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Financial implications of plans to combat methicillin-resistant *Staphylococcus aureus* (MRSA) in an orthopaedic department

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ABSTRACT

INTRODUCTION The aim of this study was to calculate retrospectively the cost of MRSA infections in the elective and trauma orthopaedic population in Rotherham District General Hospital in a 3-month period during 2005.

PATIENTS AND METHODS A total of 686 patients were admitted to the orthopaedic wards and the surgical wounds 10 patients became infected with MRSA.

RESULTS The cost of these infections when extrapolated over 12 months was £384,000 excluding staff costs.

CONCLUSIONS The key in the fight against MRSA in the hospital setting is multifactorial and requires a combination of measures. Our solution is: cohort nursing; non-selective screening of all admissions to the orthopaedic wards; use of a polymerase chain reaction as a diagnostic tool; ring-fencing of beds; and separate wound dressing rooms for each ward. The total cost is projected to be £301,000.

KEYWORDS

MRSA – Orthopaedics – Cost analysis

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World-wide, MRSA has become an increasingly difficult clinical and political management issue in both the community and in hospitals.[1–9] Both its incidence and isolation[10] continues to rise. The previous belief that it was limited to those older, 'high-risk', institutionalised, elderly patients and in hospitals no longer seems to be true as is also affects the fit and younger patients and also those in the community.[11,12] The heterogeneity of colonised and sometimes subsequently infected groups of patients may make selective screening programmes less useful and force healthcare professionals to move towards a non-screening policy due to the apparently endemic nature of MRSA. However, control of MRSA in the hospital setting is only possible through the application of a host of measures, none of which is effective in isolation. It appears that the following may play a part in the solution: cohort nursing; non-selective screening of all admissions to the orthopaedic wards; ring-fencing of beds; screening of staff; separate wound dressing rooms for each ward; and use of a polymerase chain reaction (PCR) based screen for rapid testing of patient MRSA status. The future of screening will be in the form of the IDI-MRSA system (Cepheid; Sunnyvale, CA, USA), a qualitative *in vitro* system for the rapid identification of MRSA in clinical specimens. The test uses a real-time PCR methodology (Smart Cycler) to amplify the Staphylococcal Cassette Chromosome mec (SCCmec), which contains both the *mecA* gene (for methicillin resistance) and the highly conserved *orfX* found in *Staphylococcus aureus*. In the presence of these sequences, target-specific primers within the assay will bind and generate an MRSA-specific amplicon, which is then detected by a complimentary molecular beacon probe. Through appropriate calculations and suggestions for the future, we have been able to provide an accurate assessment of the financial impact of MRSA infection and calculated the cost of implementing change, which may reduce its clinical and financial impact.

Patients and Methods

A total of 686 consecutive patients admitted to two adult orthopaedic wards were screened for MRSA on admission over a period of 3 months in 2005 in our district general hospital. Admissions to this department included, trauma,

Table 1 Sample costing

Rotherham General Hospital NHS Trust

Patient ID	*******		
New profile of care	Orthopaedics		
Theatre minutes (165 min @ £6.67 per min)	£1,100.55		
Pathology	£365.00		
	Unit cost	Total units	Total cost
Biochemistry tests			
Urea & electrolytes	4.00	6.00	24.00
CRP blood test	6.00	2.00	12.00
Group and screen blood test	25.00	1.00	25.00
LFT blood test	9.00	1.00	9.00
P/U osmolity	6.00	2.00	12.00
Plasma viscosity	6.00	1.00	6.00
TB culture tissue	16.00	1.00	16.00
ZN tissue sample		1.00	0.00
Haematology tests			
Full blood count	5.00	6.00	30.00
Glucose blood test	5.00	1.00	5.00
Blood culture	17.00	1.00	17.00
Histopathology tests			
MRSA wound swab	9.00	1.00	9.00
Anaerobic wound swab	12.00	3.00	36.00
Wound pus swab	12.00	1.00	12.00
MRSA catheter culture	9.00	1.00	9.00
Wound culture	12.00	2.00	24.00
MRSA wound culture	9.00	2.00	18.00
Microbiology tests			
MRSA perineum swab	9.00	4.00	36.00
MRSA nasal swab	9.00	4.00	36.00
MRSA axilla swab	9.00	2.00	18.00
Eye swab	11	1.00	11.00
Ward costs (33 days @ £155.35 per day)	£5,437.25		
Total costs	£10,771.98		

elective, and inter- and intrahospital transfers. All patients had nasal and pereneal swabs taken within 24 h of admission as a combination of the two has been shown to increase detection sensitivity.[15] Those patients who subsequently developed an MRSA wound infection requiring additional hospital management were then identified and their hospital notes accessed. We did not include those patients infected with other organisms. All hospital events (hardware), which occurred as a result of the MRSA infections were recorded and costed via the hospital finance department (Table 1). These events included: all blood tests; X-rays; days in hospital; minutes in theatre; theatre equipment; ECGs; swabs; dressings; and all drugs. Staff costs could not be coded in a scientific manner and were thus excluded. However, £91 million (75%) of the Trust's budget of £131 million is spent on salaries and the remainder on hospital 'hardware'. We did not think that extrapolation of staff costs could be done accurately but a significant sterling (£) figure should be considered by the reader when making an allowance for the overall total. The total cost in this 3-month period was then extrapolated across the remainder on the financial year. This total relates to those hospital episodes, which would not have been otherwise necessary in the absence of an MRSA infection. It does not account for costs associated with any other orthopaedic microbial infection.

