate in Scotland. EMRSA-15 and EMRSA-16 account for 70% and 23%, respectively. In fact the rapid rise of MRSA in Scotland correlates with the introduction of these two clones, probably from England. Each has distinctive antibiotic susceptibility patterns. EMRSA-15 is relatively susceptible, with almost all being resistant to ciprofloxacin and 88% resistant to erythromycin. Up until 2002, resistance to gentamicin and high-level mupirocin resistance were infrequent but a new clonal variant (subtype d) emerged in 2002 and has spread in the West of Scotland. The SMRSA has identified 42 other PFGE defined MRSA clones. Of these, two predominate: SMRSA-105 (Clonal Complex 5) and SMRSA-108 (CC8).

MRSA evolution
Two new typing techniques have greatly facilitated the study of both the epidemiology and evolution of MRSA. The MLST method involves sequencing seven relatively stable ‘house keeping’ genes, to give a 3500 base sequence that is easy to analyse and is ‘portable’ between laboratory and countries. Isolates that differ at one or two of the house keeping genes are referred to as Single (SLV) and Double Locus Variants (DLV), respectively, and are grouped together into Clonal Complexes (CC). Five major international Clonal Complexes have been identified. CC8, which includes the ‘first’ MRSA (the Jevons strain) and CC5, which includes the majority of VISAs reported from Japan and the USA, are ‘old’ clones whereas CC22 (EMRSA15), CC36 (EMRSA16) and CC45 (which includes Scottish MRSA type 111) are relatively ‘new’ clones. Staphylococcal Cassette Chromosomal mec (SCCmec) typing identifies the ‘resistance island’, which carries the *mecA* gene. Four SCCmec Types (I-IV) have been identified which range in size from 21-67kb. They are composed of the Mec Complex (encoding *mecA*, *mecRI* and *mecI* genes), the ccr Complex (encoding the cassette recombinase genes responsible for the mobility of the element), various other elements such as transposons, insertion elements and plasmids and the J (Junk) Regions, which contain various unknown elements.
New MRSA nomenclature

The proposed new international nomenclature for MRSA clones is in the format Sequence Type-Resistance Characteristic-SCCmec type. For instance, ST22-MRSA-IV is the new designation for EMRSA-15.

Mobile mec DNA

The presence of the ccr genes in the SCCmec DNA indicates that these elements have the potential for transfer. The larger size of the SCCmec Type 1 (34kb), II (53kb) and III (67kb) suggests that these in their present form are unlikely to be mobile. There is evidence, however, to suggest that the SCCmec Type IV is more likely to be a mobile DNA element. It is relatively small (21kb), is the commonest type in the UK and has been found in 16 different PFGE defined clones. The fact that SCCmec Type IV is carried by methicillin-resistant coagulase negative staphylococci (CNS) strengthens the theory that these organisms are the source of mecA in MRSA and that this element is capable of moving between species. This has implications for infection control, which up until now has concentrated only on the possibility that MRSA spreads from patient to patient in cross-infection and outbreak situations. We do not yet understand which factors would encourage the transfer of SCCmec Type IV from CNS to methicillin-susceptible S.aureus.

Community-MRSA

The generally accepted view is that hospitals are the ‘breeding ground’ for MRSA, hence the further from hospital ‘contact’ the lower the prevalence. MRSA arise in the community following the discharge of colonized hospital patients and this is supported by evidence that MRSA carriage can persist for several years. There have recently been several reports indicating that the epidemiology of MRSA is changing, as MRSA appear to be evolving in the community itself. There is now a new category of MRSA designated C-MRSA (Community MRSA). The risk factors normally associated with hospital acquisition of MRSA, such as previous hospital admission and antibiotic use, are not evident amongst individuals with C-MRSA. In addition, C-MRSA are ‘non-multi resistant’ (resistant to three or less antibiotics), carry the Panton-Valentine Leucocidin (PVL) gene and SCCmec Type IV elements and belong to different clones from those associated with hospital MRSA strains. C-MRSA was first reported in Australia but there have been recent reports from Europe, Japan and North America. It appears to be particularly successful at spreading, since in some native American communities it is more prevalent than fully susceptible S.aureus. It is often associated with skin or soft tissue infections, primarily in children, and has also been responsible for cases of fatal necrotising pneumonia. It is proposed that the pathogenicity of these strains is due to the action of the PVL toxin. This toxin has been associated with a chronic incident of skin infection in a Glasgow family, which lasted for almost a year and proved extremely difficult to eradicate - despite intervention at various levels by public health and infection control teams.1 This isolate proved to be a methicillin susceptible variant of EMRSA 16, the second commonest MRSA clone in Scotland.

