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Citation

Gilligan P, Quirke M, Winder S, Humphreys H. Impact of admission screening for methicillin-resistant Staphylococcus aureus on the length of stay in an emergency department. Journal of Hospital Infection 2010;75(2):99-102.

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The impact of admission screening for meticillin-resistant *Staphylococcus aureus* (MRSA) on the length-of-stay in an emergency department

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Funding source This work was not supported by an external research grant or funding from a commercial or other source.

Conflict of interest HH has received research funding from Pfizer, Steris Corporation, 3M, Inov8 Science and Cepheid in the last three years. He has also received lecture or consultancy fees from 3M, Novartis and Astellas.

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Running title *MRSA and Emergency Department length-of-stay*

Abstract

Preventing and controlling meticillin-resistant *Staphylococcus aureus* (MRSA) includes early detection and isolation. In the emergency department (ED), such measures have to be balanced with the requirement to treat patients urgently and transfer quickly to an acute hospital bed. We assessed the contribution that previous MRSA risk group identification and selective rescreening of those patients who were previously documented in the research hospital as being MRSA positive made to a patient's stay in a busy, overcrowded ED. Patients with a previous diagnosis of MRSA colonisation were flagged automatically as a "risk group" (RG) patient on their arrival in the ED and were compared with those non-risk group (NRG), i.e. not previously proven in the research hospital to be infected or colonised with MRSA. Over an 18 month period, there were 16,456 admissions via the ED of which 985 (6%) were RG patients. The expected median times to be admitted following a request for a ward bed for NRG and RG patients were 10.4 hours and 12.9 hours, respectively. Female sex, older age (over 65 years old) and RG status all independently predicted a statistically significant longer stay in the ED following a request for a hospital bed. We consider that national and local policies for MRSA need to balance the welfare of patients in the ED with the need to comply with best practice, when there are inadequate ED and in-patient isolation facilities. Patients with MRSA requiring emergency admission must have a bed to go to.

Key words: Emergency department, MRSA, surveillance, isolation, boarders

Introduction

Healthcare-associated infection affects 5-10% of patients in an acute hospital, many of these infections are device-related and meticillin-resistant *Staphylococcus aureus* (MRSA) accounts for approximately 16% of all infections.[1,2] General infection prevention and control measures, such as the use of standard precautions, as well as specific measures for MRSA are justified as the outcome from MRSA infections is less favourable compared with other infections. A meta-analysis comparing bloodstream infection due to MRSA and methicillin-susceptible *S. aureus* showed a significant increase in mortality associated with MRSA bloodstream infection.[3]

Preventing and controlling MRSA requires a multi-faceted approach that includes early detection and isolation, a common feature of many national guidelines.[4] In the UK and elsewhere, there is a move towards the introduction of universal screening, i.e. the taking of swabs from all patients irrespective of risk, and this has provoked some discussion on its merits.[5]

In the emergency department (ED), infection prevention and control measures have to be balanced with the requirement to treat patients urgently and to transfer patients requiring admission as quickly as possible to acute hospital beds. Furthermore, in North America and elsewhere, the phenomenon of community-acquired MRSA is being seen, particularly in EDs, in patient's without known risk factors for healthcare-associated MRSA.[6] We have documented that anything that prolongs the patient's ED stay may adversely affect patient welfare and compound overcrowding.[7] Most national and local guidelines on the prevention and control of MRSA largely focus on in-patients but their implementation have implications for the ED. Prolonging a

patient's stay in the ED will further compound overcrowding, which is a recognised contributor to spread of hospital acquired infection.[8]

We assessed the contribution that previous MRSA risk group identification and selective rescreening of these patients made to their stay in a busy, overcrowded ED.

Materials and Methods

Institution and patients

The study was conducted in the ED of an urban academic teaching hospital with an annual census of approximately 46,000 patient visits, an admission rate of approximately 23% and an average occupancy with patients awaiting admission (boarders) of 105%. The observational study was approved by the chair of the institution's ethics committee. From the first of November 2006 to the 30th of April 2008, data were gathered in the ED's Oracle database on all patient attendances that resulted in admission. This Oracle database was interrogated using the Diver Solution programme which is a data warehousing solution that facilitates the gathering of data from different databases.

