A Strategy for the Control of
Antimicrobial Resistance in Ireland

SARI

The Control and Prevention of MRSA in Hospitals and in the Community

SARI Infection Control Subcommittee

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The Infection Control Subcommittee has produced these guidelines as part of its remit under the Strategy for the Control of Antimicrobial Resistance in Ireland (SARI). The membership of the Subcommittee is:

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Dr Mary Crowe, representing the Irish Society of Clinical Microbiologists.

Dr Robert Cunney, representing the Health Protection Surveillance Centre (formerly the National Disease Surveillance Centre), **Honorary Secretary**.

Ms Eleanor Devitt, representing the Infection Control Nurses Association

Ms Mary Durcan, representing Bord Áltranais.

Ms Patricia Garry, representing the Institute of Community Health Nursing.

Dr Blánaid Hayes, representing the Faculty of Occupational Medicine, Royal College of Physicians of Ireland.

Professor Hilary Humphreys, representing the Faculty of Pathology, Royal College of Physicians of Ireland, **Chairman**.

Dr Máire O'Connor, representing the Faculty of Public Health Medicine, Royal College of Physicians of Ireland.

A draft version of this document was circulated for consultation to a wide range of professional and other bodies. Thirty-seven written or electronic submissions were received in response to the consultation request, many of which were very comprehensive in their review of the draft document, and these were considered in the preparation of the final draft of the guidelines. The Subcommittee would like to thank all of those who took the time to respond to the consultation request. A list of organisations, infection control teams and individuals who submitted comments is included in Appendix 4.

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Foreword

This document represents the expert opinion of the SARI Infection Control Subcommittee, following a review of the scientific literature and an extensive consultation exercise. Responsibility for the implementation of these guidelines rests with individuals, hospital executives and, ultimately, the Health Services Executive. Whilst we accept that some aspects of the recommendations may be difficult to implement initially due to a lack of facilities or insufficient personnel, we strongly believe that these guidelines represent best practice. Where there are difficulties, these should be highlighted locally and elsewhere so that measures are taken to ensure implementation.   We have endeavoured to ensure that the recommendations are as up-to-date as possible, however we acknowledge that new evidence may emerge that may overtake some of these recommendations.   Consequently, the Subcommittee undertakes to review and revise as and when appropriate, and to review the recommendations at a minimum of three years from the publication date.

Executive Summary

Background

- Methicillin resistant *Staphylococcus aureus* (MRSA) is widespread in many Irish hospitals and is increasingly seen in community health care units such as nursing homes. The impact of MRSA is considerable; in Ireland approximately 40-50% of isolates of *Staphylococcus aureus* recovered from bloodstream infections are methicillin resistant, and this is significantly higher than in some European countries such as the Netherlands and the Scandinavian countries (data from the European Antimicrobial Resistance Surveillance System (EARSS)).

- Measures to control the emergence and spread of MRSA are justified because there are fewer options available for the treatment of MRSA infections and because these strains spread amongst vulnerable at-risk patients. Patients with MRSA bloodstream infection are twice as likely to die from their infection, compared to patients with bloodstream infection caused by methicillin-sensitive *S. aureus*. Furthermore, isolates with reduced susceptibility or isolates that are completely resistant to glycopeptide antibiotics have been described in other countries such as the USA and France, and will probably appear in Ireland eventually.

- The prudent use of antibiotics underpins any approach to the control of antibiotic resistant bacteria, including MRSA. This, together with good professional practice and routine infection control precautions, such as hand hygiene, constitute the major measures in controlling and preventing healthcare-associated infection, including that caused by MRSA, both in hospital and in community health care units.

- The Infection Control Subcommittee of the Strategy for the Control of Antimicrobial Resistance in Ireland (SARI) has reviewed the literature and revised the 1995 Irish guidelines. The Subcommittee has utilised guidelines produced in other countries, including the United Kingdom, the United States of America, New Zealand and the Netherlands. In drafting a set of recommendations for Ireland, the Subcommittee has graded these in accordance with the strength of evidence.

- The Subcommittee acknowledges that many Irish healthcare facilities will have difficulties implementing all of the recommendations included in this guideline document, due to inadequate infection control resources. Where this is so, this should be communicated to senior management and these guidelines should be used as a basis for the provision of appropriate resources.

*Main Recommendations

- Hand hygiene before and after each patient contact is essential. Grade A Recommendation

  Grade A Recommendation

- The physical environment of any health care institution must be clean and the Chief Executive Officer must take corporate responsibility for this.

  Grade D Recommendation

- Every hospital and health-care institution must take steps to prevent patient overcrowding and ensure adequate space between adjacent beds.

  Grade B Recommendation

• Hospitals should have a sufficient number of isolation rooms to assist in the control of infection, including MRSA, in addition to single rooms required for other purposes. Hospitals should also provide appropriate hand hygiene and bathroom facilities to facilitate infection control and phase out large multi-bedded wards wherever possible.	Grade D Recommendation
• Healtcare facilities should ensure that patients who are found to carry MRSA are informed of this and provided with appropriate information. Information leaflets on MRSA should also be available for all patients, carers and family members, as well as visitors to the healthcare facility.	Grade D Recommendation
• Patients with MRSA in high-risk units, e.g. intensive care units must be isolated. Patients with MRSA in other units should be isolated wherever possible.	Grade B Recommendation
• Health care institutions should institute antibiotic stewardship programmes in line with the recommendations of the SARI Hospital Antibiotic Stewardship Subcommittee, and in particular, limit the use of broad-spectrum antibiotics.	Grade B Recommendation
• Early detection of MRSA through surveillance is fundamental to preventing spread. Patients who should be screened for MRSA include those known previously to be positive and who are re-admitted to hospital, patients admitted from a hospital or health-care facilities known or suspected to have MRSA, and patients during an outbreak as determined by the infection control team. Other patients may be included in routine screening, as deemed appropriate by the local infection control team.	Grade C Recommendation
• Although staff may carry MRSA, such carriage is often transient and is not believed to contribute significantly to the spread of MRSA. Therefore the screening of staff on a routine basis is generally not indicated. Staff screening may be considered for institutions without endemic MRSA, or for specific high-risk units, as determined by the local infection control team.	Grade C Recommendation
• Patients colonised with MRSA who meet any of the following criteria should undergo nasal and general body decolonisation: • Patients due to undergo an elective operative procedure • Patients who have a prosthesis *in-situ* • Patients who are in a clinical area where there is a high risk of colonisation leading to invasive infection, e.g. intensive care unit.	Grade C Recommendation
• All laboratories should ensure that MRSA isolates that are non susceptible or are fully resistant to vancomycin are detected rapidly and that this is communicated to infection control teams and the relevant authorities.	Grade D Recommendation
• There must be good communications between hospitals discharging patients with MRSA and carers or family members, general practitioners, community nurses and community units to minimise spread.	Grade D Recommendation

- As there is little risk of transmitting MRSA to healthy members of the community and there is minimal risk of them becoming infected, eradication of MRSA carriage in the community is generally not required.

