Compliance of Hospital Staff with Guidelines for the Active Surveillance of Methicillin-Resistant Staphylococcus aureus (MRSA) and its Impact on Rates of Nosocomial MRSA Bacteremia

Marwan Zoabi MD¹, Yoram Keness PhD²,³, Nava Titler³ and Naiel Bisharat MD PhD⁴,⁵

¹Department of Medicine, Nazareth Hospital EMMS, Nazareth, Israel
²Microbiology Laboratory, ³Infection Control Unit and ⁴Department of Medicine D, Emek Medical Center, Afula, Israel
⁵Rappaport Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel

ABSTRACT: Background: The compliance of hospital staff with guidelines for the active surveillance of methicillin-resistant Staphylococcus aureus (MRSA) in Israel has not been determined.

Objectives: To evaluate the compliance of hospital staff with guidelines for the active surveillance of MRSA and assess its impact on the incidence of nosocomial MRSA bacteremia.

Methods: We assessed compliance with MRSA surveillance guidelines by assessing adherence to the screening protocol and reviewing medical and nursing charts of patients colonized with MRSA, and observed hand hygiene opportunities among health care workers and colonized patients. Rates of nosocomial MRSA bacteremia and of adherence with hand hygiene among overall hospital staff were obtained from archived data for the period 2001–2010.

Results: Only 32.4% of eligible patients were screened for MRSA carriage on admission, and 69.9% of MRSA carriers did not receive any eradication treatment. The mean rate of adherence to glove use among nurses and doctors was 89% and 31% respectively (P < 0.01) and to hand hygiene 59% and 41% respectively (P < 0.01). The hospital overall rate of adherence to hand hygiene increased from 42.3% in 2005 to 68.1% in 2010. Rates of nosocomial MRSA bacteremia decreased by 79.2%, from 0.48 (in 2001) to 0.1 (in 2010) per 1000 admissions (P < 0.001).

Conclusions: The compliance of medical and nursing staff with guidelines for active MRSA surveillance was poor. The encouraging increase in adherence to hand hygiene and concomitant decrease in nosocomial MRSA bacteremia is gratifying. The deficiencies in compliance with MRSA infection control policy warrant an adjusted strategy based on the hospital resources.

KEY WORDS: methicillin-resistant Staphylococcus aureus (MRSA), nosocomial infections, medical staff, nursing staff, surveillance, hand hygiene compliance

Methicillin-resistant Staphylococcus aureus is a major cause of hospital-acquired infections in many countries around the world [1,2] and in recent years it has become a significant cause of community-acquired infections [3]. A recent study from Israel addressed the role of community acquired-MRSA in pediatric soft tissue infections [4].

In the last decade numerous reviews and consensus statements have endorsed policies to control the spread of nosocomial MRSA infections [5,6]. The most widely addressed policy is perhaps active MRSA surveillance to detect and isolate MRSA carriers among hospital admissions, mainly a subgroup of patients at high risk for MRSA carriage [7,8]. Nevertheless, there is still controversy regarding the role of active surveillance in the control of MRSA infections, with a few systematic reviews suggesting that there are no good data to support this approach [9,10].

In Israel, methicillin resistance among S. aureus isolates is variable. Some authors reported very low rates (~0.6%) of nasal MRSA carriage among healthy children and 7.6% among chronically institutionalized children [11], while others presented rates ranging from 11.4% in community-acquired infections, 27% among hospital-acquired infections, and up to 50% among patients in long-term care facilities [12]. The use of active MRSA surveillance to control nosocomial MRSA infections has been officially adopted by only a few hospitals in Israel. One group published an initial report describing its efficacy [13] and recently published a second report after 5 years of follow-up, proving that rates of nosocomial MRSA bacteremia can be reduced when using active surveillance together with contact isolation and monitoring to ensure compliance with screening and contact isolation guidelines [14].

Our medical center adopted a policy of active MRSA surveillance in 2005, restricted to a subgroup of patients at high risk for MRSA carriage. It is unclear to what extent the medical
and nursing staff complied with MRSA surveillance guidelines for detecting colonized patients, isolation procedures, and what treatment, if any, was prescribed to colonized patients.

The purpose of the present study was to assess the compliance of medical and nursing staff with active MRSA surveillance guidelines, assess adherence of hospital staff to hand hygiene, and investigate its impact on rates of nosocomial MRSA bacteremia.