Vancomycin-resistant Staphylococcus aureus (VRSA)

It is surprising that it has taken 30 years of clinical use of vancomycin before the development of vancomycin resistance in Gram-positive organisms. This first occurred not in S.aureus but in another genus that has capacity to acquire similar resistance genes - the enterococci. Even more surprising is the fact that despite high use of this antibiotic for treating MRSA infections, and concurrent isolation of both vancomycin-resistant enterococci and MRSA from hospitalised patients, it has taken a further 15 years for resistance to appear in MRSA. The first case was reported in Michigan, USA, in July 2002 and was closely followed by a second, apparently unrelated, case in Pennsylvania, USA, in September 2002. There is little evidence for the future progression of vancomycin resistance in S.aureus other than consideration of the past - in particular, the evolution of first penicillin and then methicillin resistance in S.aureus. Such progression suggests that ultimately we will see significant increases in glycopeptide-resistant S.aureus. This possibility underlines the current importance of MRSA control both in hospitals and the community.

References

The failure to control MRSA. What can be learned?

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Despite attempts over many years, MRSA has not been controlled in Britain or in most of the rest of the world. The Figure (courtesy of PHLS) shows the relentless rise in its prevalence in England and Wales.

There may be various explanations for this failure. It may be that the basic principles of control are sound, but that we do not have sufficient resources (e.g. staffing levels, isolation facilities) to implement them sufficiently well. Alternatively, it may be that the common sense methods practised in the name of control are intrinsically ineffective and that we do not know how to control the spread of MRSA. Another possibility is that despite all appearances, healthcare workers are not taking MRSA seriously and are not attempting control in most cases. The latter is sometimes the view of workers in the small number of countries where MRSA are not widespread (e.g. The Netherlands and Scandinavia). Anyone who has worked in infection control in Britain, however, will probably believe that staff do whatever they can within the resources available to effect control. It may be, therefore, that there are other unexplained factors accounting for low MRSA prevalence in these few countries - for example, antibiotic policies, isolation facilities, estates and maintenance.

The original reason for attempting to control the spread of MRSA was that these organisms might cause serious infections in hospitalised patients. With time, however, the control of MRSA became an objective in its own right, as shown by the media interest generated by the ‘league tables’ of MRSA bacteraemia rates now published for England by the Department of Health. Given that eradication of MRSA is no longer a realistic goal, what can be salvaged from the situation? Firstly, it is necessary to recognise that it is the control of infection that is of primary importance, and that limiting the spread of certain bacteria such as MRSA is only a means to achieving this end. Secondly, the wealth of literature on the subject of MRSA control has revealed much about the transmission dynamics of bacteria in hospitals confronted with shortages of staff and other resources. Mathematical modelling has been particularly effective in explaining the discrepancies in reports of the success of different control measures. Finally, the almost exclusively hospital-acquired nature of MRSA makes their spread an excellent indicator of the extent of microbial transmission, and thus of hygiene, within a hospital.

It has been recognised in recent years that standards of hospital hygiene, even of matters as basic as hand washing, are far below what most people would consider acceptable. MRSA rates, therefore, should be explored as an index of hygiene, in order to improve hygienic practices so that the transmission of all organisms, of which MRSA is the most readily measurable, is reduced. Rather than attempting to reduce numbers of MRSA, the aim should be to remedy the shortcomings that lead to the spread of such bacteria.