  Grade D
  Recommendation

- There is no indication for routine screening before hospital discharge to home or to a community unit. Patient isolation is usually not required in community units.

  Grade C
  Recommendation

- MRSA carriage must not be a reason for exclusion of patients from rehabilitation or discharge to a community unit.

  Grade C
  Recommendation

- MRSA control measures should be incorporated into an institution-wide strategy for the control and prevention of infection.

  Grade D
  Recommendation

* The grade of recommendation, i.e. A, B, C & D indicates the strength of the scientific evidence with Grade A having the strongest scientific basis (see section A.12 for details).

The Future
- Improvements in controlling MRSA are possible. However current resources (specialist personnel, hospital facilities, etc) in Ireland are inadequate to achieve this.

- Studies on the usefulness and cost effectiveness of new approaches to detection are required, as well as an assessment of the financial impact in Ireland of MRSA on hospitals, community units, and on patients themselves.

A Background and justification for guidelines

A.1 Introduction

MRSA stands for methicillin-resistant *Staphylococcus aureus*. *Staphylococcus aureus* is a bacterium that can reside on the skin or can be found in the nose of about one third of healthy individuals. It is generally non-pathogenic except where it gains access to deep tissues such as broken skin, resulting in surgical site or wound infection, the bloodstream leading to bloodstream infection or bacteraemia, and to the lungs causing for example ventilator-associated pneumonia. Early penicillin antibiotics such as flucloxacillin were effective in the treatment of infections caused by *Staphylococcus aureus* but since the late 1960s many strains have become resistant, but as methicillin was amongst the first anti-staphylococcal agents used, these strains have subsequently been known as MRSA. The prevention and control of MRSA is a challenge in hospitals and in the community throughout the world.

MRSA has been prevalent in many Irish hospitals since the early 1970s. Considerable work was undertaken on the epidemiology and clinical importance of MRSA, which has significantly contributed to the world literature.(1-4) At that time, most MRSA isolates were recovered from burns, surgical wounds and traumatic skin lesions, and invasive infection such as bloodstream infection, deep wound sepsis and osteomyelitis, was rarely seen during that early period.(2) However, the importance of MRSA and its contribution to hospital-acquired infection was not widely acknowledged at the time, despite the efforts of those involved in describing their clinical experiences and in undertaking significant laboratory research. Nonetheless, our knowledge of MRSA, and in particular its contribution to hospital morbidity and mortality, owes much to this seminal body of work and to others.

A.2 Why control MRSA?

The objective of control measures should be to improve patient care, minimise patient mortality and morbidity, and to help contain healthcare costs. In hospitals where MRSA is endemic, the objective is to minimise spread and in particular to avoid as far as possible the clinical impact of systemic or deep infection in high-risk patients such as those in the intensive care unit (ICU) or other key clinical areas. Harbarth and colleagues argue that the number of patients with MRSA bacteraemia correlates with the hospital-wide prevalence of MRSA and that control measures have a substantial impact on both the reservoir of MRSA patients and the attack rate of MRSA bacteraemia or bloodstream infection.(5)

In a French study assessing the efficacy of a control programme during the mid 1990s, the rate of MRSA infection decreased from 5.9 to 0.8/1,000 patient-days as did the prevalence of MRSA carriage and the ratio of MRSA to all *Staphylococcus aureus*.(6) In a Spanish study, three time periods were studied, i.e. pre-outbreak, during an outbreak of MRSA, and when a control programme was instituted; the authors estimated that the programme prevented 76% of expected MRSA cases and 85% of expected fatalities due to MRSA in the ICU. (7) The experience in Finland, where two successive MRSA outbreaks in the early 1990s were successfully managed and where there is now no endemic MRSA, suggests that it is possible in the non-endemic situation to control the spread of MRSA and eradicate it. (8) MRSA control measures may have additional advantages to those of just controlling MRSA as they accentuate the awareness of the importance of hospital-acquired infection and assist in the containment of other multiple-antibiotic resistant bacteria. (9) Efforts should be made to eradicate MRSA when it does arise in centres or units where it has not been previously. Consequently, specific measures to control MRSA as part of an overall strategy of hospital infection prevention will help reduce the number of patients likely to acquire both MRSA and also strains resistant to vancomycin (see below).

A.3 Epidemiology of MRSA in hospitals in Ireland

The most up to date comprehensive epidemiology of MRSA in Ireland comes from the North/South Study of MRSA conducted in 1999. (10-14) During a two-week period, 508 cases were identified in the South and MRSA was reported in every Health Board region. (11) The majority of cases were attending acute hospitals but 62% of patients were colonised only.(11) However, a related assessment of bacteraemia occurring during 1998 revealed higher MRSA bacteraemia rates in the South compared with the North (7.6 per 100,000 population per year *versus* 4.5 per 100,000) and 36% of isolates of *Staphylococcus aureus*

bacteraemia in the South were methicillin resistant.(14) In the intervening years, the proportion of bloodstream isolates of *Staphylococcus aureus* that are methicillin-resistant has increased to 40-50% as documented by the data collected through the European Antimicrobial Resistance Surveillance System (EARSS).(15)   Further analysis of isolates in the 1999 Study revealed that most isolates were non-typable using phage typing, but 68% of isolates revealed a pattern of antimicrobial resistance susceptibility typing that was already familiar to us.(12)   In addition, however, the 1999 North/South study revealed significant discrepancies in the provision of facilities for the control of MRSA in hospitals(13) and hence it was decided to update and revise the guidelines previously produced by the Department of Health in 1995.(16)