**Patients and Methods**

From 2005 and based on guidelines of the Society for Healthcare Epidemiology of America [8], the infection control unit at HaEmek Medical Center adopted a policy that all patients from the following categories should be screened on admission for MRSA carriage: a) patients with known history of MRSA colonization or infection, b) patients admitted from other hospitals/nursing homes, c) patients receiving long-term hemodialysis, d) patients readmitted to the hospital within 3 months from their discharge, e) patients who underwent a major operative procedure in the previous month, f) all patients admitted to the intensive care unit, and g) patients with pressure sores or permanent tracheostomy living at home. Samples were obtained for culture from anterior nares and from the perineum (only in bedridden patients). A sputum culture was obtained from intubated patients, and the skin was sampled in patients with dermatitis or open wounds. Due to the shortage of single rooms, no request was made to transfer positive carriers to single rooms or to put them with each other in the same room. Nosocomial MRSA bacteremia was defined as an MRSA-positive blood culture result from blood that was drawn 48 hours after admission. The local ethics committee at HaEmek Medical Center approved the study.

**Study Design**

The study consisted of two parts – retrospective and prospective. In the retrospective part we assessed adherence to guidelines for active MRSA surveillance by reviewing medical and nursing charts of patients who were admitted from January 2006 to January 2007 and were found to be colonized with MRSA. In the prospective part we started by assessing the adherence of nursing staff to the screening protocol (the number of patients eventually screened from among all the patients who should have been screened according to the guidelines); this was carried out in four medical and two surgical wards for 2 successive months, 10 months apart (early 2006 and late 2006), and a third survey carried out in mid-2009. On identifying a colonized patient, we assessed the opportunities for hand hygiene and adherence of staff to contact isolation alerts by direct observations that were carried out during morning shifts and in different sections of the medical and surgical wards.

Adherence to hand hygiene practices was evaluated by direct observation of contacts between health care workers and patients during hand hygiene opportunities. Measuring hand hygiene adherence was evaluated in accordance with published guidelines [15]. We also monitored the thoroughness of cleansing and whether gloves were used and changed when indicated. The adherence rate was calculated as previously described [16]: the total number of acts of hand hygiene when the opportunity existed divided by the total number of hand hygiene opportunities.

**Measuring Adherence of Hospital Staff to Hand Hygiene (2006–2010)**

The assessment of adherence to hand hygiene practices among hospital staff was performed as part of an ongoing hospital-wide campaign initiated by the hospital infection control unit in 2004 to increase awareness to hand hygiene practices among hospital staff (N. Titler, unpublished data). Data of adherence rates were archived in the division of quality control and were retrieved for the purposes of this study.

**Microbiologic Analysis**

Swabs were collected from the anterior nares and rectum of the patients and streaked on chromogenic agar (HyLabs, Israel). Plates were incubated overnight at 37°C, colonies with typical morphology were confirmed as *S. aureus* using Pastorex coagulase test (BioRad, Marnes-La-Coquette, France) and for DNase production on DNase agar (HyLabs). Methicillin resistance was determined using the Kirby-Bauer disk diffusion test with a 30 µg cefoxitin disk. An inhibition zone diameter of ≥ 22 mm was considered diagnostic for methicillin-susceptible *Staphylococcus aureus*. Susceptibility testing for mupirocin was performed for MRSA eradication purposes using a 200 µg mupirocin disk on a Mueller-Hinton agar plate. Any zone was considered susceptible.

**Statistical Analysis**

We used the chi-square test to assess differences in compliance and adherence rates between the study groups. Data analysis was conducted using SPSS version 17 (SPSS Inc., Chigaco, IL, USA). Significance was determined at the 0.05 level.

**Results**

**Retrospective Phase**

During the study period from January 2006 to January 2007 we obtained 2857 swabs (nares, perineum, and trachea) from 1321 adult patients; 103 swabs (7.8%) were positive for MRSA. Approximately two-thirds of the swabs were obtained in the medical wards. There was no documentation of a management MRSA plan in 69.9% of the medical charts. In only 29% of the patients was the eradication treatment started...
within 24 hours of confirmation of the result. Among the patients who received eradication treatment, 78% had a daily application of nasal mupirocin ointment to the anterior nares for 5 days, 68% had their bed linen changed daily for 5 days, and only 4% had a daily bath with 4% chlorhexidine for 5 days. Among MRSA carriers, sticky “contact isolation” labels were found in 93% of the medical and nursing charts, and in 85% of cases a sticky “contact isolation” label was found on the patient’s bed.