References

MRSA control does work
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Methicillin-resistant Staphylococcus aureus (MRSA) has become endemic in most UK hospitals over the last decade. The practical difficulties in controlling this organism have engendered a body of opinion that control strategies are futile and detract attention from other areas of infection control. Further arguments against control efforts include perceived avirulence of epidemic strains, cost of control strategies, lack of evidence for efficacy of specific procedures, overburdened isolation facilities, difficulties in managing colonised people, the epidemiological course of the ‘hospital staph’ in the 1960’s (it went away without us doing anything), laboratory inadequacies and the inevitability of universal replacement
of methicillin-susceptible \textit{S. aureus} (MSSA) by MRSA.\textsuperscript{1} Thus it has been said that, ‘Trying to control MRSA causes more problems than it solves’\textsuperscript{1}, and even that ‘MRSA is a suitable case for inactivity’.\textsuperscript{3} Perhaps we should, indeed, ‘Stop searching for MRSA’.\textsuperscript{3}

There are, however, good reasons for reconsidering control strategies for MRSA and for challenging endemic MRSA in our hospitals. Firstly, MRSA carriage is more likely than MSSA to lead to infection and MRSA bacteraemia has a worse outcome than MSSA bacteraemia.\textsuperscript{5,6} One recent study showed that the attributable mortality rate for MSSA bacteraemia was 1.3\%, compared to 23.4\% for MRSA bacteraemia in critically ill patients.\textsuperscript{6} Control strategies are well established and almost certainly cost-effective – one case-control study showed that MRSA bacteraemia costs three times more than MSSA bacteraemia in terms of days spent in hospital.\textsuperscript{7} Another study found that the cost of eradicating MRSA, with isolation, screening, topical clearance and education, was approximately half that of treating one single MRSA bacteraemia.\textsuperscript{6} Clinicians may shrug off the possibility that MRSA will become the norm for \textit{S. aureus}, but how do they feel about all \textit{S. aureus} eventually becoming intermediate or even totally resistant to glycopeptides? Scotland has already experienced three episodes of Glycopeptide-Intermediate \textit{S. aureus} (GISA), the most recent of which was responsible for the death of a previously fit woman in her fifties.\textsuperscript{5,10} Such an outcome, within the current climate of increasing antimicrobial resistance, will launch us back into history, when infection was untreatable. It has already been established that patients with GISA tend to have a less favourable outcome than patients with MRSA.\textsuperscript{11}

For these reasons, we need to re-examine the control methods we have at our disposal, and, perhaps, our attitude to the whole debate on MRSA control. There is evidence that basic control measures clearly impact upon MRSA rates in individual hospitals, community care-homes and across whole countries. This is the case even when MRSA is endemic in the institution. Harbath \textit{et al} demonstrated that despite delayed implementation, standard control measures (isolation, screening and hand hygiene) had a significant effect on both the MRSA patient reservoir and attack rate of MRSA bacteraemias.\textsuperscript{12} Screening and isolation strategies halted an outbreak and cost 19-27-fold less than the attributable cost of MRSA bacteraemias in another outbreak, which was not properly controlled.\textsuperscript{13} Rumbak showed that the incidence of MRSA ventilator-associated pneumonia decreased after a bi-weekly topical clearance regimen.\textsuperscript{14} Even just instituting a hand hygiene programme, or increasing basic cleaning on a ward, can have significant benefits towards MRSA control and infection.\textsuperscript{15,16}

Such strategies work equally well in the community – introducing screening, isolation and a topical clearance regimen into a nursing home caused the colonisation rate to drop from 52\% to 2\%, and the infection rate from 33\% to 1.4\% over the period of one year.\textsuperscript{17} The process was shown to be cost-effective. The reasons for the decline, and continued absence, of MRSA in Denmark are attributed to the usual control measures as well as strict antibiotic policies.\textsuperscript{18}

There is good evidence for basic control strategies, therefore, and plenty of information about staphylococcal epidemiology. There is nothing wrong with our national guidelines. We are simply not adhering to basic principles, for a variety of reasons, and these include a lack of unified commitment and motivation from senior infection control staff. Trust managers need more than the Infection Control committee minutes before diverting scant resources into infection control and countries need more than individual pockets of activity scattered from east to west before targeting funding priorities. Both require firm microbiological leadership.