A.4   MRSA in the community
MRSA detected in the community may be classified according to the following categories:
• Patients discharged from hospital with MRSA
• Nursing home residents with MRSA
• MRSA transmitted to non-hospitalised patients or individuals from MRSA patients
• MRSA arising *de novo* in community

A recent study identified 12% of MRSA isolates as being community-associated, and skin and soft tissue infections were more common among community-associated cases compared with those acquired in hospital or in healthcare associated institutions.(17) In a study carried out in the mid 1990s in Dublin, 8.6% of residents of six nursing home were positive for MRSA and 24% of environmental samples were also positive.(18)   Risk factors associated with MRSA amongst these patients included male sex, age greater than 80 years, resident in the nursing home for less than 6 months, hospitalisation during the previous 6 months, antibiotic therapy during the previous 3 months and poor mental test score.(19)   In the 1999 North/South study, 3.9% of cases were identified by general practitioners and/or midwives and 2.2% were in nursing homes.(10) However as we cannot be certain whether these patients had previously been in contact with hospitals and we don't know the screening policy of many of the participating hospitals, it is difficult to be certain whether these are health-care associated or true community-acquired MRSA.

The principles of control are similar for all four circumstances. Good infection control practices must be instituted for all patients, and not just for those known to be colonised or infected with MRSA. Patients with MRSA colonisation can be returned safely to their own homes or to residential accommodation, without significant risk to the community. Simple hygienic precautions usually suffice.

Good communications between hospitals discharging patients home with MRSA i.e. to the carers or family members, community nurses and General Practitioners (GPs), and between hospital and community hospitals or long-stay residential units, are essential in minimising spread. Likewise, the patient's MRSA status should be communicated to the receiving hospital or admitting doctor when the patient requires admission to hospital. However, MRSA carriage must not be a reason for exclusion of patients from rehabilitation or discharge to a community unit.

A.5   The clinical and financial impact of MRSA
The majority of patients who acquire MRSA are merely colonised and do not become ill or require antibiotic therapy. However, a significant proportion of patients may develop infection, including invasive infection, a small proportion of which can result in death. Among patients who had a staphylococcal infection listed as a cause of death the number of patients in whom infection with MRSA has been associated with death, as recorded on death certificates, has increased from 8% in 1993 to 44% in 1998 in England and Wales.(20)

Many historical or retrospective studies are difficult to assess because of deficiencies in data capture and because due allowance has not been made for inadequate initial antibiotic therapy. A meta-analysis was performed on studies published between 1980 and 2000. Only studies that included the numbers and mortality rates for patients with MRSA and methicillin-susceptible *Staphylococcus aureus* (MSSA) bacteraemia were included. When the results were pooled, MRSA bacteraemia was associated with a significantly higher mortality than MSSA bacteraemia (pooled odds ratio of 1.93).(21) In a prospective study

of patients with ventilator-associated pneumonia caused by MRSA or MSSA, the presence of bacteraemia and septic shock were more frequent in the MRSA group and mortality directly due to pneumonia was significantly higher amongst patients with MRSA infection.(22)

A variety of efforts have been made to document the increased costs associated with MRSA. However, separating the true cost of MRSA compared with the cost of MSSA is difficult. In a prospective case-control study in a US hospital, the median hospital stay attributable to primary nosocomial MSSA bacteraemia was four days compared with 12 days for MRSA and the overall cost was $9,661 and $27,083 respectively.(23) In a Canadian hospital the cost of isolation and management of colonised patients was $1,363 per admission, and extrapolating that throughout Canada the authors concluded that the costs associated with MRSA in Canada in hospitals were between $42 and $59 million annually.(24) A study of two tertiary neonatal units where efforts to control spread and prevent infections were different revealed costs from $48,617 to $68,637 in a hospital where control measure were relatively successful, but in another hospital, where efforts at control were less successful, the costs of care were $1.3m.(25)

A.6   Glycopeptide-resistant MRSA
The appearance of isolates of MRSA with either reduced susceptibility to glycopeptides, including vancomycin, (glycopeptide-intermediate *Staphylococcus aureus* or GISA) or isolates fully resistant to glycopeptides (GRSA), has caused considerable concern as it significantly reduces the options available for the therapy of systemic staphylococcal infections. Whilst there are many controversial issues regarding, the evolution of these bacteria, their genetics, mechanisms of resistance, and optimal methods of detection, it is generally acknowledged that they represent an additional challenge in the control of *Staphylococcus aureus* infections in addition to those posed by MRSA.(26-28) Increased cell wall thickness is one of the mechanisms of resistance amongst those isolates non-susceptible to vancomycin and the presence of the *van*A gene is the mechanism amongst isolates fully resistant to vancomycin, something which may have arisen from transfer of the gene from enterococci.(26) There is no universal agreement on specific evidence-based measures to control the spread of these isolates. Current recommendations from the USA and elsewhere highlight the importance of basing these on guidelines already available to control MRSA, while ensuring stricter enforcement and improved detection of carriers or contacts.(29, 30)

A.7   Role of antibiotic stewardship
De novo selection of methicillin resistance in previously sensitive strains of *Staphylococcus aureus* appears to be relatively rare. Rather, excessive antibiotic use appears to promote the spread of existing strains of MRSA through reduction in colonisation resistance in patients and by giving such resistant strains a survival advantage in the hospital environment.(30)

Under-dosing, multiple courses and excessive duration of antibiotic therapy and the over-use of broad-spectrum agents are major factors in the spread of antibiotic resistance in healthcare settings. Numerous antibiotic classes have been associated with MRSA colonisation and infection in different studies.(31-35) Exposure to broad spectrum antibiotics, particularly third generation cephalosporins and flouroquinolones, has been shown to be an independent risk factor for MRSA colonisation and infection in numerous studies.(34, 36-39) Antibiotic stewardship programmes have been shown to result in significant reductions in MRSA colonisation and infection rates.(40-42)

