Methicillin-resistant *Staphylococcus aureus* in an Irish orthopaedic centre

A FIVE-YEAR ANALYSIS

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This prospective five-year study analyses the impact of methicillin-resistant *Staphylococcus aureus* (MRSA) on an Irish orthopaedic unit. We identified 318 cases of MRSA, representing 0.76% of all admissions (41,971). A total of 240 (76%) cases were colonised with MRSA, while 120 (37.7%) were infected. Patients were admitted from home (218; 68.6%), nursing homes (72; 22.6%) and other hospitals (28; 8.8%). A total of 115 cases (36.6%) were colonised or infected on admission. Many patients were both colonised and infected at some stage. The length of hospital stay was almost trebled because of the presence of MRSA infection.

Encouragingly, overall infection rates have not risen significantly over the five years of the study despite increased prevalence of MRSA. However, the financial burden of MRSA is increasing, highlighting the need for progress in understanding how to control this resistant pathogen more effectively.

Methicillin-resistant *Staphylococcus aureus* (MRSA) infection is universally feared because it is difficult to manage and often leads to increased morbidity and a protracted hospital stay. The costs to the patient, the hospital and society are high.1

MRSA, first isolated in 1961,2 is increasingly problematic. Ireland has one of the highest nosocomial MRSA colonisation rates in the European Community.3 This prospective study gives an insight into the evolution of MRSA in a mixed trauma and elective unit over a five-year period. It shows that despite contemporary guidelines, the number of cases is rising. It broaches the issue of whether more needs to be done and if so, the possible direction of future initiatives, based on the current situation and professional opinion.4,5

Methods

A prospective study of the effects of MRSA was undertaken in a mixed trauma and elective unit over a five-year period. It shows that despite contemporary guidelines, the number of cases is rising. It broaches the issue of whether more needs to be done and if so, the possible direction of future initiatives, based on the current situation and professional opinion.4,5

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Methods

A prospective study of the effects of MRSA was undertaken in a mixed trauma and elective, university-affiliated orthopaedic unit in Ireland. Positive cases of MRSA colonisation or infection were identified and investigated between 1999 and 2003.

The unit has 99 beds and six intensive care beds, which are shared with other surgical services. The orthopaedic service is separate from other in-patient services. The unit receives all orthopaedic trauma from an estimated population of 360,000 and approximately two million tourists who visit the area annually. Two theatres are devoted to trauma, while elective operations are carried out in two separate theatres on another floor. Elective cases are nursed separately from trauma in the majority of cases, according to bed availability. The unit is divided into three wards, two of which are primarily for elective cases and the third for trauma. Whenever trauma and elective cases are on the same ward, every effort is made to ensure that they are grouped separately.

The infection control department actively implements a policy, as defined by the Irish Department of Health in 1995.6 It also incorporates the recommendations of the 1998 United Kingdom Guidelines.7 Routine screening is carried out on every patient previously colonised or infected with MRSA, transfers from nursing homes and long-stay residential institutions, frequently hospitalised patients and all national and international transfers. The screening protocol did not alter during the study.

An initial screen entails swabbing the nose, axillae, groin and any wounds. Suspected MRSA cases are admitted to a single room whenever possible. However, if this is not feasible, they are barrier nursed. Positive cases carry a yellow sticker on their case notes in order to alert personnel. Nasal carriers of...
MRSA are treated with topical mupirocin ointment to the anterior nares three times a day for five days. Those in whom a body swab is positive, undergo a 4% chlorhexidine gluconate bodywash once daily for five days. Colonised cases are appropriately isolated and rescreened after eight days. They are only considered to be clear when three screenings are negative. An oxacillin mannitol salt agar medium was used to detect MRSA during the study. The infected cases were categorised according to the Centre for Disease Control international guidelines for the prevention of surgical site infection. The implant-level of infection that gives the greatest cause for concern is described as an organ space infection.

Cases of MRSA infection were isolated and treated with appropriate antimicrobial therapy. The typical dosages used were vancomycin 1 g b.d., linezolid 600 mg b.d. and daily teicoplanin 400 mg o.d.

Vancomycin was the therapy used initially and the other agents used either singly or in combination was by the recommendation of the microbiology department. Patients undergoing implant-related surgery received second or third generation cephalosporins as prophylaxis. The threshold for using vancomycin was significantly lower if the patient was previously infected with MRSA.

Data on MRSA expenditure were collected from the hospital pharmacy and the cost of agents used on each ward and the intensive care unit assessed.

A database was created with Microsoft Access software (Microsoft Corp.). Parameters included source of admission, surgical site infection, type, treatment, diagnosis, operative procedure, follow-up and long-term outcome. Changes in the pattern of MRSA infection or colonisation rates were analysed.

