

Prevention and control of methicillin-resistant *Staphylococcus aureus*

H. Humphreys¹, H. Grundmann², R. Skov³, J.-C. Lucet⁴ and R. Cauda⁵

1) Department of Clinical Microbiology, Royal College of Surgeons in Ireland and Beaumont Hospital, Dublin, Ireland, 2) Laboratory for Infectious Diseases and Surveillance, Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands, 3) National Centre for Antimicrobials and Infection Control, Statens Seruminstitut, Copenhagen, Denmark, 4) Infection Control Unit, Bichat-Claude Bernard Teaching Hospital, Paris, France and 5) Department of Infectious Diseases, Catholic University, Rome, Italy

Abstract

Recent efforts to combat infections have focused on pharmaceutical interventions. However, the global spread of antimicrobial resistance calls for the reappraisal of personal and institutional hygiene. Hygiene embodies behavioural and procedural rules that prevent bacterial transmission. Consequently, the chance of spreading bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) is significantly reduced. Hygiene is part of the primacy and totality of patient care, ensuring that no harm is done. Any prevention and control strategy must be underpinned by changes in attitude, embraced by all. The major components of preventing and controlling MRSA include hand and environmental hygiene (as part of standard precautions), patient isolation, and patient/staff decolonization. Improving hand hygiene practice is especially important where the risk of infection is highest, e.g. in intensive care. Physical isolation has two advantages: the physical barrier interrupts transmission, and this barrier emphasizes that precautions are required. With limited isolation facilities, risk assessment should be conducted to indicate which patients should be isolated. Environmental hygiene, although important, has a lower priority than standard precautions. When a patient is ready for discharge (home) or transfer (to another healthcare facility), the overall interests of the patient should take priority. All patients should be informed of their MRSA-positive status as soon as possible. Because of increased mupirocin resistance, a selective approach to decolonization should be taken. When MRSA-positive staff are identified, restricting their professional activity will depend on the nature of their work. Finally, politicians and others need to commit to providing the necessary resources to maximize MRSA prevention and control.

Keywords: Decolonization, disinfection/cleaning, hand hygiene, isolation/cohorting, MRSA, patient transfer/discharge, review

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Corresponding author and reprint requests: H. Humphreys, Department of Clinical Microbiology, Education and Research Centre, Beaumont Hospital, PO Box 9063, Dublin 9, Ireland
E-mail: h Humphreys@rcsi.ie

Introduction

In addressing the challenge to modern societies imposed by infections, too much attention has been focused for the past half-century on the elimination of the disease-causing pathogen, e.g. *Staphylococcus aureus*, and too little on the factors involved in transmission leading to infection in a new host, despite the explanatory power of the germ theory and Koch's postulates, recently re-evaluated, in understanding the aetiology and epidemiology of infections [1]. This emphasis on treatment has led to an over-reliance on antimicrobial chemotherapy, with the consequent emergence of antimicrobial resistance.

In the face of increasing resistance and new threats such as community-acquired methicillin-resistant *S. aureus* (CA-MRSA) [2,3], there is a need to re-emphasize the role of personal and institutional hygiene and of well-known methods for preventing bacterial transmission within an individual, among family and household members, within the community, and within hospitals and other institutions. Contributory factors, such as underlying disease or recent major surgery, are important because they serve to highlight the patients who are at particular risk.

What follows is a consensus statement derived from practitioners in the field with considerable experience in the prevention and control of healthcare-associated infection (HCAI), including MRSA.

Underlying Principles of Prevention and Control

When drafting recommendations for preventing and controlling infection, in acute-care hospitals or elsewhere, important principles govern the primacy and totality of patient care. These ensure that well-intended infection prevention and control measures do not compromise other important aspects of patient care. They include:

- 1 Ensurance that infection prevention and control measures do not harm the patient.
- 2 Adherence to high standards of professionalism, including basic personal hygiene on the part of all healthcare workers (HCWs).
- 3 Agreement on professional dress codes.
- 4 Compliance with a minimum standard of hospital cleanliness, i.e. visible cleanliness (absence of dirt and soilage) that is acceptable to patients, staff and visitors [4].

