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ARTICLE

The effectiveness of methicillin-resistant *Staphylococcus aureus* colonisation screening in asymptomatic healthcare workers in an Irish orthopaedic unit

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Abstract Methicillin-resistant *Staphylococcus aureus* (MRSA) infections are associated with increased mortality, costs and length of stay compared to non-MRSA infections. This observational 4-year study analyses the impact of screening and treating orthopaedic healthcare workers for MRSA colonisation. A total of 1,011 swabs were taken from 566 healthcare workers. Positive healthcare workers were treated with topical mupirocin to both anterior nares. The prevalence of MRSA colonisation on initial testing was 4.77%. The rate of positive MRSA colonisation of those tested on more than one occasion fell from 5.88% to 2.71% ($p=0.055$) on subsequent screening. All healthcare workers receiving treatment were successfully cleared of colonisation; however, some required more than one course of treatment. These results show that there could be a role for screening and treating orthopaedic staff for MRSA colonisation as part of a strategy to reduce the prevalence of MRSA infections in orthopaedic units.

Introduction

The prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) continues to rise [1] since first being isolated in England in 1963 [2]. MRSA infections are associated with increased costs, pre-discharge mortality and length of stay compared with non-MRSA infections [3]. The length of hospital stay can nearly treble because of the presence of MRSA infection [4]. The average MRSA colonisation rate amongst healthcare workers is approximately 4.6% and evidence suggests that healthcare workers are likely to be important in the transmission of MRSA [5]. This observational study looks at the effects of a screening and treatment programme for MRSA colonisation in orthopaedic staff over a 4-year period.

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Methods

MRSA colonisation screening of orthopaedic staff was carried out over a 4-year period from 2005 to 2008. All orthopaedic doctors, theatre nurses, ward nurses, physiotherapists, porters, radiographers and occupational therapists were screened biannually as available. This included all healthcare workers likely to come into contact with orthopaedic patients. No other units within the hospital were part of the screening policy. Screening was carried out by the infection control team situated in the hospital.

The orthopaedic unit located in a hospital in the west of Ireland has 32 beds. The orthopaedic service is separate from other in-patient services. The unit receives all orthopaedic trauma from an estimated population of 125,000, as well as many tourists who visit the area.

The Strategy for the control of Antibiotic Resistance in Ireland (SARI) [6] was launched in 2001 and guidelines produced in 2005 are followed within our infection control department. 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, all national and international transfers, and all patients undergoing major joint arthroplasty. The screening protocol for patients did not alter during the study period.

The orthopaedic healthcare workers were screened twice a year by rotating a sterile cottoned-tipped swab to both anterior

Table 1 Methicillin-resistant *Staphylococcus aureus* (MRSA) colonisation rates of orthopaedic healthcare workers per year

	Year			
	2005	2006	2007	2008
Total healthcare workers Screened	201	207	237	186
Total screening swabs	246	262	295	208
No. of positive healthcare workers	9	12	11	7
No. of positive swabs	10	12	13	7
% of positive healthcare workers	4.48%	5.80%	4.64%	3.76%
% of positive swabs	4.07%	4.58%	4.41%	3.37%

nares. Those staff found positive for MRSA colonisation had treatment consisting of topical 2% mupirocin ointment in paraffin base to the anterior nares three times a day for 5 days before being re-swabbed. Those with a positive nasal swab underwent a full-body screen with groin and axilla swabs. Treatment of a positive body screen for MRSA was chlorhexidine 4% during bathing or showering to skin and hair for 7 days. At least 2 days following treatment, the staff member was then re-swabbed from all positive sites. Each staff member found positive was re-assigned to a lower risk area until 48 h on treatment. If they were found to be a continuous carrier, then they would be re-deployed to a low-risk area on a more permanent basis until negative swabs were obtained. A low-risk area was defined as any area outside the theatre department.

Calculations were performed using Microsoft Office Excel 2007. Odds ratios were calculated, comparing each swab screening session to the initial screening swab result for those staff members undergoing two or more screening sessions separated by at least 6 months. Any staff member found positive prior to 2005 was omitted from the study. Only swabs taken at screening sessions were included in the study. Any further swabs taken as a result of a healthcare worker being positive were not included in the analysis. *Z*-scores and *p*-values were determined and significance was set at $p<0.05$.

Results

During the 4 years of our study, 1,011 swabs were taken from 566 orthopaedic healthcare workers, of which 413 were female (73.0%) and 153 were male (27.0%). The mean age at first screening 31.4 years (range 16.1 to 64.7 years). Twenty-seven healthcare workers out of 566 (4.77%) tested positive on their first screening session. A total of 14 out of 445 (3.15%) swabs taken at subsequent screening sessions tested positive. This represents 12 of 221 (5.43%) healthcare workers who had screening on more than one occasion and, of these, 9 (4.07%) had not tested positive at first screening.