Among 103 patients who were found to be MRSA carriers during the study period, only 30.1% (n=31) received eradication treatment. The rest of the carriers did not receive any treatment during their hospitalization and no mention of MRSA carrier status was recorded in the discharge notes. During 1 year of follow-up, 34 colonized patients (33%) were readmitted, of whom only 6 were found to still be MRSA carriers. None of the patients who were identified as MRSA carriers was admitted within the following year with invasive MRSA infection.

PROSPECTIVE PHASE

Compliance with the MRSA surveillance protocol was initially assessed by determining the adherence rate to the screening protocol (number of patients screened from all patients who should have been screened). The adherence rate varied between the different departments, ranging from 17.3% to 61.5% in the medical departments and from 32.2 to 41.4% in the surgical departments [Table 1]. Overall, only 32.4% of the patients who should have been screened upon admission were eventually screened. Sixty-eight patients colonized with MRSA were identified during this part of the study, and only 42% of them received eradication treatment.

During this phase of the study we monitored 839 contact opportunities between health care personnel and colonized patients. The mean rate of adherence among nurses and doctors to glove use was 69% and 31% respectively ($P < 0.01$), to use of medical aprons 39% and 7% respectively ($P < 0.01$), and to hand hygiene 59% and 41% respectively ($P < 0.01$).

### Table 1. Adherence rates to MRSA screening protocol at the departments of medicine and surgery

<table>
<thead>
<tr>
<th>Department</th>
<th>No. of patients who should have been screened*</th>
<th>No. of patients actually screened</th>
<th>Adherence rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine A</td>
<td>165</td>
<td>59</td>
<td>36.2</td>
</tr>
<tr>
<td>Medicine B</td>
<td>148</td>
<td>34</td>
<td>22.8</td>
</tr>
<tr>
<td>Medicine C</td>
<td>172</td>
<td>30</td>
<td>17.3</td>
</tr>
<tr>
<td>Medicine D</td>
<td>187</td>
<td>115</td>
<td>61.5</td>
</tr>
<tr>
<td>Surgery A</td>
<td>91</td>
<td>29</td>
<td>32.2</td>
</tr>
<tr>
<td>Surgery B</td>
<td>85</td>
<td>35</td>
<td>41.4</td>
</tr>
<tr>
<td>Total</td>
<td>848</td>
<td>275</td>
<td>32.4</td>
</tr>
</tbody>
</table>

**Adherence of Hospital Staff to Hand Hygiene (2005-2010)**

Adherence to hand hygiene was evaluated by direct observation between health care personnel and patients during hand hygiene opportunities. Figure 1 shows adherence rates among doctors, nurses and paramedical staff during 5 years of unscheduled yearly observations carried out by the division of quality control. In 2005, the hospital overall adherence rate for hand hygiene was 42.3% (40.1%, 52.2% and 41.2% for doctors, nurses and paramedical staff, respectively), and in 2010 the overall adherence rate was 68.1% (58.5%, 73.3% and 56.6%, for doctors, nurses and paramedical staff, respectively) ($P < 0.01$ for each of the three groups).


Figure 2 shows the rates of nosocomial MRSA bacteremia during the last decade. Rates of nosocomial MRSA bacteremia decreased by 79.2% from 0.48 cases for 1000 admissions (2001) to 0.1 cases for 1000 admissions (2010) ($P < 0.001$).
DISCUSSION

We found that the compliance of medical and nursing staff with active MRSA surveillance guidelines was poor. Overall, nearly two-thirds of patients who should have been screened for MRSA carriage on admission were not screened, and more than two-thirds of those who were found to be MRSA carriers did not receive any eradication treatment. Yet, and despite the poor compliance with active MRSA surveillance guidelines, rates of nosocomial MRSA bacteremia decreased continuously during the years 2005–2010.

The low compliance with MRSA surveillance guidelines in our hospital is rather disappointing but not surprising. Previous, and rather few, studies that assessed compliance rates among medical and nursing staff with active MRSA surveillance guidelines reported similar findings [17,18]. Furthermore, compared with nurses, doctors have performed poorly in all aspects of infection control precautions.