Measures to minimize and prevent MRSA must not be adopted at the expense of other aspects of patient care, as patients with infections due to MRSA have the same rights to the highest standards of care as all other patients. This means that the necessary resources, both physical and with respect to personnel, to care for patients with MRSA must be provided.

Patient-to-patient contact, primarily via the hands of HCWs, is thought to be the primary route of transmission of MRSA. Contact transmission includes direct and indirect contact. Preventive strategies are therefore directed at interrupting the chain of transmission. MRSA carriers repeatedly contaminate their hands by touching colonized body parts, e.g. the nose, especially in cases of unknown asymptomatic carriage, and the capacity of *S. aureus* to survive for months in a dry, often relatively hostile, environment contributes to environmental reservoirs of MRSA, e.g. door handles and beds. The principles behind the prevention and control of HCAI have been known for some time, and are incorporated into many national MRSA guidelines [5], but it has repeatedly proven difficult to apply them. Therefore, although there are specific interventions that are recognized as being important, e.g. hand hygiene, any strategy that includes a number of specific interventions must be supported by major changes in attitude. This behavioural change must be embraced by all concerned in the organization, i.e. healthcare executives as well as the HCWs delivering services.

The prevention and control of MRSA and all HCAIs must be a priority of government agencies and healthcare executives with responsibility for the delivery of healthcare. Good professional practice, e.g. hand hygiene and the use of

protective clothing, must be undertaken by all HCWs, and they in turn must be empowered to change practice where this is suboptimal. Leadership is necessary to drive this change and to ensure the implementation of good practices. Continuous education is a key component in achieving this.

It is important to re-emphasize the importance of hygiene in hospitals and all healthcare premises. With advances in many areas of healthcare and the widespread use of antibiotics for 50 years and more, the importance of personal hygiene, on the part of both patients and healthcare professionals, as well as of environmental hygiene is increasingly less recognized. High standards of hygiene are important not just for acute healthcare facilities, including outpatient clinics, but also for long-term-care facilities such as nursing homes, and for home-based care.

Prevention and Control Measures

Hand hygiene

Hands are the vehicles for a plethora of functions in daily clinical care, including:

- 1 Interaction with the inanimate physical environment, e.g. opening doors.
- 2 Personal interaction, e.g. shaking hands, and comforting patients or relatives.
- 3 Diagnostic procedures, e.g. palpation and percussion.
- 4 Administration of food and medicines.
- 5 Placement and manipulation of indwelling (percutaneous) devices, e.g. catheters.
- 6 Washing, cleaning, etc.

There are many customs, habits, beliefs and attitudes that result in different behaviours, and that influence our knowledge about the role of hands in medical care and our understanding of hands as the most important vectors for the transmission of pathogens. There are also many reasons why compliance with hand hygiene recommendations differs largely among cultures, professional groups, social strata, and genders [6]. There is also a need to fully embrace and adopt international guidelines such as the WHO first global patient safety challenge [7] and to provide support as needed for full implementation of the guidelines.

We believe that hand hygiene is a global standard of care for patients in all healthcare settings, in both resource-adequate and resource-constrained environments. This has clear benefits for all, not least the reduction in the possibilities of the international transfer of MRSA.

Priorities for improving compliance with hand hygiene include areas where the risk of infection is highest, e.g. specialist care units such as intensive-care units and burn units.

Success in these settings will serve as an example for improving practice in other clinical areas.

Hand hygiene, an integral component of standard precautions (SPs), underpins infection prevention and control in all clinical areas. Leadership is required to ensure that all health-care workers are familiar with the components of SPs and that compliance is maximized. Quality indicators for the assessment of everyday processes should be agreed upon, on the basis of national and local standards, and audited on a regular basis.

Isolation/cohorting

The physical isolation of a patient with infection due to MRSA, either in a single room or as part of a cohort unit, has two advantages: (i) the physical barrier between an MRSA-positive patient and other patients helps to interrupt transmission; and (ii) the psychological message that this barrier gives to HCWs by highlighting the necessary precautions. Ideally, all MRSA patients should be isolated, but this may not be possible, depending upon the prevalence of MRSA locally and nationally. For example, in units where MRSA represents less than 5% of all *S. aureus* isolates, there may be sufficient single rooms available, but in countries where over 25% of *S. aureus* isolates are methicillin-resistant, the requirement of single rooms for other reasons may preclude this, as may the sheer absolute numbers of MRSA patients needing isolation. Recent mathematical modelling strongly suggests that in both endemic and epidemic settings of MRSA, it is possible to significantly reduce MRSA rates, and that this is cost-effective even when the cost of the enhanced diagnostic and control measures is taken into account [8].

