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Prevalence of MRSA colonisation among at risk patients at admission to an Irish hospital: 2007 to 2009 inclusive

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Abstract

There is a paucity of information on the prevalence of MRSA at admission to Irish hospitals yet the Department of Health and Children (DOHC) recommends admission screening of patients considered to be at increased risk of MRSA. This study aimed to determine the prevalence of MRSA at admission to one Irish hospital and make comparisons with national and international rates. Rates of MRSA colonisation were determined by taking swabs from a minimum of three body sites at the time of admission to the hospital. Screening was targeted to all patients for high risk surgery and other patients considered at increased risk of MRSA colonisation as per international guidelines.

Prevalence varied depending on speciality and patient's age. Patients aged over 70 were twice as likely to be colonised with MRSA than those under 70 (OR 2.004, $p<0.000001$). Patients over 80 years were 2.5 times more likely to be colonised with MRSA (OR 2.52, $p<0.00001$).

This study provides valuable data on the overall prevalence of MRSA in at risk patients admitted to an Irish Hospital.

Key words

MRSA, admission screening, targeted screening

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Introduction

Over the past ten years there has been an increasing recognition of the numbers of patients colonised with Methicillin resistant *Staphylococcus aureus* (MRSA) and the major problems this causes for hospitals.[1-3] The proportion of patients colonised with MRSA in a hospital is now recognised as one of the most important factors influencing MRSA acquisition and is often referred to as colonisation pressure.[4,5] Furthermore, many studies have identified the increased risk of developing MRSA infection in patients with MRSA colonisation.[6-8] The success of programmes to control MRSA centre around the fact that this previously unknown reservoir for MRSA is targeted, isolated and treated to prevent further spread and reduce risk of infection in the colonised individual.[6,9,10]

There is also agreement that certain 'at risk' groups are more likely to be colonised with MRSA than others with many countries now recommending targeted admission screening.[9-12] These 'at risk' patients include: those who live in or have stayed in long term care facilities such as nursing homes;[2,3,13] patients who have recently been hospitalised where MRSA is prevalent;[14,15] those who have had MRSA in the past[12,15] and those of increased age.[15-17] Across Europe and in Ireland there is a growing trend in Healthcare to screen these patients for MRSA at time of admission to hospital.[10-12] Some countries such as England now recommend universal screening, proposing that targeted screening would miss significant numbers of MRSA positive patients without risks factors.[18-20]

Although a small number of studies exist providing data on MRSA infections in the United Kingdom and Ireland, there are few that examine the prevalence of MRSA colonisation in whole hospitals in these countries.[19-23] Without this data, it is difficult to make an informed decision as to how best to efficiently manage the finite resources available to hospitals. Our study provides data on the prevalence of MRSA colonisation in at risk patients being admitted to a tertiary referral acute care private hospital in Ireland from January 2007 until December 2009.

Methods

The study was set in a 186 bed acute care tertiary referral private hospital. The average number of admissions per year during the three years of the study was 10,009 and the average length of stay was 5 days. In addition to general medical and surgery admissions and a large oncology radiotherapy unit, high volumes of cardiac surgery and orthopaedic implant surgery are carried out in the hospital. During the period of the study, the average number of inpatient bed days per year was 48,500, of which 78% were private patients and 22% public patients. All patients admitted for at least one night's stay during the years 2007-2009 inclusive were eligible for inclusion. Risk assessment for MRSA at admission was carried out on all patients. Those fulfilling the 'at risk' criteria as set out below were then screened.

Screening for MRSA on admission was well established having commenced in 2000. From January 2007, patients with a known history of MRSA, patients transferred from other healthcare facilities and patients hospitalised in the past month were screened on admission. In addition to these patients with known risks for MRSA, all patients for cardiac surgery and joint replacement surgery and all those for cardiac pacemaker insertion were also screened. Patients were asked if they had a history of MRSA or recent contact with MRSA at time of admission. If so, this was recorded in their notes and they were also screened. These 'at risk' patients were targeted for screening based on recommendations from United States guidelines[9] and from DOHC, Ireland.[11] Swabs were reserved from nose, throat, groin and any broken skin if present and sent directly to the laboratory.

The process for identifying MRSA involved direct plating of swabs onto Pastores coagulase, Cefoxitin based, serosep agar (BioRad) plates and incubation for 18 hours. Absence of pink colonises after 18 hours indicated MRSA was not present and thus a negative result was reported. Pink colonises on the plate were considered suspicious of MRSA and were removed using 10mm loop. They were then re-suspended in 4ml nutrient broth and tested against appropriate antibiotics to determine sensitivity patterns using disc diffusion method. MRSA was confirmed using tube coagulase tests for *Staphylococcus aureus* if necessary.