Colonisation or infection with glycopeptide-intermediate and glycopeptide-resistant *Staphylococcus aureus* (GISA and GRSA) is strongly associated with prolonged exposure to glycopeptides and prior colonisation or infection with MRSA.(43-45) Promotion of prudent glycopeptide use has been shown to reduce the prevalence of vancomycin-resistance enterococci (VRE) in intensive care units(46) and it follows that prudent glycopeptide use should also be promoted to prevent glycopeptide resistance in staphylococci.(47)

A.8   Infection control measures
Generally, the inanimate environment within healthcare facilities has not been directly associated with the transmission of microorganisms.(48-51) There is little direct evidence linking the environment with *Staphylococcus aureus* transmission, except in a burns unit, but the significance of the environment in

MRSA transmission remains controversial.(52) Dry conditions such as dust and environmental surfaces act as reservoirs for *Staphylococcus aureus* and MRSA, and Gram positive cocci generally, which transfer easily to hands when such surfaces are touched. Conversely, Gram positive cocci acquired on hands and/or gloves may be transferred to environmental surfaces and equipment when they come into contact with such surfaces, e.g. curtains, equipment, switches/buttons (ventilators, infusion pumps, feeding pumps, etc.), phones, computer keyboards, touch panel screens, door handles, light switches, bed tables, bed rails, mattresses and even pens.(48-51, 53;54)

Expert groups agree that the major focus on MRSA control is the prevention of hand transfer of MRSA. (16, 41, 55-57)This is achieved by performing hand hygiene directly before and after each and every physical contact with a patient or their immediate environment, before performing aseptic procedures, before the handling or manipulation of any invasive device including injection through venous catheters and when emptying drains or catheters. Also, hand hygiene is required before entering and upon leaving critical care units, isolation rooms, and open rooms used for cohorting of MRSA cases.

National recommendations on hand hygiene have been issued issued also as part of the Strategy for the Control of Antimicrobial Resistance in Ireland (SARI). These recommendations should be adopted by each healthcare institution for prevention of transmission of pathogenic organisms, including MRSA. A summary of the recommendations is included (Appendix 1). All senior medical, nursing, allied health professional and administrative personnel, whose staff have clinical involvement, must ensure that staff understand the importance of hand hygiene, are familiar with, and adhere to the national recommendations.

The use of protective clothing such as gloves is an important component of the control of healthcare-associated infection. Gloves are required when entering an isolation room or cohort area. They are also required if there is a likelihood of contact with body fluids or other contaminated material (e.g. dressings), as part of standard precautions. Gloves do not preclude the need for hand hygiene. It is extremely important to perform hand hygiene upon leaving the isolation room

The use of facemasks for the control of MRSA transmission is controversial.(52, 58) In Canada it is suggested that a facemask may be required if a patient with MRSA has a superimposed respiratory viral infection.(52) As there is no evidence linking MRSA nasal carriage in healthcare workers directly to MRSA transmission, a facemask is probably only necessary where the patient has a superimposed transmissible viral respiratory tract infection, i.e. respiratory precautions.

The value of wearing aprons and gowns to control the spread of MRSA is generally accepted.(52, 58, 59) There is evidence that nurses' uniforms can easily become contaminated in high risk areas such critical care units.(58) Many expert groups advise that staff clothing should be protected in isolation rooms, as clothing will have contact with the patient, environmental surfaces or item items within the patient's room, and protection will limit the transfer of micro-organisms to other patients from such a source.(41, 48, 52, 55, 57, 60) The protective apron/gown is removed before leaving the patient environment.(52;55) Long sleeved gowns are recommended for very close patient contact (e.g. lifting), prolonged patient contact or contact with patients with exfoliative skin conditions or extensive colonisation with MRSA.(55)

A.9   Isolation and cohorting of patients with MRSA

In theory standard precautions should prevent the transmission of MRSA from one patient to another, regardless of whether or not the index patient is nursed in a single room or in a multi-bed ward. In practice, this approach has generally been unsuccessful. Attempts to contain MRSA without isolation precautions is further complicated by highly transmissible MRSA strains, such as EMRSA-15 and EMRSA-16, and the fact that some colonised patients may be heavy dispersers of MRSA.

Every effort should be taken to minimise the transmission of MRSA, and other pathogens, even in the absence of specific isolation facilities. It seems plausible to suggest that under-staffing, combined with over-crowding results in greater pressure on healthcare staff and contributes to hospital-acquired infection, including MRSA. It is considered that cost-driven downsizing and changes in staffing patterns contribute

to nosocomial infection but more research is needed to better define the optimal patient-to-nurse ratio in various hospitals. (61) In particular, staff are less likely to perform hand hygiene when they are too busy.(62) Finally, when there are more patients in a defined area, it is likely that the burden of MRSA will increase. When a fifth bed was added to what was previously a four-bed bay, the relative risk of colonisation in the five-bed bay was 3.15 compared with the four-bed bays.(63) Increased patient/staff ratios are also associated with increased transmission rates(64, 65) as has increased staffing by temporary or locum nursing staff.(66)

There is increasing interest in allocating sufficient space around each bed to minimise infection. Recent UK guidelines have suggested a minimum distance of 2.7m between the centres of adjacent beds and 3.7m^2 of clear space around each bed, excluding space for storage, hand hygiene and worktops. (67, 68) Clearly many current facilities are inadequate, in the light of such recommendations, but when upgrading facilities or designing new hospitals or units, these dimensions should be complied with to minimise infection, including MRSA.

Experience with epidemic strains of MSSA in the 1960s demonstrated that isolation was a key component in controlling the spread of staphylococci.(69, 70) A recent study from France found that MRSA infections decreased by 17.9% with the introduction of isolation precautions.(71) Jernigan *et al* demonstrated a 15.6-fold lower MRSA transmission rate when colonised patients were cared for using strict isolation precautions, compared to standard precautions.(72)

Options for isolation precautions include single rooms, cohorting of colonised patients and dedicated control of infection wards. The choice of isolation facility depends on hospital size, activity and the local MRSA rates. Isolation rooms should have their own toilet en-suite, including dedicated washing/bathing facilities for patients. There should be a separate hand-washing sink and alcohol hand gel dispenser at the entrance to the room.