Where there is limited isolation capacity, risk assessment should be conducted to determine which patients should be isolated, based upon the likelihood of transmission. Patients with, for example, underlying skin diseases such as eczema, who are more likely to shed large numbers of MRSA organisms, must be given priority. Other considerations include the possible impact of MRSA spread to vulnerable patients, e.g. orthopaedic patients, who are particularly vulnerable to chronic debilitating infections due to MRSA. Where a patient with MRSA is isolated or cohorted, it is preferable to have separate HCWs, especially nursing staff, caring for the patient in isolation, in order to minimize transmission.

Environmental decontamination

The environment has been documented as being a source of MRSA or as being involved in transmission, but it is not clear how important this is relative to other factors [9], e.g. suboptimal compliance with hand hygiene. A clean environment is particularly important in the case of surfaces that are frequently

touched, e.g. monitors and keyboards, by which HCWs may transmit MRSA to patients via their hands. Although environmental hygiene has a lower priority in prevention and control than do SPs and hand hygiene, cleanliness and general environmental hygiene are important, and failure in this sphere may demotivate HCWs and detract from patient care.

Official documents pertaining to building standards (at the national, regional and local levels) should embrace hygiene as a priority. Recommendations for optimal facilities, e.g. the physical and environmental parameters outlined in the guidelines concerning intensive-care unit design issued by the European Society of Intensive Care Medicine [10], should be adopted, especially when units are being built, upgraded, or refurbished. Furthermore, each ward or clinical area should be capable of isolating/cohorting MRSA-colonized or MRSA-infected patients. Moving patients from one ward to another for isolation/cohorting may compromise overall care for the patients by depriving them of specialized care or facilities. Also, unnecessary patient movement facilitates the spread of MRSA within an institution.

The intensity of measures necessary to achieve environmental decontamination depends on the circumstances, the level of environmental contamination, and the risk to patients, and perhaps a standard requiring more than merely visual cleanliness may have a greater impact on MRSA transmission [11]. In many circumstances, warm water and simple detergent, when applied appropriately, are adequate to significantly reduce the burden of MRSA in the environment. The additional use of disinfectants contributes to efforts to eradicate MRSA, but the use of disinfectants must be governed by risk and circumstances.

Patient discharges/transfers

When a patient is ready for discharge (home) or transfer (another hospital or healthcare facility), the overall interests of the patient should take priority. The discharge (home) of MRSA-infected patients, when clinically appropriate, will reduce the risk of transmission to other patients that might occur in the hospital.

All patients (and/or their relatives, as appropriate) should be informed as soon as possible of their MRSA-positive status. In addition, those institutions to which a patient is being transferred, e.g. another hospital or a long-term-care facility, must be informed of a patient's MRSA-positive status. Patients and their relatives should also be educated about the significance of MRSA, its possible consequences for the particular patient, its mode of transmission, and how to reduce the risk of transmission.

Because MRSA colonization may be prolonged, i.e. over 12 months, it is important to include all partners concerned

with the delivery of healthcare (i.e. hospitals, long-term-care facilities (public and private nursing homes), general practitioners, tissue viability clinics etc.) in a coordinated approach. The importance of district (regional) infection control teams harmonizing approaches and addressing the respective needs of the institutions serving the same catchment population should therefore be emphasized. For example, agreement may be possible on minimizing the inter-institution transfer of patients with MRSA, to reduce the possibilities of transmission, while safeguarding the right of the individual patient to whatever care he or she requires. Transparency and clear communication processes are critical once patients with MRSA have been discharged or transferred to another institution. The inclusion of general practitioners is essential, as they can advise on personal hygiene (e.g. the exchange or sharing of fomites such as towels and clothing), including sports-related and sexual hygiene, which is potentially important in true CA-MRSA transmission.