Table I: Number of patients colonised with MRSA by site

Site screened	Number of screens 2007-2009	Number identified as MRSA positive	Percentage positive	Only site positive
nose	13,219	858	6.50%	499
throat	10,849	169	1.56%	75
groin/perineum	10,572	225	2.10%	94
wound/ulcer	1,138	84	7.40%	29
multiple sites	14,301	482	3.37%	n/a
total	**14,301**	**1,179**	**8.24%**	**n/a**

Patients queried positive were isolated and treatment commenced pending confirmation by culture.

Ethical approval was granted by the local research ethics committee.

Results

From January 2007 until December 2009 a total of 14,301 patients, representing 47% of all admissions were screened for MRSA. A total of 1,179 were identified as colonised with MRSA.

In total, 6.5% (858 of 13,219) of nasal swabs reserved were colonised with MRSA. Throat swabs were positive 1.56% (169 of 10,849) of the time, although the throat was the only site positive in 75 cases. Groin/perineum swabs revealed MRSA colonisation 2.1% (225 of 10,572) of the time and 94 of these patients did not have MRSA at any other site. Although 482 patients had MRSA at multiple sites, screening nasal site alone would have missed 321 patients or 27% of those identified as positive (table I).

The majority of patients identified as colonised with MRSA at admission had known risks for MRSA (Figure 1). They included direct transfers form other healthcare facilities (13% or 153 patients); Patients with a history of MRSA colonisation or infection (35% or 413 patients and those who were in a hospital in the past month (13% or 153 patients). A further 9% or 106 patients were identified as MRSA positive because they stated they had recent contact with an MRSA positive person when asked. However, a substantial number of patients (283 or 24%) were identified as colonised with MRSA at admission but did not have a specific recognised risk factor. These patients had been screened because they were admitted for a high risk procedure such as joint implant surgery, cardiac surgery or cardiac pacemaker insertion.

Prevalence of MRSA among these at risk groups, where all patients were screened, varied. In patients for cardiac surgery, 2.5% were colonised with MRSA on admission while 5% of patients requiring cardiac pacemaker were noted to be colonised. In those for joint replacement surgery, 4% were identified as positive.

In patient groups where screening was targeted to those with known risks only, colonisation rates at admission varied from 15% in those for cataract extraction and lens implant to 4.64% in general medical patients with an average rate of 8.24% of those screened found to be colonised with MRSA.

The average age of patients admitted to the hospital between 2007 and 2009 was 59 years. However, examination of the average age of patients identified as MRSA positive on admission during the same period was 73 years. Further analysis of the data using Chi-squared test and Fisher test and assuming a 95% confidence interval demonstrated that patients aged