The number of isolation rooms needed for a given institution will depend on overall bed numbers, patient case mix and local MRSA prevalence. A few years ago a UK expert committee report recommended one isolation room for every six to seven general acute beds, or for every four to six critical care beds.(73) Others have recommended a minimum for intensive care units of one isolation room for every six beds.(74) More recently a report from NHS Estates in the UK recommends that 50-100% of hospital beds should be single rooms.(75) Isolation rooms must be specified for infection control use: additional single rooms should be available for other purposes (e.g. care of terminally ill patients). This may double the overall number of single rooms needed, depending on individual hospital activity. Where sufficient isolation rooms, or a dedicated isolation unit, are not available colonised patients may be cohorted in designated areas. This approach has been effective in controlling MRSA outbreaks.(76)

Negative pressure rooms are not generally required for care of patients colonised or infected with MRSA as MRSA transmission is generally via contact or droplet spread, rather than airborne spread. Nevertheless it must be borne in mind that isolation rooms will be used in the care of patients with other transmissible infections. It has been recommended that there should be at least two negative pressure ventilation rooms for every 250 general hospital beds. This requirement may be increased for centres with specialist units, such as an infectious disease unit, large intensive care units or paediatric services.(73)

Dedicated isolation units, also known as control of infection wards, allow patients to be nursed in an open ward, avoiding some of the psychological impact of isolation in a single room. It also means that colonised patients are cared for by designated staff, using designated shared patient equipment. Such units are particularly useful in hospitals where MRSA is endemic, as is the case in many Irish and UK hospitals, or during large hospital outbreaks. A purpose built MRSA cohort unit in a Dublin hospital has proven effective in controlling MRSA transmission, while maintaining the overall quality of care.(77) The introduction of dedicated isolation units was associated with significant reductions in MRSA transmission in a number of UK hospitals during the 1980s, though other pressures subsequently led to most of these being closed.(78-81) Control of infection wards should not be sited away from the main hospital environment, to ensure that patients are not distanced from specialist care.(73)

A.10   Eradication of MRSA carriage (decolonisation)

MRSA decolonisation refers to the use of

(a) Topical agents such as nasal ointment and bodywash/shampoo, to eradiate nasal and skin carriage

(b) Use of systemic antibiotics to clear persistent carriage, for example persistent throat carriage.

The efficacy of any decolonising regimen will depend on the number of patient sites colonised with MRSA, presence of wounds, extensive skin lesions, gastrointestinal colonisation, foreign bodies such as urinary catheters, PEG (percutaneous gastrostomy) tubes, haemodialysis lines, etc.

Although staff carriage of MRSA may be responsible for transmission, detailed studies on this are few, and often staff carriage is transient. Compliance with good practice including the wearing of protective clothing and hand hygiene measures should minimise the risk of cross-infection. However, there may be situations where epidemiological or other evidence suggests that persistence of MRSA in a clinical area may be due to staff carriage and transmission.

A.10.1   Nasal decolonisation

Topical nasal mupirocin (2% in paraffin base) eliminates nasal carriage of MSSA (82), but up to 30% of individuals become recolonised again 12 weeks after completion of a mupirocin course. However, Kluytmans *et al* found that the incidence of post-operative cardiothoracic wound infection fell from 7% (among historical controls) to 2% in patients treated with a five day course of intranasal mupirocin starting one day before surgery.(83) In another study among cardiac surgery patients by Yangco *et al*, perioperative nasal mupirocin reduced the incidence of *Staphylococcus aureus* sternotomy wound infection, but did not reduce the overall incidence of post-operative sternotomy infection (1.4%).(84) Mupirocin has also been used to eradicate nasal colonisation with MSSA in patients undergoing chronic haemodialysis or peritoneal dialysis and reduced the incidence of invasive staphylococcal infection in several studies.(85, 86)

Mupirocin has been used in conjunction with other infection control measures to reduce transmission of MRSA, and MRSA decolonisation leading to a lower incidence of invasive infection in at-risk patients. MRSA eradication was achieved in 25% of patients who received intra-nasal mupirocin/chlorhexidene baths compared with 18% eradication in those who received placebo/chlorhexidene baths.(87) Unfortunately the emergence of mupirocin resistance both low (MIC 4-256mg/L) and high level (MIC > 256mg/L) has been reported when mupirocin has been used widely and for prolonged periods in endemic MRSA settings. It is advised that extensive use of topical mupirocin should be avoided in settings where MRSA is endemic.(88)

Preliminary evaluation of newly tried agents such as povidone-iodine cream, tea tree oil, and extract of green tea have been reported, and recently investigators have attempted 'bacterial interference therapy' with the aim of eradicating MRSA colonisation by artificial implantation of non pathogenic corynebacterium species to the anterior nares.(89)   However, further studies are awaited to determine if the potential of these products is realised in clinical practice.

A.10.2   Decolonisation of non-nasal sites

Recommendations in this area are based on evidence and consensus from previous guidelines.(58, 60, 90) Eradication of carriage of MRSA, from sites other than the nose, may fail. Prolonged repeated courses of decolonisation regimens are not likely to be effective but may lead to the development of resistance to some topical disinfectants or antiseptics, or result in side effects for the patient.

Topical 4% chlorhexidene bodywash/ shampoo or 7.5% povidone iodine are equally efficacious for decolonisation of non-nasal sites. 2% Triclosan is not currently available. For patients with eczema, dermatitis or other skin condition and MRSA colonisation or infection, the priority is to treat the underlying skin condition, because by returning the skin to normal or near normal health, this will reduce the risk of MRSA shedding. Advice on suitable topical eradication protocols for such patients should be sought from a consultant dermatologist. Emollients, with or without an added antiseptic with activity against MRSA, may be useful for topical treatment of MRSA colonised patients with dermatological problems, but these should only be prescribed on the advice of a dermatologist.