Selective screening, involved the taking of swabs from nose, groin and wounds (if present) from patients at the time of their re-attendance to the ED where there was a previous positive swab for MRSA in the research hospital. The prior diagnosis of MRSA colonisation or infection in the research hospital automatically gave rise to the patients being flagged as a "risk group" (RG) patient on the ED information technology system. For the purposes of this study the term "risk group" is applied only to those diagnosed with MRSA in the hospital laboratory on a previous admission. All such risk group patients were screened for evidence of ongoing MRSA colonisation. Previous MRSA carriers were declared clear on the basis of three negative swab results but even those cleared of infection remained as RG on return to the hospital.

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Patients with a previous diagnosis of MRSA colonisation and / or infection, whether or not they had negative screens subsequently, were flagged automatically as a "risk group" (RG) patient on their arrival in the ED using the Oracle database. Those patients with a prior diagnosis of MRSA colonisation were compared with those without it with respect to age, sex, triage category, total ED processing time and time from a bed on a ward being requested until the patient was admitted. Triage is the systematic prioritisation of patients. The Manchester Triage System uses a series of criteria to decide what level of priority a patient should have on the basis of their presentation. The National Triage scale from the United Kingdom is used in many EDs and is a five point scale from immediate (red), very urgent (orange), urgent (yellow), standard (green) to non-urgent (blue).[9]

The results from all patients screened for MRSA by the hospital's diagnostic laboratory were entered on the laboratory information system and this informs the hospital's inpatient system at 6 am on the morning following MRSA results being available. The hospital's inpatient system informed in turn the Oracle database, and if the patient subsequently re-attended the ED, that patient was automatically flagged as a RG patient and selectively screened for evidence of ongoing MRSA colonization. Previously MRSA positive or RG patients were screened with swabs from the nose, groin and broken areas of skin, and swabs were cultured on MRSA Select Chromogenic Agar (Bio-Rad Life Science group, France). Patients positive for MRSA were decolonised according to guidelines, and this was commenced in the ED and continued on hospital wards after admission.[10]

The ED is open plan with fourteen cubicles and two side rooms. Clinically stable patients with a prior history of MRSA were isolated, where possible in these rooms, pending the availability of other isolation facilities in the hospital. However, these side rooms do not have separate toilet facilities or an ante room, and frequently the number of patients requiring isolation for MRSA and for other indications exceeds the capacity of the two rooms. Other patients in the department wait on trolleys or chairs, usually in close proximity to other patients in the open plan area.

Statistical analysis

Cox proportional hazards methods were used to evaluate relative probabilities of being admitted for RG patients versus non-RG patients (NRG) who acted as controls. The interval time to event analysis determines whether a patient category has an increased or decreased chance of admittance at a particular time point and the result is defined by a hazard ratio.

A multi-factorial model was used to examine if risk group identification was independently significant in the presence of confounding variables such as age and sex. In addition the model was stratified into triage categories. Stata (version10, College Station, Texas) was used to analyse the data and a p value less than 0.05 was deemed to be significant.

Results

Over the 18 month period of the study there were 16,456 admissions via the ED. Of these, 985 (6%) had a prior diagnosis of MRSA colonisation, i.e. were RG patients. Amongst the NRG patients, 48.4% were female compared with 45.2% of RG patients. The Manchester triage category for those who were triaged in RG and NRG patients are compared in Table 1. Over the time frame of the study 161 of the 16,456 subsequently admitted patients did not undergo triage and are not represented in table 1.

The total time from arrival in the ED to admission to a ward bed was a median of 20.3 hours. For NRG and RG patients it was a median of 19.9 hours, [IQR 10.5 – 29.8 hours] and 22.6 hours [IQR 12.2 – 33.4 hours], respectively.