Results

We prospectively screened 686 patients and identified a total of 27 MRSA cases in the form of colonisations or wound infections in the 3-month period over which the study ran. This total was divided into two groups. The first group of 13 patients included those who had been identified previously as colonised or infected with MRSA (known MRSA cases). The second group consisting of newly identified MRSA cases (colonisations or wound infections) totalled 14 (new MRSA cases). Ten of these patients developed wound infections identified by MRSA culture and required additional hospital treatments. When extrapolated from the 3-month period studied, the total cost of MRSA wound infections for that year would have been £384,000 excluding the personnel costs. Staff salaries in this Trust accounted for 75% of the total budget; therefore, the final figure relating to the cost of MRSA is likely to be a gross under-estimate.

Following this costing, we initiated a clinical solution to reduce the incidence, and thus financial burden, of infection using cohort nursing. Cohort nursing means that, at the beginning of a shift, nurses or auxiliaries care only for the patients in the bay assigned to them and no on else. They are not permitted to move from that bay for any reason. For safety reasons, this will have an impact on staffing costs and, to minimise this, auxiliaries are used in certain circumstances. In order to implement nurse cohort management effectively, we would need an additional 8 auxiliary staff to cover the two orthopaedic wards. Each ward has 5 bays with 6 beds in each. The additional nurses/nursing assistants would mean that patients could be nursed with-

out the need for other nurses from other bays, at an additional cost £120,0000/year. Each ward is to have its own positive pressure dressing room to dress wounds (cost £20,000). The cost of the PCR rapid MRSA detection device plus staffing for a year with culture media for the trauma cases will cost £149,000. The cost of screening elective cases is estimated at £12,000. The total cost for the fist year would be £301,000; in subsequent years the cost would be £261,000 as the PCR device will already have been purchased. This should be compared with the annual cost of MRSA infections (£384,000).

Discussion

Despite the fact that deaths related to MRSA are low,[14] morbidity is high as will be the cost of managing infection particularly in the orthopaedic setting in the form of revision surgery and length of stay in hospital. Many previous papers on MRSA colonisation and infection have focused on the process of selective surveillance[15,16] in those patients deemed as high risk of either colonisation or infection. Those risk factors have included age,[17] domiciliary status, with infection being higher in institutions,[18] previous antibiotic use,[19] sex,[20] co-morbidities such as diabetes,[21,22] and the presence of catheters, open wounds (sores) and reduced mobility.[23] As a result of these numerous publications and the apparent reproducibility of risk factors, selective screening policies have been advocated and national guidelines produced by a working party;[24] these have been followed by NHS trusts. The argument against non-selective screening seems to centre around cost.[25,26]

In our non-selective screening policy, we identified a number of MRSA colonisations that would not have fallen into any high-risk group and would have been missed in any routine selective screening programme. As a result, we feel that all patients admitted to orthopaedic wards need to be screened on admission. The elective patients could be screened with cheaper Oxacillin Resistant Screening Agar and suspect colonies confirmed with the Pastorex Staphylococcus-plus latex agglutination test.

We are proposing to use real-time PCR on trauma patients.[45,46] This more rapid test (2 h) is necessary for trauma patients, as they will be admitted straight to the ward or theatre. In this lag time, the patients will wait in a predetermined MRSA 'suspect' holding bay or side room and treated on the basis of their test result. Those colonised will be treated with Bactroban, Aquasept. At induction of anaesthesia for surgery, the patient will be loaded with teicoplanin and gentamicin and then nursed in a side room. Those patients who subsequently test negative will go into a bay with other negative patients; subsequent surgery for these patients will be with cefuroxime.

The concern with selective screening would be that some patients who were actually positive for MRSA on admission would go undetected, leading to an increase in cross-infection, colonisation and subsequent infection in other patients.[27] In some series, a 7.5-fold increase has been reported.[28] Certainly, groups of patients newly identified as MRSA positive came as a surprise in our cohort of patients, including a number of young people with no identifiable risk.[29]

We recommend, along with others, that beds should now to be ring-fenced which will help prevent intrahospital transfer; this has been shown to increase the risk of infection 2.5-fold.[30] If this ring-fencing is breached for any reason, we suggest that the elective lists should be cancelled.

Nurse cohorting seems to have had a significant impact on the control of MRSA but reduction in hospital budgets has led to a steady decrease in the number of nurses on the wards in our and other trusts. Many studies have shown the benefit of nurse cohorting in a surgical setting.[31–37]

Conclusions

Active surveillance,[38] patient isolation, nurse cohorting, topical decolonisation[39] and, most likely, a non-selective screening policy[40] reduce infection rates. However, these measures need to be introduced wholesale and not individually, which may represent a false economy. It seems that the key in the fight against MRSA and its decline in the hospital setting is multifactorial requiring combined measures and not those in isolation.[41–44] We will report later when these changes have been fully implemented and audited and anticipate that they will represent a gold standard in orthopaedic care at a local level.

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