A.10.3 Decolonisation of throat carriage

The role of the throat in the transmission of MRSA is uncertain. Systemic treatment should be considered only in exceptional circumstances, for example evidence of transmission from a throat carrier, when throat carriage is contributing to a continuing outbreak, or when the patient carrying MRSA in the throat has already experienced one or more episodes of invasive infection. The reasons for using systemic antibiotics must be clearly explained to the patient or member of staff. The advice of a consultant microbiologist should always be sought before initiating such therapies

A.11   Responsibility and accountability

All healthcare workers, both in the acute hospital, in community and in other units, have a responsibility to minimise the occurrence of infection. The ultimate responsibility for the implementation of guidelines, however, rests with senior management or the Chief Executive of the institution. Senior management should take advice from infection control teams on the implementation locally of national guidelines, including those on the prevention and control of MRSA. All healthcare institutions need to be motivated to ensure the highest standards of care, including those that minimise the occurrence of hospital-acquired infection. Therefore, adequate resources should be allocated to ensuring that these guidelines can be implemented, and where this is not possible in the short term, measures should be undertaken to ensure that as far as possible best practice can be implemented. However, future planning must incorporate strategies to provide the resources to implement them in the future. Such an approach will benefit patients by minimising patient morbidity and mortality from hospital-acquired infection, enhance the status of the healthcare institution, reduce the possible consequences of occupational-acquired infection, including even MRSA, and contribute to a climate of quality healthcare provision.

A.12   Basis for revised MRSA guidelines and strength of evidence

In recent years, guidelines on the control and prevention of MRSA have been developed and published in the UK (Community and Hospital),(60, 91) the United States of America (41) and New Zealand.(55) The groups that have published these guidelines have reviewed the literature and made their recommendations, in many instances, on observations or based upon expert opinion, rather than on randomised clinical trials, which are relatively rare. This reflects the literature on hospital infection control in general, which is largely based upon descriptions of outbreaks, observational studies and retrospective analyses. The SARI Infection Control Subcommittee was strongly of the view that it would not be productive to conduct another literature search and assessment, as this was unlikely to alter significantly the subsequent recommendations and because it would take a considerable amount of time and require significant resources. Consequently the recommendations that follow are based on these guidelines and are applied to Irish settings. The Subcommittee took cognisance of the approaches adopted in countries with very low levels of endemic MRSA, such as Finland and the Netherlands.(8, 57) While the core principals of MRSA control used in these countries (such as surveillance, patient isolation and hand hygiene) are the same as those contained in this guideline document, the Subcommittee felt that the overall approach may not reflect appropriate practice in this country where many healthcare institutions have endemic MRSA.

The strength of each recommendation or its grade is based on that used recently in the UK when producing guidelines for the prevention of healthcare-associated infections in the community.(92) These are as follows

Grade A	Evidence from meta-analysis of randomised controlled trials or from at least one randomised controlled trial.
Grade B	Evidence based on one controlled trial without randomisation, a quasi-experimental study, or extrapolated from category 1 evidence.
Grade C	Evidence from comparative studies, correlation studies, case-control studies or extrapolated from category A or B.
Grade D	Evidence from expert committees, reports or opinions and/or the clinical experience of respected authorities.

These guidelines do not specifically deal with the best approach to the laboratory detection of MRSA which requires a major review and close collaboration between relevant professional bodies such as the

Irish Society of Clinical Microbiologists and the Academy of Medical Laboratory Science, amongst others. New guidelines should address the most efficient methods of conventional detection, i.e. direct and enrichment culture, identify the role of newer technologies such as the detection of penicillin-binding protein 2[1], and the molecular detection of the *mec*A gene. However, an overview of current approaches is provided in Appendix 2.

The Infection Control Subcommittee, when reviewing the literature and the evidence, undertook to provide guidelines according to what is currently consistent with best practice. However, it is acknowledged that in many healthcare settings in Ireland, it will not be possible to implement much of what follows despite the best efforts of all healthcare professionals, because of inadequate resources, sub-optimal infrastructure and a lack of access to relevant expertise locally. Nonetheless, these are guidelines that all healthcare facilities should aspire to implement. Where it is not possible to implement some or part of the recommendations, the reasons for this should be highlighted to senior management. In this way, it is hoped that these guidelines, in tandem with other measures, will heighten the profile of infection control and prevention, and also facilitate the provision of the appropriate resources.

B Recommendations

B1. Prevention and control in hospitals

B.1.1 General measures

B.1.1.1Infection control measures

Hand hygiene must be carried out: **Grade A**
  • Before and after each patient contact
  • Before and after handling or manipulation of any invasive device
  • Before entering and upon leaving critical care areas, isolation rooms and areas used
    for cohorting of MRSA cases

Cuts or breaks in the skin of carers should be covered with impermeable dressings.   **Grade B**

The hospital environment must be visibly clean, free of dust and soilage, and acceptable   **Grade C**
to patients, visitors and staff, and all hospital surfaces should be intact and made of a
durable, washable material. This is fundamental to the control of all healthcare-associated
infections, including MRSA

Hospital management should ensure that all hospital staff (including supervisory staff)   **Grade D**
involved in cleaning processes must be trained, and certified as competent in such
processes. Training should commence within the first week of employment.

The Chief Executive Officer, or equivalent, of every healthcare facility must take corporate   **Grade D**
responsibility for ensuring cleanliness standards are maintained and for providing
adequate resources for both cleaning and training.

National recommendations on hand hygiene should be followed.   **Grade D**

All healthcare staff should comply with best practice for insertion and care of invasive   **Grade C**
medical devices, such as intravascular catheters, urinary catheters etc.

Additional cleaning and disinfection measures are necessary on discharge of MRSA   **Grade C**
patients and in outbreak situations

B.1.1.2 Antibiotic stewardship

Inappropriate or excessive antibiotic therapy and prophylaxis should be avoided in all   **Grade B**
healthcare settings. Particular attention should be given to obtaining an accurate
diagnosis when considering antibiotic therapy and ensuring that antibiotic therapy, if
required, is appropriate to the diagnosis.

Antibiotics should be given at the correct dosage, correct timing and for an appropriate   **Grade B**
duration. Excessive duration of antibiotic therapy is particularly associated with selection
of resistance and should be avoided.

The use of glycopeptide antibiotics should be limited to situations where their use has   **Grade C**
been shown to be appropriate. Prolonged courses of glycopeptide therapy should be
avoided, if possible, as this is strongly associated with the selection of glycopeptide
resistance.