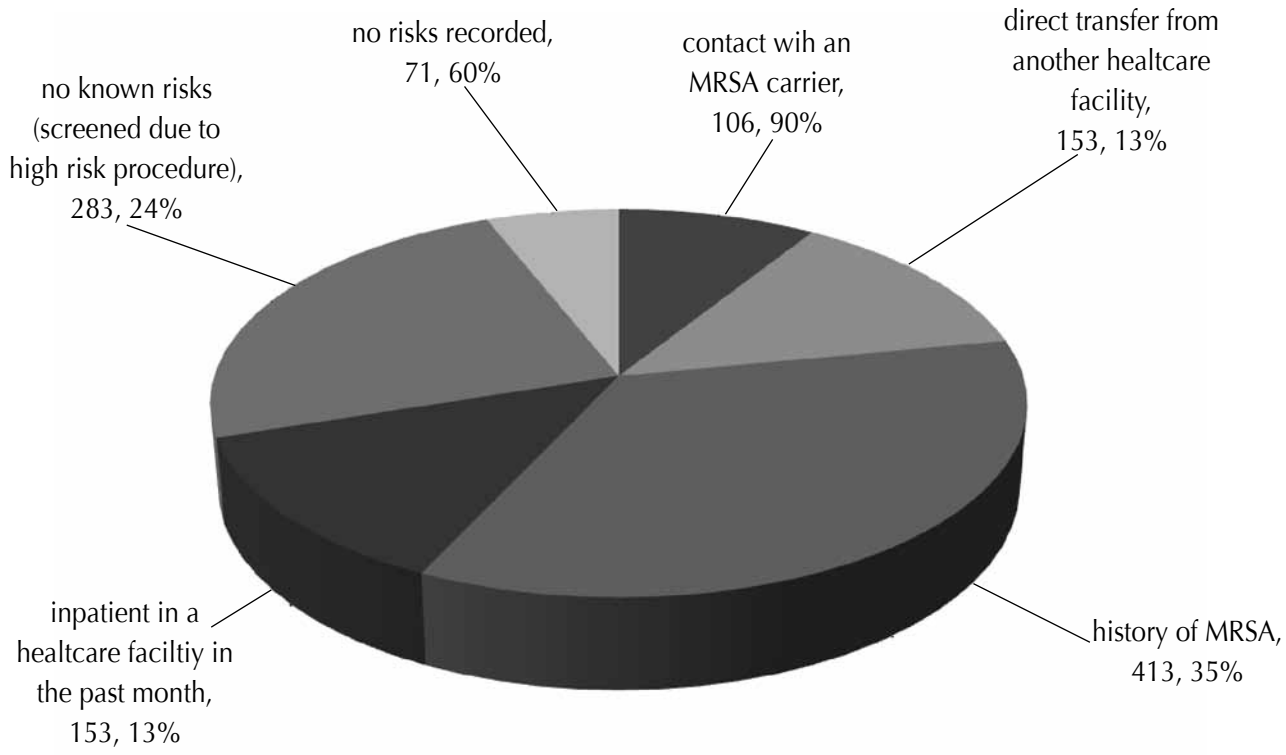

Figure 1: Risk factors for MRSA at admission

over 70 years were twice as likely to be colonised with MRSA than those under 70 with the same risk factors (OR 2.004, p<0.000001). This risk increased with age and patients over 80 years were 2.5 times more likely to be colonised with MRSA (OR 2.52, p<0.00001).

Discussion

The success of targeted screening for MRSA at admission is well documented and has been implemented in many countries.[6,7,9-12] Some researchers argue that targeted screening is not as effective as universal screening because a significant percentage of those identified by universal screening would not be identified by targeted screening [18,19] In England the Department of Health recommend universal screening for MRSA at admission.[20] In Scotland the health protection centre is currently undertaking a review of the clinical benefit and cost effectiveness of universal screening for MRSA in a whole health board.[23] Our study is timely in that it is the first study to provide three years of data on the prevalence of MRSA in the acute hospital setting in Ireland. The findings are significant in terms of future screening programmes and provision of isolation facilities for patients with MRSA colonisation.

We examined the prevalence of MRSA colonisation at admission by targeting our screening to patients most likely to be MRSA positive. Patients were also asked if they had recent contact with MRSA or if they had ever had MRSA to ensure those at risk were not missed. Compliance with screening was high as the programme had been established for many years. To increase the likelihood of identifying MRSA colonisation, a minimum of three sites were screened for each at risk patient.

When the risk factors for MRSA carriage are examined individually, the results from this study were very similar to results from studies in other countries.[24] They demonstrate that risks in Ireland are similar to those in other countries and re-iterate the increased risks associated with increased age.

In our study screening was targeted to those with increased risks of colonisation with MRSA. Therefore, transfers from other healthcare facilities, those hospitalised in the past month and those with history of MRSA made up the vast majority (61%) of the patients identified as colonised with MRSA at admission.

A simple intervention, that of asking patients if they had recent contact with MRSA, identified a further 9% who would have been missed by the earlier targeted screening.

However, a further 24% (283) were identified as colonised with MRSA who did not have any of these risks perhaps adding to the argument towards universal screening. The majority of these patients were identified due to the practice of screening all patients for cardiac surgery, joint replacement surgery and cardiac pacemaker insertion. The decision to screen all these patients was taken due to the increased morbidity and mortality associated with infection in this group.[25] Indeed our screening programme was combined with decolonisation of all MRSA identified as part of a search and destroy programme for MRSA in place in the hospital aimed at reducing risks of healthcare associated infections in these high risk groups.

Universal screening may however be regarded as unnecessary for patients having minor procedures if screening can be successfully targeted to patients with known risks. By asking patients if they have had MRSA contact, further risks can be identified, increasing the effectiveness of the targeted screening programme. Our findings would suggest that the answer may be to weigh the risks of infection versus screening costs.