Results
During the five years of our study, the orthopaedic department admitted 41,971 patients (Table I), of which there were 318 MRSA cases (0.76%).

We divided the cases into two groups, those infected and those colonised with MRSA. Many patients were both colonised and infected at some stage, therefore considerable overlap exists between the two groups. In the first group, 120 patients (0.29% of the total number of patients admitted) had confirmed MRSA infection, of which 48 (15% of all MRSA cases) had infection on admission to hospital. Of these 48 there were 28 men and 20 women, with a mean age of 63.8 years (12 to 100). Of these cases 30 (62.5%) were emergency admissions and 18 (37.5%) were elective admissions. This apparently high percentage is explained by the fact that the majority were admitted for treatment of known MRSA infection, for example revision of a total hip arthroplasty or debridement of osteomyelitis. There were 39 (81.3%) patients admitted from home, whilst five (10.4%) were transferred from nursing homes and the remaining four (8.3%) from other hospitals. The types of infection in those infected on admission were seven superficial incisional, 28 organ space and 13 deep incisional, according to Centre for Disease Control international guidelines.

In the second group, 240 patients (76% of the MRSA cases) were colonised with MRSA, of which 67 (27.9%), comprising 58 trauma and nine elective patients, were colonised on admission to hospital. Their mean age was 73.5 years (15 to 97) and 24 (35.8%) were admitted from home, 30 (44.8%) from a nursing home and 13 (19.4%) from another hospital.

There were 67 cases of confirmed MRSA infection which developed after admission. Of these, 48 (71.6%) were trauma and 19 (28.4%) elective patients. The reasons for emergency admission included multiple fractures, road traffic accidents and fractures of the femoral neck. Seven patients needed readmission, directly related to MRSA infection. The average length of stay for those developing infection after admission was 40.52 days (16 to 130). It was possible to predict the length of stay for those infected based on hospital in-patient enquiry data. The sum total estimate was 962.6 days, suggesting that the duration of in-patient care is almost tripled by MRSA infection.

Interestingly, of the 1790 primary total hip arthroplasties undertaken at the study hospital, 18 (1%) became infected with MRSA.

Of these, nine were organ space infections, of which four underwent excision arthroplasty. Revision was required in two, a further two resolved after antibiotic therapy and two await revision. There were three cases of deep incisional infection and six superficial infections all treated successfully with antibiotics. The mean length of stay for an infected total hip arthroplasty was 44.7 days (14 to 130), exceeding the routine stay of less than ten days.

Table I. Demographics and activity data of our study group

<table>
<thead>
<tr>
<th>Year</th>
<th>Total orthopaedic admissions</th>
<th>Trauma</th>
<th>Elective</th>
<th>Day-care</th>
<th>Total MRSA cases (%)</th>
<th>MRSA Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>7813</td>
<td>2456</td>
<td>1530</td>
<td>3827</td>
<td>33 (0.42)</td>
<td>15 (0.19)</td>
</tr>
<tr>
<td>2000</td>
<td>8620</td>
<td>2840</td>
<td>1748</td>
<td>4032</td>
<td>51 (0.59)</td>
<td>23 (0.27)</td>
</tr>
<tr>
<td>2001</td>
<td>8602</td>
<td>2983</td>
<td>1422</td>
<td>4197</td>
<td>77 (0.89)</td>
<td>34 (0.40)</td>
</tr>
<tr>
<td>2002</td>
<td>8297</td>
<td>2880</td>
<td>1521</td>
<td>3896</td>
<td>71 (0.85)</td>
<td>19 (0.23)</td>
</tr>
<tr>
<td>2003</td>
<td>8639</td>
<td>2819</td>
<td>1597</td>
<td>4223</td>
<td>86 (0.99)</td>
<td>29 (0.34)</td>
</tr>
</tbody>
</table>

* MRSA, methicillin-resistant Staphylococcus aureus. Total MRSA cases relates to total annual orthopaedic admissions.
Hospital pharmacy data show a steady increase in expenditure on MRSA during the study (Fig. 1). The budget for MRSA treatment in orthopaedic patients also increased (Fig. 2). Figure 3 shows the agents used in treating confirmed MRSA infection. Any regime was individually assigned, with vancomycin being the first line drug of choice. Over the five-year period, there was a noticeable, unexplained, increase in the age of those affected by MRSA (Figs 4 and 5). The most common comorbidities in the infected patients included diabetes, co-existent remote infection, immunocompromise due to renal or respiratory impairment, obesity and hypertension.