The use of broad-spectrum antibiotics, particularly third generation cephalosporins and fluoroquinolones, should be restricted. Restriction of broad-spectrum antibiotic use is particularly important in healthcare institutions where MRSA is endemic.

Grade B

Healthcare institutions should institute antibiotic stewardship programmes, in line with the recommendations of the SARI Hospital Antibiotic Stewardship Working Group (Appendix 4). Key components of such programmes include identification of key personnel with responsibility for antibiotic stewardship, surveillance of antibiotic resistance and antibiotic consumption, strategies to optimise clinical management of infections, local antibiotic formularies and guidelines, point of prescribing interventions and prescriber education.

Grade D

B.1.2. Specific measures to control and prevent MRSA

B.1.2.1 Surveillance and screening of patients

Effective control strategies are dependent on good surveillance data and early detection. Detecting MRSA carriage depends on many factors including the laboratory methods used, the number of times the patient is screened, the types of samples obtained, and when they are obtained. Although there are a variety of options in terms of which samples to take, those outlined below are the most useful, when conducting routine surveillance. Patients who should be screened for MRSA include:

Grade C

- Patients known to be previously positive and who are being re-admitted to hospital
- Patients admitted from another hospital or health-care facility, unless that hospital or facility is known to be free of MRSA
- During an outbreak as determined by the infection control team
- Patients with non-intact skin, including wounds and ulcers
- Patients due to undergo elective high-risk surgery (e.g. cardiothoracic surgery, orthopaedic implant surgery)
- On admission to ICU/high-risk areas, with weekly screening thereafter
- Other patients, as determined by local risk assessment

There is no indication for the routine screening of patients prior to discharge, ie discharge screening.

Grade C

When screening patients, swabs from the anterior nares, perineum or groin, any skin lesions (e.g. surgical site) and any medical device sites (e.g. urinary catheter, central venous catheter) should be obtained from the patient. Other samples may be taken, e.g. throat swab, if MRSA is persistent following attempts at decolonisation.

Grade C

Periodic e.g. weekly surveillance cultures, should continue to be taken from patients remaining in high-risk areas of the hospital, e.g. ICU, special baby care unit, orthopaedic unit, solid organ or bone marrow transplant unit, and especially where MRSA is epidemic or where it has been endemic in the past.

Grade C

Patients, with MRSA, who have had three consecutive negative sets of screening samples, at least 72 hours apart, after decolonisation regimens, can be removed from isolation. However, such patients should continue to be screened at weekly intervals whilst in hospital. Patients, with MRSA, who have wounds or large areas of non-intact skin (e.g. decubitus ulcers) are not likely to lose MRSA and generally require isolation until the wound is healed. When re-admitted to hospital in the future, these patients should be placed in isolation pending the results of screening samples.

Grade C

Acute hospitals should carry out surveillance for MRSA. This should include rates of invasive MRSA infection, rates of nosocomial MRSA acquisition and the proportion of *Staph. aureus* blood culture isolates resistant to methicillin. This data should be regularly fed back to hospital clinicians and other staff, including hospital management. **Grade B**

B.1.2.2
Surveillance and screening of staff
The screening of staff on a routine basis, e.g. pre-employment, or at regular intervals is not indicated, but may be considered in hospitals where MRSA is not endemic or for specific units on the basis of local risk assessment. **Grade C**

The screening of medical, nursing and other health-care staff may be indicated during the investigations of an outbreak where MRSA persists or where an unusual strain of MRSA is isolated. However, this should be discussed with the healthcare workers involved and should be carried out by the Occupational Health Department in collaboration with and after discussion with the Infection Control Team. **Grade C**

A nasal swab and a swab from any skin lesion are usually sufficient when initially screening staff for MRSA. Full screening is necessary after an initial MRSA positive site. **Grade C**

Unless staff identified as carrying MRSA work in high-risk wards, i.e. intensive care units, neonatal units, orthopaedic units, solid organ or bone marrow transplant unit, they should not be excluded from work. Staff working in these areas should be excluded from work, or reassigned to a low-risk area, for 48 hours only from the start of decolonisation therapy. **Grade C**

B.1.2.3
Patient isolation and cohorting
Every hospital must take steps to prevent patient overcrowding and understaffing, in order to minimise the risk of MRSA transmission. **Grade B**

Multi-bedded general wards or units should have at least 2.9 metres between the centres of adjacent beds. If this is currently not the case, future refurbishment should address this. Greater space between beds is required for high-risk units. **Grade D**

Hospitals should have a minimum of one isolation room for every six to seven general acute beds, and at least one isolation room for every four to six critical care beds. Hopitals should provide appropriate hand hygine and bathroom facilities to facilitate infection control and phase out multi-bedded rooms wherever possible. When building new hospitals or units at least 50% of beds should be in single rooms, with appropriate facilities for patient isolation. **Grade D**

Risk stratification must be performed to identify areas where MRSA infection results in high morbidity and mortality and where therefore patient isolation or cohorting is essential. Isolation or cohorting is essential in high-risk areas, i.e. ICUs, orthopaedic units, vascular surgery units, transplant units and other specialised clinical areas with vulnerable patients. **Grade B**

Hospitals with endemic MRSA should consider the establishment of a dedicated isolation unit or control of infection ward. Control of infection wards should not be sited away from the main hospital environment to ensure that patients are not distanced from specialist care. **Grade D**

Where sufficient isolation rooms or a dedicated isolation unit are not available, colonised patients may be cohorted in designated areas with designated staff, e.g. a six-bedded room on a ward may be used to isolate MRSA patients. **Grade C**

Patient care equipment such as blood pressure cuffs and stethoscopes should be designated for use only on a single patient who is colonised or infected with MRSA. Patients' charts including observation charts and drug charts should be kept outside the patients' room.

Grade D

The number of healthcare staff who have direct contact with patients colonised or infected with MRSA should be kept to a minimum. Staff with exfoliative skin lesions should be excluded from the care of patients colonised or infected with MRSA.

Grade D

Isolate or cohort all national and international patient transfers to an acute setting, until MRSA screens are negative.

