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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

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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 69% 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.

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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

MRSA = methicillin-resistant *Staphylococcus aureus*

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 (2005–2010)

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-Co-quette, 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

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

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).

RATES OF NOSOCOMIAL MRSA BACTEREMIA (2001–2010)

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) ($P < 0.001$).

Figure 1. Adherence rates to hand hygiene among doctors, nurses and paramedical staff during 2005–2010

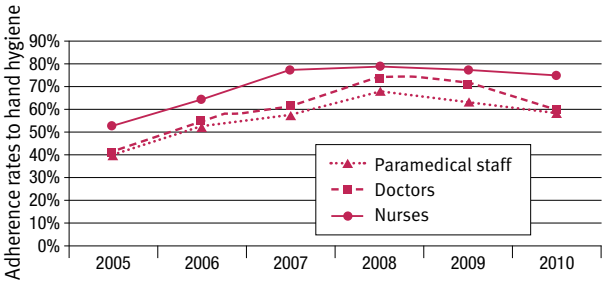
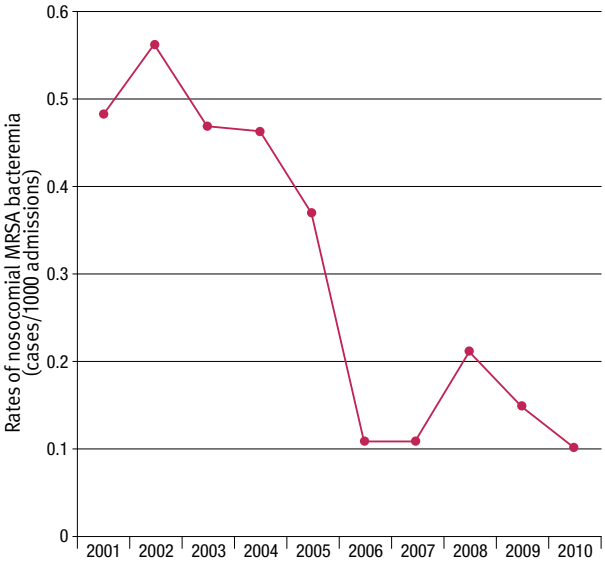


Figure 2. Rates of nosocomial MRSA bacteremia, 2001–2010



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 our view, the poor performance in implementing acceptable infection control precautions, the significant deficiencies in contact isolation (lack of single rooms, low adherence to use of gloves, aprons, and hand hygiene) and afterwards, in providing eradication treatment for the colonized patients, argues against a major role for active MRSA surveillance, as a consolidated plan, in reducing rates of nosocomial MRSA bacteremia in our hospital.

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.

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.

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References

1. Klevens RM, Morrison MA, Nadle J, et al. Invasive methicillin-resistant *Staphylococcus aureus* infections in the United States. *JAMA* 2007; 298: 1763-71.
2. Boucher HW, Corey GR. Epidemiology of methicillin-resistant *Staphylococcus aureus. Clin Infect Dis* 2008; 46 (Suppl 5): S344-9.
3. Zetola N, Francis JS, Nuermberger EL, Bishai WR. Community-acquired methicillin-resistant Staphylococcus aureus: an emerging threat. *Lancet Infect Dis* 2005; 5: 275-86.
4. Nevet A, Ashkenazi S, Samra Z, Livni G. Community-associated methicillin-resistant *Staphylococcus aureus* infections in Israel. *IMAJ Isr Med Assoc J* 2010; 12: 428-30.
5. Siegel JD, Rhinehart E, Jackson M, Chiarello L. Management of multidrug-resistant organisms in health care settings, 2006. *Am J Infect Control* 2007; 35: S165-93.
6. Gould FK, Brindle R, Chadwick PR, et al. Guidelines (2008) for the prophylaxis

and treatment of methicillin-resistant *Staphylococcus aureus* (MRSA) infections in the United Kingdom. *J Antimicrob Chemother* 2009; 63: 849-61.