Over the 4-year period, there was an overall fall in the swab colonisation rate from 4.07% to 3.37% (Table 1), but this was not significant. When looking at staff members who had at least two screening sessions, the positive rate comparing the subsequent screening session to the initial screening session showed a fall in rate from 5.88% to 2.71%, which approached significance ($p=0.055$) (Table 2).

All healthcare workers receiving treatment were subsequently found to be clear of colonisation prior to subsequent screening. However, two healthcare workers required two courses of treatment before testing negative.

Discussion

To our knowledge, this is the first study investigating the screening of staff over an extended period in an orthopaedic unit. The percentage of MRSA-positive swabs amongst orthopaedic staff on first screening was found to be 4.77%. The initial positive nasal MRSA screening rate of 4.77% was comparable with previous studies of 4.6%. There was a near-significant reduction in positive swab rates from

Table 2 Comparison of subsequent MRSA colonisation screening sessions with initial screening

Screening session	Positive swabs	Negative swabs	Total Swabs	% of positive swabs	Odds ratio (using first screening as the baseline)	*Z*-statistic	*p*-value
1st	13	208	221	5.88%	1	–	–
2nd	6	215	221	2.71%	0.4465	−1.6028	0.0545
3rd	4	112	116	3.45%	0.5714	−0.9592	0.1687
4th	3	64	67	4.48%	0.7385	−0.4385	0.3305
5th	1	38	39	2.56%	0.4324	−0.8218	0.2056

5.88% to 2.71% from the initial screening session to the second follow up screening, which is likely to be a result of treating positive cases effectively. Although the positive swab rate for the third, fourth and fifth screening sessions were lower than the initial screening session, the results were not significant, likely due to inadequate numbers of healthcare workers having undergone screening at that number of occasions.

It is thought that healthcare workers are the victims rather than the source of MRSA transmission; however, Albrich and Harbarth identified 79 studies that supported a causal role of healthcare workers in the transmission of MRSA to patients. They also found 18 studies with proven and 26 studies with likely transmission to patients from healthcare workers who were not clinically infected with MRSA [5].

Screening healthcare workers for MRSA colonisation is time-consuming and costly, and requires the use of laboratory facilities. The results of positive MRSA screening may have emotional implications to staff and possible threats to future employment [7, 8]. Current guidelines in the UK for the control and prevention of MRSA in healthcare facilities suggest that staff screening should only be undertaken if an 'outbreak' occurs [9]. Albrich and Harbarth, however, state that pre-employment screening should take place with, perhaps, periodic testing, as selective screening will likely miss a large number of asymptomatic personnel capable of transmitting MRSA to patients [5]. Regions with low MRSA prevalence, such as Scandinavia, the Netherlands and western Australia, all have routine close healthcare worker surveillance.

Orthopaedic infections are expensive and difficult to treat. The cost implications of hospital-acquired infections are enormous. A study by the Department of Health in the UK in 1995 demonstrated that the costs incurred by orthopaedic patients with one or more hospital-acquired infections were 2.6 times greater than uninfected patients [10]. Two separate studies at the same centre by Roche et al. and Walls et al. demonstrated that, although only 0.1% of total orthopaedic elective admissions were colonised with MRSA on admission over a 5-year period [4], the incidence of infection with MRSA after primary total hip replacement (THR) was 1% [11].

Carriers of MRSA are colonised predominantly in the nares [12]. Kunori et al. showed that the most cost-effective screening site to determine MRSA colonisation is the nose in terms of its sensitivity, specificity and time taken to obtain a result [13]. This reservoir can cause hand contamination, the strain of which is typically of the nares.

Cookson et al. collected nasal swabs from 26 nurses working in close contact with MRSA-infected patients. They found that a large number of nurses had transient carriage after a shift that was lost before the next shift (46%); however, there were cases in which short-term carriage (15%), defined as two consecutive swabs, and persistent carriage (4%) occurred [7]. The healthcare workers who remained positive in this study and those in our study who tested positive underwent eradication therapy, which was successful in all of them. Not all subjects undergoing eradication treatment are successful, but the most effective treatment to date of intra-nasal colonisation by MRSA is mupirocin ointment [14, 15].

This study suggests that there could be a role for screening of healthcare workers for colonisation of MRSA. It is not possible to say that screening has a direct effect on the rate of MRSA wound infections, but screening appears to lower the colonisation rate of staff. Further long-term studies are needed, together with studies comparing rates of MRSA infections with colonisation rates amongst healthcare workers. This may lead to change in the national policy for staff screening for MRSA colonisation.

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