Direct comparison of results with other studies is difficult due to variability in methodologies and methods of data reporting. However, our results are comparable to a 4.5% colonisation rate identified in a London hospital.[26]

The increasing prevalence associated with increased age in this study is also comparable to other research findings.[3,15,16] Our study found that patients over 70 years were twice as likely to be colonised with MRSA as those under 70 years (OR 2.004, $p<0.000001$) with similar risks. We also noted this risk seemed to increase with age as those over 80 years were 2.5 times more likely to be colonized (OR 2.52, $p<0.00001$). Eveillard reported age greater than 80 years when combined with usual risk factors for MRSA, was seen to increase the prevalence of MRSA.[16] They identified a prevalence of 11.7% colonised with MRSA when those with risk factors in this age group were screened. In our study prevalence among those over 70 years was 7.25%. Difference may be explained by the fact that some over seventies in our study did not have risks but were screened due to their pending high risk surgery. A study by Grundmann[17] deduced that it was the increased hospitalisations and presence of wounds in the older age groups that increased their risks of MRSA and not their age.

The differences in the findings of the studies may be explained by the different numbers of body sites screened. Our study and the studies by Eveillard and Harbarth screened three body sites for MRSA whereas Grundmann screened only the nose of participants. Analysis of sites found positive in our hospital where a minimum of three sites were swabbed found that screening the nose alone would have missed 27% of those found positive. Indeed when positive sites are examined, it is of note that screening of throat identified 6.3% of patients with MRSA who would have been missed by omission of this site. Screening without sampling the groin or perineum would have missed 94 patients or 7.9% of those identified as colonised. This would certainly suggest that screening multiple sites is an essential step in ensuring targeted screening identifies as many of those with MRSA as possible.

A limitation of this study is that it was set in a private hospital and thus it could be argued that the health status of patients may have been better than those found in public healthcare settings. However the hospital treated a significant number of public patients as part of the national treatment purchase fund (NTPF) during the study period. Indeed public patients accounted for 22% of total bed days in the study period. It is also of note that 50% of the Irish population have private health insurance.[27] A second limitation is the fact that only targeted screening was carried out. A more accurate picture of prevalence can only be obtained if universal screening had been carried out, however this would have been beyond the resources available at this hospital.

Conclusion

While the debate continues as to whether screening all patients or targeting screening to high risk groups is the better option, certainly resources available to hospitals must be put to the most efficient use.

Identification of MRSA colonisation at admission is recognised as a step towards reducing the risk of infection. Based on the findings of this study, targeted screening of multiple sites that involves the patient and adapts to local risks seems to be an efficient method of identifying the most common sources of MRSA at admission.