The increasing prevalence of multiply resistant bacteria in our hospitals justifies the implementation of control measures ahead of their definitive validation.\textsuperscript{19} There has been enough debate. We should take the half-century worth of data that we have and try to change things whilst we still can.\textsuperscript{20} Action has to be multifaceted because we do not know what impact each strategy has on control, but such a deficit in the current evidence base cannot be used as an excuse for doing nothing.\textsuperscript{21} Just because something is difficult is not a valid reason for not trying. As Einstein said, ‘Imagination is more important than knowledge’.\textsuperscript{20}

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MRSA in an intensive care unit: 
the role of the environment in cross infection

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"A hospital should gleam...." (Dancer 2002)1

MRSA can easily be recovered from the hospital environment, but is this associated with a potentially significant source of cross infection? The move of our hospital to a brand new facility in March 2001 provided an opportunity to examine the epidemiology of MRSA in some detail.

The new spacious intensive care unit was provided with roof mounted horizontal arms from which all monitoring devices and ventilatory equipment could be suspended, thus keeping the floor free from equipment, cables and tubing. This provides a de-luxe working environment for staff who are able to move freely around the beds. However, the Infection Control Team (ICT) became uncomfortable at the numbers of patients acquiring MRSA in this unit. In the old ICU, 29 of 504 admissions (5.8%) acquired MRSA between April 2000 and March 2001, compared with 54 of 475 (11.4%) admissions to the new unit between April 2001 and March 2002.

A thorough review of infection control procedures did not reduce the acquisition of MRSA, and the next step was to look at environmental factors. When the ICT arrived one day to take microbiological samples, it was obvious that the unit was under positive pressure rather than having the intended balanced air flow. No one had any idea how long this had been going on, although some staff did comment that it felt rather chilly!

Up to head height the majority of surfaces were clean to a high standard; above this level thick layers of dust had accumulated, especially evident on the horizontal beams that surrounded each bed space. Microscopic examination of this material revealed clothing fibres and skin scales, and luxuriant growth was obtained of Staphylococcus aureus (including MRSA) coliforms and Pseudomonas aeruginosa, together with skin commensals.

We postulated that the air swirling around the unit could be conveying this bacteria-laden dust directly to patients. In a major logistic exercise, the unit was closed to allow the ventilation system to be repaired and the whole area was ‘deep’ cleaned. A proactive programme of regular cleaning was planned.

The results to date (April to October 2002) suggest that the acquisition rate of MRSA has been reduced by approximately a third for patients in the unit ventilated for longer than one day (this eliminates very short stay, mainly post-operative patients, whose numbers are unpredictable and who are unlikely to stay in the unit for more than a few hours).

Is this a successful outcome or a disappointment? In practice, the cleaning schedule has proved very difficult to implement. Repeat microbiological sampling in September showed greater numbers of potentially pathogenic bacteria than previously, although the cleaning was planned.

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This experience suggests that the introduction of innovative technology (the roof mounted arms) without proper consideration of how it should be kept clean was at least partly responsible for dissemination of MRSA within the unit.

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Clusters, cross infection and cleaning?
Anne Eastaway, D. Moir, Giles Edwards, J. Whelan and Carole Reed
Royal Alexandra Hospital, Paisley

Introduction
In November 2001, there was an apparent rise in the number of deep-seated infections due to MRSA in the orthopaedic wards. Initial morphology and susceptibility suggested that these were all the same strain. The only common factor was the pre-admission ward, in the environment of which MRSA had already been found. In view of a possible outbreak, an investigation was initiated.