MRSA Decolonization of Patients and HCWs

Patients

The literature available on the effectiveness of eradication of MRSA, which depends on the setting and the number of patients studied, is often somewhat confusing [12]. The experience from Denmark and from other countries with low MRSA prevalence rates shows that decolonization can be successful in the long term, especially when a holistic approach, including the treatment of the patient's family, is taken. This must also be accompanied by environmental cleaning. There is an urgent need for randomized studies in settings with different prevalence rates of MRSA, to determine whether decolonization truly diminishes the transmission of MRSA, and if so, where and when. There is also a need for the development of, and trials in, alternative regimens for decolonization.

Because of the increasing emergence of mupirocin resistance, especially after repeated courses of mupirocin treatment [13] when MRSA-colonized patients are identified, a selective approach to decolonization with mupirocin, taking risk factors into consideration, should be taken, rather than the automatic use of this agent for all patients. Patients due for surgery, particularly surgery involving an implantable device such as an artificial hip, should be decolonized before surgery; the same holds for liver and stem cell transplant recipients, who are at risk of poor outcome from invasive MRSA infection. Other patients, for whom the risk of infection is lower and the consequences are less severe, should be decolonized according to a risk assessment. However, all MRSA-positive patients can undergo chlorhexidine baths.

There are several principles that should influence when patient decolonization is attempted:

- 1 Decolonization should not be attempted as long as there is active MRSA infection.
- 2 Patients with foreign bodies (devices) or patients with underlying skin conditions, which will reduce the possibility of successful decolonization, should preferably await the removal of the foreign body (device) or the treatment of the skin condition before MRSA decolonization regimens are started.
- 3 Topical treatments (e.g. with mupirocin for nasal carriage) should be used first, before recourse to the use of systemic antibiotics.
- 4 The decolonization of patients with CA-MRSA must be accompanied by environmental cleaning [3], and consideration should be given to decolonizing other MRSA-positive members of a household.

HCWs

There are differences among countries in the approach to the screening of HCWs for MRSA, which may be followed by decolonization and, in some cases, re-location to work with a lower risk of transmission. In low-endemicity countries such as The Netherlands and Denmark, this is an important component of eradication. In countries where MRSA is endemic, HCW screening is less frequently used. Therefore, due consideration needs to be given to the role that staff screening may play, depending on the local prevalence, and the impact that the identification of MRSA-positive HCWs may have on control. Staff identified as MRSA-positive should be offered decolonization, with, for example, chlorhexidine baths or mupirocin treatment, to prevent MRSA transmission to patients and their relatives. Where necessary, assistance should be sought from dermatologists, occupational health workers, and other professional groups.

Restriction of the professional activity of MRSA-positive staff will be dependent on the general situation in the institution and upon the nature of their work. Greater restrictions will apply in clinical areas where the consequences of MRSA acquisition are greatest for patients, e.g. in intensive-care units.

Unaddressed Issues

- 1 All prevention and control measures are dependent upon the early identification of MRSA-positive patients, whether colonized or infected. Therefore, screening policies and the choice of the sites optimal for screening play a key role in the identification of MRSA-positive patients and in the application of control measures [14].

2 The appropriate and sensible use of antibiotics, i.e. antibiotic stewardship, is of importance if the chances of MRSA emergence and spread are to be reduced. Antibiotic stewardship has been comprehensively addressed elsewhere, e.g. by study groups of the European Society of Clinical Microbiology and Infectious Diseases [15], and the scientific basis for the use of antibiotics (which may or may not be appropriate), which contributes to the emergence and spread of MRSA, has been exhaustively reviewed recently [16].

Conclusions

Success in preventing and controlling MRSA is dependent on the appropriate attitude and high standards of professionalism among all who deliver healthcare, as well as on strong leadership and appropriate governance to highlight the importance of all HCAs and MRSA infections. Standard precautions, especially hand hygiene, together with isolation/cohorting, education and patient decolonization in selected circumstances, are key components of MRSA prevention and control measures.

Every reasonable measure should be taken to maximize efforts to prevent and control MRSA, but HCWs are reminded of the maxim 'first do no harm'. The overall welfare and safety of the patient is of paramount importance, and measures undertaken to control MRSA should not compromise the safety and quality of patient care. Therefore, politicians, administrators and national bodies need to commit to providing the necessary human resources (e.g. nursing staff and appropriate experts) and physical resources (e.g. adequate numbers of isolation rooms) to optimize efforts to prevent and control MRSA.

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