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References

1. Kuehnert M, Hill H, Kupronis B, Tokars J, Solomon S, Jernigan D. Methicillin resistant *Staphylococcus aureus* hospitalizations, CDC, Atlanta, Georgia, USA, United States 2005.
2. Casas I, Esteve M, Andres I, Blanco S, Caraballo M, Sabria, M. Prevalence of and risk factors for methicillin resistant *Staphylococcus aureus* carriage at hospital admission. *Infect Control Hosp Epidemiol* 2007; **28(10):** 1134-1141 (doi:10.1086/520738).
3. Harbarth S, Sax H, Uckay I *et al*. A predictive model for identifying surgical patients at risk of MRSA carriage on admission. *J Am Colo Surg* 2008; **207(5):** 683-689.
4. Eveillard M, Lancien E, Barnaud N *et al*. Impact of screening for MRSA carriers at hospital admission on risk adjusted indicators according to the imported MRSA colonisation pressure. *J Hosp Infect* 2005; **59:** 254-258 (doi: 10.1016/j.jhin.2004.09.028).
5. Merrer J, Santoli F, Appere de Vecchi C, Tran B, De Jonghe B, Outin H. "Colonisation Pressure" and risk of acquisition of methicillin resistant *Staphylococcus aureus* in a medical intensive care unit. *Infect Cont and Hosp Epidemiol* 2000; **21:** 718-723.
6. Bissett. L. (2005) Controlling the risk of MRSA infection by screening and isolating patients, Br J Nurs **14**: (7), 386-390.
7. Wertheim H, Vos M, Boelens H, Voss C, Vandenbroucke-Grauls C. Low prevalence of MRSA at hospital admission in the Netherlands: the value of search and destroy and restrictive antibiotic use. *J Hosp Infect* 2004; **56:** 321-325 (doi:10.1016/j.jhin.2004.01.026).
8. Clancy M, Graepler A, Wilson M, Douglas I, Johnson J, Price C. Active screening in high risk units is an effective and cost avoidant method to reduce the rate of Methicillin resistant *Staphylococcus aureus* infection in the hospital. *Infect Control Hosp Epidemiol* 2006; **27(10):** 1009-1017.
9. SHEA. Guideline for preventing nosocomial transmission of multi-drug-resistant strains of *Staphylococcus aureus* and enterococcus. *Infect Control Hosp Epidemiol* 2003; **24**: 639-641.
10. Meester M, Kluytmans J, Van Keulen P, Vergrugh H. Low prevalence of MRSA at hospital admission in the Netherlands: the value of search and destroy and restrictive antibiotic use. *J Hosp Infect* 2004; **56:** 321-325.
11. SARI. The control and prevention of MRSA in hospitals and the community, Health Service Executive, Health Protection and Surveillance Centre, Dublin, Ireland 2005.
12. The National Board of Health. Prevention of MRSA spreading guidelines [in Danish]. Copenhagen: Sundhedsstyrelsen; 2007.
13. O Sullivan NP, Keane CT. The prevalence of methicillin resistant *Staphylococcus aureus* among the residents of six nursing homes for the elderly. *J Hosp Infect* 2000; **45(3):** 206-210.
14. Jernigan J, Pullen A, Flowers L, Bell M, Jarvis W. Prevalence of and risk factors for methicillin resistant *Staphylococcus aureus* carriage at hospital admission. *Infect Control Hosp Epidemiol* 2003; **24(6):** 409-414.
15. Lucet JC, Grenet K, Aramand-Lefevre L *et al*. High prevalence of carriage of MRSA at hospital admission in elderly patients: implications for infection control strategies. *Infect Control Hosp Epidemiol* 2005; **26(2):** 121-126.
16. Eveillard M, Mortier E, Lsecure F, *et al*. Consideration of age at admission for selective screening to identify methicillin resistant *Staphylococcus aureus* carriers to control dissemination in a medical ward. *Am J Infect Control* 2006; **34(3)**: 108-113 (doi:10.1016/j.ajic.2006.01.001).
17. Grundman H, Tami A, Hori S, Halwani M, Slack R. Nottingham *Staphylococcus aureus* population study: prevalence of MRSA among elderly people in the community. *BMJ* 2008; **324**: 1365-1366 (doi:10.1136/bmj.324.7350.1365).
18. Dancer SJ. Considering the introduction of universal MRSA screening. *J Hosp Infect* 2008; **69:** 315-320 (doi:10.1016/j.jhin.2008.05.002).
19. Gopal Rao G, Michalczyk P, Nayeem N, Walker G, Wigmore L. Prevalence and risk factors for methicillin resistant *Staphylococcus aureus* in adult emergency admissions – a case for screening all patients? *J hosp infect* 2007; **66**: 15-21 (doi:10.1016/j.jhin.2007.01.013).
20. Department of Health. Clean, safe care. Reducing infections and saving lives, Crown Publications, London, UK 2008.
21. Roche S, Fitzgerald D, O Rourke A, McCabe J. Methicillin resistant *Staphylococcus aureus* in an Irish Orthopaedic Unit: A five year analysis. *J Bone Joint Surg Br* 2006; **88(6):** 807-811 (doi:10.1302/0301-620x.88B6).
22. Keshgar M, Khalili A, Coen G *et al*. Impact of rapid molecular screening for methicillin resistant *Staphylococcus aureus* in surgical wards. *Br J Surg* 2007; **95**: 381-386 (doi:10.10.1002/bjs.6013).
23. Health Protection Scotland. NHS Scotland MRSA screening pathfinder programme, summary interim report. HPS, Edinburgh, Scotland 2009.
24. Rubinovitch B, Pittet D. Screening for MRSA in the endemic hospital: what have we learned? *J Hosp Infect* 2001, **47:** 9-18 (doi:10.1053/jhin.2000.0873).
25. Tai C, Nirvani A, Holmes A, Hughes S. Methicillin resistant *Staphylococcus aureus* in orthopaedic surgery. *Int Orthop* 2004; **28:** 32-35.
26. Harbarth S, Masuet-Aumatell C, Schrenzel J *et al*. Evaluation of rapid screening and pre-emptive contact isolation for detecting and controlling methicillin resistant *Staphylococcus aureus* in critical care: an interventional cohort study. *Crit Care* 2006; **10:** 1-8 (doi:10.1186/cc3982).
27. Nolan B. The Interaction of Public and Private Health Insurance: Ireland as a case study. *The Geneva Papers* 2006, **31(4):** 633–649.