Two deaths were directly attributable to MRSA. An 88-year old female developed fatal MRSA after hemi-arthroplasty for a subcapital fracture, whilst an 82-year old female developed MRSA septicaemia after fixation of a humeral shaft fracture. The patient died, despite implant removal, debridement and antibiotic treatment.

Discussion
The publicity engendered by MRSA significantly increased during the study. The hospital ‘superbug’ flourishes despite attempts to eradicate it. This strain, first described in 1961, possesses the mecA gene and the penicillin binding protein PBP2a, making it resistant to methicillin and oxacillin. Although many measures can be taken to control this
pathogen, there is a paucity of high quality evidence to prove their effectiveness.10

Since 1999, Ireland has participated in the European Antimicrobial Resistance Surveillance System (EARSS), which shows that MRSA levels vary throughout Europe.3 Although still prevalent on a national basis, the increase in MRSA cases appears to be stabilising. A significant contribution to this trend was made by the Strategy for the Control of Antimicrobial Resistance in Ireland (SARI), an initiative focusing on surveillance of antimicrobial resistance.11 Our figures correlate with these findings and confirm that much progress has yet to be made if the trend is to be reversed.

We have shown that 0.76% of total admissions were infected or colonised during the study. Relatively few comparative data on MRSA in orthopaedics and trauma are available. Tai et al12 reported that 1.6% of all orthopaedic admissions in a UK hospital were either infected or colonised with MRSA over a 12-month period. A Spanish study13 showed the prevalence of MRSA to be 1.6%. When compared with figures from general medical and intensive care wards, the SENTRY study showed that overall numbers of staphylococcal infections in orthopaedics are relatively low.14 The cost of treating MRSA in orthopaedics is colossal. Nathwani1 compartmentalised the effects into separate elements; patient, hospital and society. In line with other studies12,15 we demonstrated that in-patient stay is almost tripled once MRSA infection occurs.

The financial implications of MRSA colonisation is a more complicated issue. Our study attempts to address this problem by assessing the impact on the pharmacy budget. An overall increase in the percentage of total costs devoted to MRSA treatment can be seen. The cost of MRSA treatment rose for four of the five years. Possible explanations include a steady increase in patient numbers and the increasing cost of the individual agents used.

Risk factors associated with contracting MRSA that have previously been identified include older age, residence in a nursing home, open skin lesions, protracted hospitalisation and concurrent use of antibiotics.16–19 In the ICU setting for trauma patients, length of ICU stay and the mechanisms of trauma are of predictive value.20 Our figures show the average age of those affected has increased. Although male gender is suggested as a risk factor,16 the male-to-female ratio was 1:1 for the total cohort.

Our database was valuable in the long-term follow-up of those with MRSA infection. The majority of those with an organ space infection made an excellent recovery, despite undergoing revision procedures. Only two deaths were directly attributable to MRSA from a total of 120 with a documented MRSA infection (1.6%) either on or after admission.

The chief measures to control MRSA are hand hygiene, restriction of antibiotics and the detection and appropriate isolation of infected or colonised patients. The American Academy of Orthopaedic Surgeons advises the prophylactic use of vancomycin for a maximum of two doses for elective cases wherever a MRSA prevalence of greater than 10% to 20% among orthopaedic patients has been identified.21 Biant et al22 advocate a ring-fenced orthopaedic ward and stringent control measures. Other approaches include grouping those infected or colonised to intensify treatment at the source;23,24 or the use of additional prophylaxis.3,13,25 Cooper et al10 recently evaluated the evidence for the effectiveness of isolation measures. They concluded that there are no well-designed studies which allow the role of isolation measures alone to be assessed. Marshall et al17 agree and suggest that measures may need to be tailored to individual environments in order to remain cost effective. However, it is emphasised that concerted efforts, which include isolation, can reduce MRSA even in endemic settings.

The cost effectiveness of screening is contentious.26 Giannoudis et al4 suggest the broadening of presently recommended protocols to include screening patients on discharge. Marshall et al3 concluded that unless there is an epidemiological link between MRSA in a patient and staff member, there is no evidence to support routine screening of healthcare workers. Our experience suggests that widespread screening of staff is impractical. With only nine elective cases colonised with MRSA on admission (0.1% of total elective admissions) over five years, more rigorous pre-admission screening protocols are not cost effective.

We have shown that levels of MRSA continue to rise. Risk factors include older age, male gender and residence in a nursing home. The majority of those infected or colonised on admission come directly from home showing the contribution made by significant community levels of MRSA. These data suggest that greater prophylaxis may be advantageous in certain higher risk patients. Our figures are different to those studied in other units, suggesting that local protocols should target the specific population rather than a universal standard. Further studies are necessary in order to better evaluate present control measures.

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References