The role of policies and practices for the prevention, decolonization and eradication of MRSA in hospitals is widely accepted among health care providers; some have showed impressive results in reducing the MRSA disease burden [13,19-21], while others were more skeptical regarding its efficacy [10,22]. In support of those arguing against active surveillance and detection for MRSA, some hospitals reported significant reductions in the MRSA disease burden by the use of approaches that do not include an active “search and destroy” policy for MRSA [23-25]. The major interventions employed in these reports were mainly high adherence to hand hygiene. In our case and apart from the debate whether active surveillance for MRSA is effective in reducing the MRSA disease burden, its cost-effectiveness should be addressed, especially when nearly two-thirds of the colonized patients were in fact ignored with regard to their carrier state. The finding that rates of nosocomial MRSA bacteremia declined significantly over the last 5 years was obviously believed by policy makers to be secondary to active MRSA surveillance. However, based on our findings, it is reasonable to speculate that the observed reduction in nosocomial MRSA bacteremia was not related only to active MRSA surveillance, particularly in view of the impressive increase (~50%) in adherence to hand hygiene among hospital staff and a steady background of MRSA colonization rate among hospital admissions that has not changed during the past 3 years (2008–2010) (N. Bisharat, unpublished data).

In conclusion, our study highlights the major deficiencies in compliance with an MRSA infection control policy in our hospital. Nevertheless, this has not adversely affected the MRSA disease burden which has significantly declined over the past 5 years. Given its high costs and the poor compliance among hospital staff, it seems that there is a need to reconsider its formation. It would be more beneficial and cost-effective to focus on improving the rate of adherence to hand hygiene among hospital staff within a bundle of other interventions aimed to reduce hospital-acquired infections.

Our study has a few limitations. The observers made every effort to be unobtrusive, but observation bias must be considered. In addition, our team of observers was a different team from the team that performed the yearly assessment of adherence to hand hygiene among the hospital staff, and therefore we cannot rule out observer-related variation. Second, our observations were made during morning shifts and included four medical and two surgical departments, which comprise almost 220 of the hospital’s 500 beds; whether the results seen in these wards can be generalized to all the departments is uncertain. Third, it would have been ideal had we used a before-and-after study design, such as before and after implementing active MRSA surveillance with and without intervention in hand hygiene practices, but this is almost impossible since adherence to hand hygiene practices is perhaps the most important factor in precautions for controlling the spread of MRSA. Furthermore, our study was carried out at three time points (twice in 2007 and once in 2009), and it is therefore difficult to draw clear and definitive conclusions on the lack of efficacy of active MRSA surveillance.

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Corresponding author:

Dr. N. Bisharat
Dept. of Medicine D, HaEmek Medical Center, Afula 18101, Israel
Phone: (972-4) 649-4520
Fax: (972-4) 649-4518
email: bisharat_na@clalit.org.il

References


### Capsule

**Desperately seeking XMRV – probably no connection to chronic fatigue syndrome**

A report that patients with chronic fatigue syndrome (CFS) are infected with a retrovirus called XMRV attracted considerable attention, but follow-up work by other investigators failed to confirm the finding. In a study by Simmons and collaborators, nine laboratories – including the authors of the original report – independently analyzed blinded blood samples from 15 individuals previously found to be positive for the virus (14 with CFS) and 15 healthy controls previously found to be negative. Only the two laboratories associated with the original report detected XMRV. However, in these laboratories, the virus was found in healthy controls as often as in CFS patients and replicate samples yielded inconsistent results. In addition to showing that current assays for detecting XMRV are unreliable, these data support previous studies that questioned the association between XMRV and CFS.

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### Capsule

**Awareness and attention**

There has been a long-standing controversy on whether activity in the primary visual cortex is necessary for perceptual awareness. In human brain-imaging experiments, Watanabe et al. were able to dissociate perceptual awareness from simple attention. Awareness was manipulated in a binocular flash suppression paradigm, and attention was manipulated by using standard attentional instructions. Activity in the primary visual cortex varied little, whether a target was visible or not. However, activity in the human primary visual cortex varied when subjects attended to the target or ignored it. Thus, humans do not need primary visual cortical activity in order to be aware of seeing something.

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