Methods
The ward was closed to admissions and patients requiring surgery were admitted to other wards. Patients and staff were screened, the latter with hand contact plates. The environment was screened generally by utilising settle plates and specifically, by sampling beds, lockers, patients’ chairs and toilet doors. Cleaning reports for the preceding six months were reviewed and all isolates were typed at the Scottish MRSA reference laboratory.

Results
MRSA was isolated from five patients with deep wound infections and four others from the screening programme. One member of staff carried MRSA on hands before and after patient contact. At least seven isolates were found from the environment: these included five from settle plates, one from a patient’s bed and one from the associated locker. Molecular typing identified 16 EMRSA-15 strains with seven sub-types, and two EMRSA-16 strains, each with a different profile (Table). All environmental isolates were from one six bedded area, through which two patients had passed 24 hours apart and who were subsequently shown to have identical strains suggesting one possible episode of cross-infection. The cleaning review confirmed an external contracted service, with regular monitoring and scoring. The latter had been either ‘failure’ or ‘referral’ on every occasion in the preceding six months, with no satisfactory levels achieved. There was also a failure to maintain or repair the ward fabric, non-adherence to cleaning schedules and a tendency to stockpile stores.

Conclusions
It was concluded that most patients were probably admitted with MRSA, but it was highly likely that the environment had played a part in the one possible episode of cross-infection between two patients. The results demonstrated dissemination of MRSA throughout the environment, presumably emanating from colonised and/or infected patients. A series of recommendations were made following the investigation: these included a review of the ward ordering system, revamping the monitoring, reporting and scoring system to better highlight failures and ensuring that key staff are aware of their responsibilities regarding cleaning. Other actions considered were the use of bed mounted alcohol hand gel, reduction in pre-op admission time, a review of antibiotic prophylaxis for patients at risk and the introduction of hospital-acquired infection surveillance for orthopaedic patients.

It was felt that in this investigation, ward cleaning was the main issue but it was difficult to implement the recommendations due to the nature of the cleaning contracts, funding problems and a lack of storage capacity on the wards. The number of patients with MRSA continues at a low level but may rise in response to increased winter admissions for orthopaedic services.

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Vacuuming in a hospital
We have heard about the management of patients who have acquired MRSA, their treatment and ensuing laboratory investigations. We would like to discuss the development of a MRSA policy within a large acute trust.

Lothian University Hospitals Trust (LUHT) has seven hospital sites dealing with many Tertiary services.

Membership of the infection control team (ICT) includes five consultant microbiologists, five infection control nurses and two surveillance nurses. The trust is an amalgamation of three other formerly independent groups of hospitals. A lead clinician for infection control was appointed in November 2001 and an infection control programme was compiled. It was recognised that there needed to be a trust-wide flagship policy for the management of patients identified with MRSA.

In the acute trusts before amalgamation, there had been active promotion of seeking out patients colonised with MRSA.

- 1987-92 infection control guidance was issued for the individual care of such patients
- 1992 Lothian Health Board issued guidance
- 1994 Numbers were about 30 a year in each of the large trusts (not RHSC)
- 1995 EMRSA15 arrived and numbers increased

As a result of different experiences and the resources/facilities available at different sites, an array of management tools were put in place, some for several years. These successfully identified patients who had MRSA and detailed their subsequent management.

There were barriers to discussing this topic, as the experiences of the respective team members were so different and everyone was busy and based at different sites. This encouraged people to be insular. Each team thought that their management tool was best and there was resistance to change. Some members of the ICT were entrenched in their views. Many comments were made, e.g. What a fuss! Why do we need another policy? We always isolate our MRSA patients! They don’t do anything at St. Elsewhere’s. We have a matrix, ICP, Protocol, whatever!! Differences of opinion were expressed and debated.