7. Wernitz MH, Swidsinski S, Weist K, et al. Effectiveness of a hospital-wide selective screening programme for methicillin-resistant *Staphylococcus aureus* (MRSA) carriers at hospital admission to prevent hospital-acquired MRSA infections. *Clin Microbiol Infect* 2005; 11: 457-65.
8. LeDell K, Muto CA, Jarvis WR, Farr BM. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and *Enterococcus. Infect Control Hosp Epidemiol* 2003; 24: 639-41.
9. Cooper BS, Stone SP, Kibbler CC, et al. Isolation measures in the hospital management of methicillin resistant *Staphylococcus aureus* (MRSA): systematic review of the literature. *BMJ* 2004; 329: 533.
10. McGinigle KL, Gourlay ML, Buchanan IB. The use of active surveillance cultures in adult intensive care units to reduce methicillin-resistant *Staphylococcus aureus*-related morbidity, mortality, and costs: a systematic review. *Clin Infect Dis* 2008; 46: 1717-25.
11. Schlesinger Y, Yahalom S, Raveh D, et al. Methicillin-resistant *Staphylococcus aureus* nasal colonization in children in Jerusalem: community vs. chronic care institutions. *IMAJ Isr Med Assoc J* 2003; 5: 847-51.
12. Chazan B, Raz R, Teitler N, Nitzan O, Edelstein H, Colodner R. Epidemiology and susceptibility to antimicrobials in community, hospital and long-term care facility bacteremia in northern Israel: a 6 year surveillance. *IMAJ Isr Med Assoc J* 2009; 11: 592-7.
13. Shitrit P, Gottesman BS, Katzir M, Kilman A, Ben-Nissan Y, Chowers M. Active surveillance for methicillin-resistant *Staphylococcus aureus* (MRSA) decreases the incidence of MRSA bacteremia. *Infect Control Hosp Epidemiol* 2006; 27: 1004-8.
14. Chowers MY, Paitan Y, Gottesman BS, Gerber B, Ben-Nissan Y, Shitrit P. Hospital-wide methicillin-resistant *Staphylococcus aureus* control program: A 5-year follow-up. *Infect Control Hosp Epidemiol* 2009; 30: 778-81.
15. Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings: recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *Infect Control Hosp Epidemiol* 2002; 23: S3-40.
16. World Health Organization. World Alliance for Patient Safety: Manual for Observers. WHO: Geneva, 2006.
17. Capriotti T. Preventing nosocomial spread of MRSA is in your hands. *Medsurg Nurs* 2003; 12: 193-6.
18. Abba M, Raja NS, Pillay DG. Compliance with MRSA hospital control guidelines in a district general hospital. *Infect Dis J* 2006; 15: 3-5.
19. Robicsek A, Beaumont JL, Paule SM, et al. Universal surveillance for methicillin-resistant *Staphylococcus aureus* in 3 affiliated hospitals. *Ann Intern Med* 2008; 148: 409-18.
20. Pan A, Carnevale G, Catenazzi P, et al. Trends in methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infections: effect of the MRSA "search and isolate" strategy in a hospital in Italy with hyperendemic MRSA. *Infect Control Hosp Epidemiol* 2005; 26: 127-33.
21. Huang SS, Yokoe DS, Hinrichsen VL, et al. Impact of routine intensive care unit surveillance cultures and resultant barrier precautions on hospital-wide methicillin-resistant *Staphylococcus aureus* bacteremia. *Clin Infect Dis* 2006; 43: 971-8.
22. Cooper BS, Stone SP, Kibbler CC, et al. Systematic review of isolation policies in the hospital management of methicillin-resistant *Staphylococcus aureus*: a review of the literature with epidemiological and economic modelling. *Health Technol Assess* 2003; 7: 1-194.
23. Edmond MB, Ober JF, Bearman G. Active surveillance cultures are not required to control MRSA infections in the critical care setting. *Am J Infect Control* 2008; 36: 461-3.
24. Harrington G, Watson K, Bailey M, et al. Reduction in hospitalwide incidence of infection or colonization with methicillin-resistant *Staphylococcus aureus* with use of antimicrobial hand-hygiene gel and statistical process control charts. *Infect Control Hosp Epidemiol* 2007; 28: 837-44.
25. Johnson PD, Martin R, Burrell LJ, et al. Efficacy of an alcohol/chlorhexidine hand hygiene program in a hospital with high rates of nosocomial methicillin-resistant *Staphylococcus aureus* (MRSA) infection. *Med J Aust* 2005; 183: 509-14.