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Estimation of methicillin-resistant *Staphylococcus aureus* transmission by considering colonization pressure at the time of hospital admission

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Summary Our objective was to evaluate the accuracy of a methicillin-resistant *Staphylococcus aureus* (MRSA) rate using the imported MRSA reservoir identified at the time of hospital admission. Two indicators were used: the number of imported MRSA patient-days/total number of patient-days [representing colonization pressure (CP) at the time of admission] and the incidence of hospital-acquired MRSA isolated from clinical samples expressed as density/100 patient-days for carriers identified at the time of admission [representing the incidence taking CP into account (ICP)]. The variations of these indicators were analysed and compared with two more common indicators: percentage of MRSA acquired in our hospital and the incidence of hospital-acquired MRSA isolated from clinical samples expressed as density/1000 patient-days within three four-month periods during 2002. Common indicators varied similarly, with marked decline during the third period; first-period CP was twice that of other periods ($P < 10^{-6}$) and the highest (>two-fold) ICP was seen in the summer (second) period ($P < 0.001$) when the personnel/patient ratio was the lowest. Thus, comparison of different indicators within four-month periods underlines important differences between common and novel indicators. Despite several limitations, ICP should be helpful in the interpretation of MRSA surveillance data, particularly for estimating the extent of MRSA transmission.

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Introduction

Hospital-acquired methicillin-resistant *Staphylococcus aureus* (MRSA) has been an increasing problem worldwide since the initial reports 35 years ago.[1] Colonized and infected patients are the major institutional reservoir, and transient carriage on the hands of hospital personnel is the most common mechanism of patient-to-patient transmission.[2]

MRSA surveillance in hospitals is universally recommended.[3,4] To assess colonization and infection rates over time or to compare them with those of other hospitals, infection control personnel must use rates adjusted for the major risk factors.[5–7] For MRSA, infection and/or colonization rates more accurately reflect the risk of acquisition when they are adjusted for the length of stay. Therefore, the most common indicator is the number of MRSA cases/1000 patient-days. To estimate MRSA transmission in a hospital or a ward, only cases of MRSA acquired in the setting are considered. However, this value does not take into account the duration of exposure to the imported MRSA reservoir (length of stay of patients infected or colonized at the time of admission). This has been identified as an independent risk factor of MRSA acquisition in a recent study conducted in a French intensive care unit (ICU).[8]

Our objective was to evaluate the usefulness of an indicator taking the imported MRSA reservoir into account.

Methods

Data were collected from January to December 2002, in a 600-bed public teaching hospital that provides a comprehensive range of departments including two ICUs, two surgical wards, a maternity unit, a psychiatric ward, a paediatric department, two internal medicine wards and a 120-bed long-term care facility for the elderly. Any patient admitted to an acute ward was included in the study (the long-term care facility was excluded). An MRSA carrier was defined as a patient from whom MRSA was detected in any clinical or screening specimen, submitted to the microbiology laboratory.

An MRSA containment programme has been implemented for several years in our hospital. Senior nurses are informed of new cases of MRSA on the day that the laboratory issues the results and they are asked to implement routine control measures. Contact precautions, similar to Centers for Disease Control and Prevention guidelines for contact isolation, are recommended for both infected or colonized patients. MRSA carriers are identified during their hospitalization with a 'wash your hands' sign in their room or placed on the patients' medical chart. In addition, selective screening samples (nasal, skin and rectal swabs) are obtained at admission from patients with identified risk factors (history of MRSA carriage or hospitalization within the previous six months, transfer from other hospital wards, chronic skin lesions).[9] Moreover, we started an automatic alert system in 1998 to identify re-admitted patients with a history of MRSA colonization or infection from a previous hospital stay. These patients are screened systematically within the first 48 h of hospitalization. It was not possible to state how effective this screening programme is, because the percentage of the target population actually screened was not available.

Screening samples were streaked on mannitol salt agar (Chapman medium, bioMérieux, Marcy-l'Etoile, France) containing an ofloxacin (10 μg) disk and incubated for 48 h at 30 °C. Plates were examined for staphylococci after 24 and 48 h. Colonies recovered around ofloxacin were tested for coagulase. Any coagulase-positive isolate was tested for susceptibility to antimicrobial agents by the disk diffusion method in Mueller–Hinton agar according to recommendations from the Antibiogram Committee of the French Society for Microbiology.[10] Methicillin resistance was confirmed at 30 °C with an oxacillin disk and a cefoxitin disk (30 μg) used to improve the sensitivity of methicillin-resistance detection.[11]

MRSA isolates were considered to be imported when they were recovered from any clinical or screening sample obtained within the first two days following admission. Otherwise, MRSA isolates from clinical samples were considered to be acquired in our hospital. Duplicate isolates from the same patient were excluded.

Different indicators were used to follow the evolution of MRSA transmission in four-month periods. These included two common and two novel parameters. Common indicators were the percentage of MRSA acquired in our hospital and the incidence of acquired-MRSA isolated in clinical specimens expressed as the density/1000 patient-days. Novel indicators were the number of patient-days for those colonized with MRSA at admission/total patient-days for all patients admitted, representing colonization pressure (CP); and the incidence of acquired MRSA expressed as density/100 patient-days for carriers identified at admission corresponding to the incidence taking colonization pressure (ICP) into account.