How did we go about collating a new policy?

New infection control team members were appointed as vacancies had arisen through retirement and promotion. The tools in place included a matrix at the Royal Victoria and Western General Hospitals, within the Children’s Service and an integrated care pathway and service protocols within the Royal Infirmary of Edinburgh Hospitals. These tools encourage staff to perform a risk assessment and make decisions based on the likelihood of transmission, facilities and resources available. Thus, patients can be identified and managed who might otherwise have posed a risk to others.

The clinician lead for infection control incorporated the need for a flagship policy within the IC plan. A policy was needed that was based on solid principles, was realistic, safe and most importantly, easy to use by staff within the very diverse services within LUHT. An individual was asked to collate the policy within a time frame and it was discussed at the monthly ICT meeting. Consultation occurred with each member of the ICT at each stage. The Executive Management Team have always supported the ICT, and this was an aid to making the process work.

We now have a policy, which has an overall strategy for MRSA and includes a checklist for managers. Policies and procedures have been agreed, with specific units adapted to their clients’ needs and resources available.

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**The control of MRSA in a busy ITU: an interventional study**

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**Introduction**

There is widespread concern surrounding the rapidly increasing numbers of antibacterial resistant bacteria and their association with hospital-acquired infection. Methicillin-resistant *Staphylococcus aureus* (MRSA) is the most worrying hospital-acquired infection both in terms of prevalence and morbidity.

MRSA has been a problem in Scotland since 1992 and in Aberdeen from 1997. Patients in intensive care units (ITU) are at particular risk of acquiring infection. In our hospital
we have observed a steady increase in the numbers of MRSA infection acquired on the ITU and planned an intervention to reduce this. The aim of our study was to determine if the introduction of topical administration of antiseptic and antibiotics active against MRSA to all patients would be effective in limiting the acquisition of MRSA.

**Methods**

The study involved retrospective data collection to determine the rate of MRSA acquisition on ITU in the previous 24 months (May 1999-April 2001). Data on index cases was abstracted from the laboratory computer (this was not screening data). A prospective study was then undertaken. All patients admitted to the adult ITU in Aberdeen Royal Infirmary between April 2001 and April 2002 were screened for MRSA by the ITU nursing staff on admission and discharge. The patients then received topical nasal prophylaxis for MRSA, and chlorhexidine 2% bed baths. All patients found to be MRSA positive were isolated and barrier nursed. The infection control nurses collected this data from the ITU.

**Results**

When we collected the retrospective data for MRSA infection acquired on the ITU (index cases), we found that on average 16% (range 4-38%) of admissions in the previous 24 months were either admitted already colonised, or acquired an MRSA infection during their stay on the ITU.

All of 691 patients admitted to the ITU during the study period were recruited for the interventional study. Data on MRSA infection acquired in the unit were collected prospectively. Following the introduction of the topical clearance regimen, the average rate of MRSA infection on the unit is now 7.5%(2-14%), which is a significantly lower rate.

**Conclusion**

The introduction of a universal topical clearance regimen for all patients admitted to the ITU seems to have been a simple and effective measure in reducing the MRSA acquisition on our ITU.

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**Staphylococcal infection in a family in Glasgow**

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This presentation describes the investigations and actions taken by our Public Health Protection Unit in collaboration with hospital infection control teams, specialist laboratory scientists, primary care infection control team and general practice personnel. The family themselves contributed towards a protracted, but eventually successful, attempt to eradicate *Staphylococcus aureus* from household members and their environment.

In April 2000, the Department of Public Health at Greater Glasgow NHS Board were contacted by a consultant in infectious diseases requesting assistance in dealing with a family who exhibited recurrent staphylococcal infections, predominantly characterised by prominent skin abscesses.