The expected median time to be admitted following a request for a ward bed was 10.5 hours; NRG patients waited a median of 10.4 hours [IQR 3.1 – 20.6 hours] compared to 12.9 hours [IQR 4.3 – 26.6 hours] for RG patients. The results of the Cox model revealed that older age (>65 years old) and female sex were statistically significant factors influencing the time spent in the ED from arrival to a bed request but MRSA colonisation was not (Table 2). However, female sex, older age and RG status all independently predicted a longer stay in the ED following a request for a hospital bed, i.e. RG status did not impact on the ED's and the on-call team's processing of patients but did influence the time taken to allocate a ward bed. (Table 2).

Discussion

Risk factors associated with healthcare-associated MRSA infection include advanced age, male gender, previous hospitalisation, nursing home care, length of hospitalisation, a stay in intensive care, chronic medical illness, prior antibiotic use, presence of indwelling devices, asymptomatic colonisation with MRSA and exposure to an infected or colonised patient.[11] In this study we applied the term risk group (RG) only to those with a prior diagnosis of MRSA colonisation or infection in our hospital laboratory. All such patients were electronically flagged as RG on their return to the ED. The flagging of patients with a prior diagnosis of MRSA and selective rescreening of this group in this study was associated with a prolonged ED stay.

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In the United States it is estimated that the rate of MRSA colonisation in the community is about 2% of the population.[12] Gopal *et al* found that 6.7% of screened adult emergency admissions to their UK based hospital were colonised with MRSA.[8] It is estimated that a non-isolated MRSA carrier will infect 0.14 patients per day in the absence of decolonisation.[13] Consequently, the early identification of colonized / infected patients and the prompt implementation of contact precautions are important in preventing MRSA transmission in hospitals. [8,14-17]

With regards to the limitations of our research the RG status of a patient is not validated but is assumed to reflect all patients with a previous positive result for MRSA colonisation in our hospital. The study required the analysis of a real time computer database which is dependent upon the medical and nursing staff putting in data in a time sensitive manner. We have no reason to believe that any failure to do so would have been more prevalent in either those with or without MRSA.

Overcrowding in EDs is a distressing and potentially dangerous phenomenon in many health systems. In our hospital, the elderly, those with prior colonisation with MRSA and women wait longest for an acute hospital bed when they require emergency admission. The research hospital has insufficient acute beds to provide for emergency admissions and this is further compounded by the fact that many patients in the hospital experience delayed discharges owing to lack of nursing home beds or step down facilities in the catchment area. The reason for the delay for females may be due to the fact that our hospital does not usually house males and females in the same bay of a ward and as more males are admitted as emergencies, finding a "female bed" can be problematic. The expected time for admission from time of arrival in the ED was a median of 22.6 hours for RG patients compared to 19.9 hours for NRG patients. The additional 2.7 hours for those requiring selective screening and in an individual patient sick enough to require hospital admission on an already unacceptably long wait for a hospital bed is of concern and further compounds overcrowding in our ED. Paradoxically, the implementation of screening to identify patients early who require isolation or cohorting in hospital impacts negatively on the provision of emergency care. Overcrowding in EDs has already been shown to increase ambulance diversions to other units, delay treatments, increase waiting times and walk outs and lead to longer lengths of hospital stay as well as increasing patient morbidity and mortality.[7]

The early identification and recognition of patients with potentially transmissible diseases and their early isolation is desirable and appropriate as illustrated by the SARS epidemic earlier this decade. However, it is neither desirable nor appropriate that such patients have more prolonged stays in the most overcrowded part of an acute

hospital i.e. the ED. Vichard *et al* argue that "sepsis containment units" where patients with MRSA can be isolated helps to prevent cross contamination,[18] but the ED can not be expected to house patients for prolonged periods in the absence of isolation rooms or cohort facilities on wards.