Three households in total were affected, the principal household consisting of two parents and five children (age range of children: 1-17 years), an aunt (three in household) and grandparents (two in household). The first reported problems occurred in the principal household in November 1999, involving the mother (age 35) and a daughter (age 16). Although all households were included in our treatment management strategy, the main focus centred on the household with five children, as this consisted of the largest burden of disease morbidity, involving admission to the Royal Hospital for Sick Children for the baby (age 1) and for a 13-year-old boy for excision and drainage of abscesses.

The common infecting organism, *S. aureus*, was susceptible to flucloxacillin, but it was believed to have originally been an EMRSA16 strain that had lost the Mec A resistance gene. Pulsed field gel electrophoresis (PFGE) samples of all isolates were indistinguishable. The organism exhibited the epidemic characteristics of its predecessor, as well as displaying both virulence and persistence properties. Isolates were susceptible to flucloxacillin, rifampicin and fusidic acid but resisted benzyl penicillin and trimethoprim. It is interesting to note that recent work on this particular strain has identified the existence of the Panton-Valentine leukocidin (PVL) gene, which has been associated with staphylococcal furunculosis and abscesses in previous cases.

Our strategy for resolving the problem within the affected households consisted of a coordinated approach involving both human decolonisation and household cleaning. These were performed in order to lower the environmental burden of staphylococci. The organism is known to survive well in the environment, having been deposited by human shedding via skin scales. One member of the family (age 16) had an extensive keratotic skin condition.
It was equally important that all family and care professionals involved were given clear and appropriate written and diagrammatic instructions regarding the tasks required, as well as the rationale for these actions. In addition, good liaison between all parties, including the family GP, was paramount.

Regular body screening of residents was undertaken (usually after 2-3 weeks of active treatment). Sites chosen for swabbing were nose, throat, groin and axillae, as well as any abscesses and skin lesions that were present. The MRSA reference laboratory provided standard charcoal swabs for the screening process, as well as a diagnostic and advisory service throughout the entire enterprise. All over body washing was performed with Aquasept liquid, with Sterzac powder for topical application after bathing. (Oilatum replaced Aquasept due to sensitivity reactions). Mupirocin was used in an attempt to decolonise the nose for a period of seven days when required. Chlorhexidine spray was used on a twice-daily basis in an attempt to eradicate throat colonisation.

The agent used for environmental cleaning (prepared disinfectant solution and wipes) was Trigene (Medichem International). We encouraged use on floors, hard surfaces, toilets, window ledges and door handles in particular. Undergarments and bedding were machine washed on a daily basis. The residents of the principal home demonstrated good personal hygiene, but the home was very cluttered and made environmental cleaning an arduous chore. The residents themselves undertook all of these activities.

The problem was pursued in an aggressive manner while infections continued to be identified. Over a year after our first intervention, no further reports of staphylococcal infection were received. This is the situation until the present day.

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**Modelling the temporal relationship between % MRSA and hospital use of macrolides, third-generation cephalosporins and fluoroquinolones: a time series analysis**


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**Objective**

To study the temporal relationship between hospital use of antibiotics and % MRSA of all *S. aureus* isolates.

**Methods**

The study was performed in Aberdeen Royal Infirmary, a 1200-bed tertiary referral, teaching hospital, during the period 01/1996-12/2000. Monthly hospital data were obtained for % non-duplicate, non-surveillance MRSA, and the use of antibiotics in Defined Daily Doses (DDD) per 1,000 patient-days. An autoregressive integrated moving average (ARIMA) model was adjusted to each of the series. A dynamic model with polynomial distributed lags was then adjusted to assess the relationship between % MRSA rate and use of various antimicrobials.