Dantas *et al* noted that prolonged stay in the ED posed a risk for colonization and the transmission of multidrug-resistant bacteria and for contracting HCAI, all associated with increased mortality. [19] Cunningham *et al* documented that overcrowding and the rapid turnover of patients in acute hospital settings contributes to cross-infection with MRSA and they argue that adequate acute capacity would help to address this.[20] Borg has described the correlation between workload indices and increased HCAI.[21]

The results of the study reported here show that the selective screening of patients with a prior diagnosis of MRSA colonisation prolongs their ED stay and increases the workload of already busy ED nursing staff, potentially increasing MRSA transmission. Reducing overcrowding in neonatal intensive care units has been shown to be effective in controlling endemic MRSA spread[22] and it is plausible that reducing ED overcrowding would have a similar positive effect.

The delay in being admitted to a ward bed from the ED in this study has been shown to be partly related to selective screening for MRSA. Being over 65 years old, being female or having MRSA should not mean that the patient will have a longer wait in the ED when they require acute admission. Being able to clarify the patients MRSA status sooner would probably help to facilitate earlier transfer to a bed. PCR testing for MRSA may be of benefit in this regard. Hospital ward staff are reluctant to accept

patients from our ED with MRSA without there being an isolation room available because of the risk of cross-infection. Clearly, leaving patients for prolonged periods in the ED which is the most overcrowded part of any acute hospital is not appropriate. Acute hospitals must accept that factors contributing to the spread of infection are important on in-patient wards and in the ED. Having identified the problem the research hospital has now allocated areas within each ward that allow for the setting up of cohorts of patients with MRSA, if no single rooms are available. Another alternative suggestion is to not selectively screen patients during the ED component of their hospital stay if in so doing ward placement is made more difficult and to allow patients to be screened on the wards.

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Harbarth *et al* investigated the use of a universal rapid MRSA admission screening in a surgical department and although they did not demonstrate a reduction in nosocomial MRSA, they acknowledge that others have recommended universal admission screening as a means to control MRSA.[23-25] Robiecsek *et al* in their study of universal admission MRSA surveillance with isolation and decolonization of patients who tested positive for MRSA, found that this was associated with a greater than 50% reduction in healthcare–associated MRSA bloodstream, respiratory, urinary tract and surgical site infections during admission and for up to 30 days after discharge.[26]

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The early isolation of patients with MRSA is the standard in most centres but adequate facilities must be available both on hospital wards and in EDs. We have shown that selective screening of patients with a prior diagnosis of MRSA colonisation in our hospital prolongs the wait for an acute hospital bed and

compounds ED overcrowding. National and local policies for MRSA control need to address this by balancing the welfare of patients in the ED with the need to comply with best practice when there are inadequate ED and in-patient isolation facilities. Patients with MRSA requiring emergency admission to hospital must have a bed to go to.

We are grateful to all the staff in the ED and the infection prevention and control team.

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1 **Table 1.** Triage categories of admitted patients from the ED with and without MRSA.

2

Category	*Immediate*	*Very urgent*	*Urgent*	*Standard*	Non-urgent
	(Red)	*(Orange)*	*(Yellow)*	*(Green)*	(Blue)
NRG	171	5936	8864	322	25
(%)	(1.1)	(38.8)	(57.9)	(2.1)	(.2)
RG	18	459	489	10	1
(%)	(1.8)	(47)	(50.1)	(1)	(.1)

3 NRG = Non-risk Group (not previously MRSA positive),

4 RG = Risk Group (previously MRSA positive).

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Table 2. Cox model of variables associated with prolonged ED stay from time of arrival to time of hospital admission.

Variable	Hazard ratio from time of arrival to bed request [95% CI]		Hazard ratio from bed request to admission [95% CI]	
RG	0.946	[0.887 - 1.010]*	0.874	[0.819 - 0.933]**
Age > 65 years	0.891	[0.863 - 0.919]**	0.780	[0.756 - 0.805]**
Female Sex	0.902	[0.875 - 0.930]**	0.883	[0.857 - 0.911]**

RG, Risk group, i.e. previously MRSA positive
*p = 0.094
** p <0.001