**Results**

The average monthly % MRSA rate was 14.9% but showed large variations from 0 to 41.5%. Examination of the % MRSA series showed a global increasing trend but included three seasonal cycles. The monthly number of *S. aureus* isolates overall (susceptible + resistant isolates) did not show this seasonal pattern. The average monthly use of macrolides (MAC), third-generation cephalosporins (3GC) and fluoroquinolones (FQ) was 90.2, 62.5 and 51.9 DDD/1,000 pt-days, respectively. There were also large variations during the study period, however, e.g. for MAC from 32.7 to 177.9. Examination of the series showed:

1) for MAC, a sustained increase over the whole study period and a seasonal pattern with maximum levels of use during winter months
Figure: Evolution of the monthly % MRSA and monthly sum of lagged antimicrobial use of macrolides, third-generation cephalosporins and fluoroquinolones, Aberdeen Royal Infirmary, 1996 - 2000.

This model explained 90% of the variation in the % MRSA rate observed during the study period.

2) for 3GC, an increase for the overall period with a sharper increase from mid-1999 to 12/2000 and a seasonal pattern with peaks in December months

3) for FQ, a less marked increase without an evident seasonal pattern.

When adjusting the dynamic model to capture the relationships between these series, we found that the monthly % MRSA rate was explained by:

1) % MRSA observed one month before
2) use of MAC up to three months before
3) use of 3GC between four and seven months before
4) use of FQ four and five months before (Figure).

This is the first substantial evidence showing a quantifiable effect between antibiotic consumption and % MRSA. By using time series analysis, we demonstrated a dynamic relationship between the use of MAC, 3GC and FQ, and the % MRSA rate in our hospital. It points the way to a better understanding of how to control resistance problems, which have thus far proved difficult and expensive.

References

Conclusions
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MRSA presents a global problem to which Scotland is no exception. At least 42% of all bacteraemias due to Staphylococcus aureus are methicillin-resistant and recent figures suggest that this proportion is increasing.1 MRSA infections are more difficult to treat and have a worse outcome than infections with MSSA. We are now contemplating MRSA strains with reduced susceptibility to glycopeptides, which do not appear to show any deficit in virulence and which may well be being missed by the laboratories at the present time.2 For many years, glycopeptide antibiotics have been the first line choice for serious staphylococcal infections and their loss will represent a particularly difficult challenge for doctors everywhere.3

This conference summarised the current situation in Scotland and the UK overall, provided a glimpse of the future and allowed both healthcare and academic staff from all over Scotland to present their own research and views on MRSA and its control. It also justified the value of implementing and maintaining control strategies, even in the face of high endemicity. Basic practices such as hand hygiene, patient and environmental screening, topical clearance, isolation, cleaning and communication came to the fore as simple yet effective methods by which to impact upon MRSA rates. More complex approaches including antibiotic usage modelling must, and will be, developed in the months and years to come. The message is that basic interventions work if implemented, just as happened in the 1960’s, when the epidemiology and control of penicillin-resistant S. aureus in UK hospitals were pioneered. MRSA control methods, therefore, are not new, not untried nor untested, and merely require commitment at all levels by healthcare staff.
There are current problems within the NHS structure, however, which will exacerbate attempts by infection control staff to really have an effect on MRSA. These include ‘hot’ bedding, overcrowding, lack of staff, grossly inadequate cleaning hours, poor laundry services, patient relocation in the hospital and overburdened isolation facilities. We also have outdated laboratory methods, poor antimicrobial prescribing practices by doctors (and other prescribers) and an erosion of the real understanding of hygiene in society today. This last perhaps emanates from the ready provision of antimicrobials in the last century. A final problem includes the highly epidemic strains circulating in the UK at the moment. All of these require consideration and action if we are to stall the relentless increase of MRSA and other resistant microorganisms. We cannot afford to wait for new antibiotics or novel strategies, immunological or otherwise.

It is not appropriate, therefore, to delay action any longer; microbiologists and infection control nurses know what to do and must now convince the managers and policy-makers. There is a real need for more resources to be diverted towards infection control and basic hygiene. This is the right time to present our case – the Scottish Executive have demonstrated commitment towards this nationwide problem, fuelled by the media, and are already organising future initiatives. Scotland can and must win this battle against MRSA. All of us have a responsibility to our patients and to the future management of infection in our society.

References