Grade C

Isolate or use contact precautions for all patient transfers into high-risk units (critical care areas, cardiothoracic units, orthopaedics, trauma, vascular surgical units and transplant units) from non-high risk areas (medical and care of elderly unit) within the same institution until MRSA screens are negative.

Grade B

Isolate or use contact precautions for all known MRSA cases upon admission and all new MRSA cases upon identification in high-risk areas (critical care units, orthopaedics, surgical wards and transplant units).

Grade B

Isolate patients that are likely to shed MRSA in high numbers, e.g. patients with eczema until advised by the local infection control team.

Grade B

Where a new case of MRSA is identified in an open room on a high-risk area, all other patients within the room should be screened for MRSA.

Grade C

Patients awaiting the results of MRSA screening should be nursed in isolation if any of the following apply:
   a) Previously colonised or infected with MRSA
   b) Recent or frequent hospital admissions
   c) Transferred from another healthcare institution (unless that institution is known to be free from MRSA)
   d) Inpatient in another healthcare institution within the previous six months (unless that institution is known to be free of MRSA)
   e) Patient with skin ulcers or chronic wounds

Grade C

Healtcare facilities should ensure that patients who are found to carry MRSA are informed of this and provided with appropriate information. Information leaflets on MRSA should also be available for all patients, carers and family members, as well as visitors to the healthcare facility.

Grade D

B.1.2.4
Eradication of MRSA carriage
Patients colonised with MRSA who are due to undergo an elective operative procedure, have a prosthesis *in situ* or are in a clinical area where there is a high risk of colonisation leading to invasive infection, e.g. the ICU, should undergo decolonisation. A risk assessment of other patients such as long stay patients or patients with chronic nasal colonisation should be carried out to determine if nasal decolonisation should be attempted in these patients. However, excessive use of nasal decolonisation agents should be avoided as this may select for resistance to these agents.

Grade C

Apply a small amount of 2% mupirocin in paraffin base (with cotton swab or gloved tip of little finger) to the inner surface of each nostril (anterior nares) three times daily for five days. Apply enough to cover the inner surface. Pinch the distal end of nose gently after application, the patient should be able to taste mupirocin at the back of the throat a minute or so later.

Grade B

Sample anterior nares at least 48 hours after completing a course of treatment. If the swab remains positive for MRSA, repeat the course once only and consider checking for throat colonisation. Repeated courses of mupirocin treatment may lead to mupirocin resistance.

Grade B

If the MRSA strain is mupirocin high-level resistant, or is not eradicated after two courses of treatment, consider an alternative such as Naseptin™ (0.5% neomycin + 0.1% chlorhexidene), chlorhexidene cream, bacitracin, or povidone iodine ointment.	Grade B
Patients should bathe daily for five days with an antiseptic detergent, if the patient's skin condition allows, such as 4% chlorhexidine, or 7.5% povidone-iodine. The skin should be moistened and the antiseptic-detergent applied thoroughly to all areas before rinsing in the bath or shower. Special attention should be paid to known possible carriage sites including axilla, groin, perineum and buttock area. The antiseptic detergent should also be used for all other washing procedures and for bed bathing. If MRSA is not eradicated, the course may be repeated and may be continued if tolerated by the patient.	Grade B
Hair should be washed twice weekly with an antiseptic detergent.	Grade B
After satisfactory completion of a course of treatment, clean clothing, bedding, towels and flannel should be provided, in addition to regular changes of clothing, bed linen etc.	Grade C
Antibiotic courses for eradication of throat carriage should only be considered if there is documented persistent throat carriage and usually not be repeated since side effects are common and increase with the length of treatment.	Grade B
If eradication of throat carriage is required, rifampicin and fusidic acid, or trimethropim combined with either rifampicin or fusidic acid, according to susceptibility results, should be given for five days.	Grade C
The value of local treatment for throat carriage such as antiseptic gargles or sprays is uncertain, but may reduce the organism load.	Grade C

B.1.2.5.
Recommendations for control of glycopeptide-intermidiate and glycopeptide-resistant strains of Staphylococcus aurues (GISA/GRSA)

Hand hygiene, before and after every contact with the patient or their immediate environment, is essential.	Grade A
It is essential that isolates that are non-susceptible or are fully resistant to vancomycin, or other glycopeptides, are detected rapidly in the laboratory and that this is communicated as soon as possible to the infection control team.	Grade D
Infection control teams should initiate an epidemiological and laboratory investigation to detect the source of these isolates.	Grade D
Patients with GISA or GRSA should be placed in isolation and contact precautions, ie gowns, gloves and a mask, (if splashing or aerosol production is likely), should be instituted.	Grade D
Nursing and medical staff should minimise the number of patients with access to the colonised or infected patient with GISA/GRSA.	Grade D
Infection control teams should inform all personnel providing direct patient care of the epidemiological significance of these strains and the requirement for additional precautions (e.g. extra cleaning/disinfection).	Grade D
The infection control team should screen to determine whether transmission has already occurred to patient contacts of the index case or to staff members.	Grade D

Transfer of colonised or infected patients with GISA/GRSA to other wards or other hospitals should be minimised if at all possible.	**Grade D**

B.2 Control of MRSA in the community

B.2.1 Recommendations for care of patients with MRSA in the home

Good communications between hospitals discharging patients home with MRSA with carers or family members, community nurses and General Practitioners (GPs), and between hospital and community hospitals or long-stay residential units, are essential in minimising spread.	**Grade D**
There is little risk of transmitting MRSA to healthy people who are at low risk of becoming infected. Patients should be informed that the risk to healthy relatives or others outside the hospital setting is extremely small, unless they are hospital workers with patient contact when they may pose a risk to other patients.	**Grade B**
Because there is little risk of transmitting MRSA to healthy members of the community and there is minimal risk of them becoming infected, eradication of MRSA carriage in the community is generally not required.	**Grade D**
In the home, the following general precautions should be followed:	**Grade C**

In the home, the following general precautions should be followed:
- Good hand washing practice is the single most important infection control measure. Care-givers should wash their hands with soap and water after physical contact with the infected or colonised person and before leaving the home.
- Disposable gloves should be worn if contact with body fluids or dressings are expected and hands should be washed after removing the gloves.
- Cuts or breaks in the skin of carers should be covered with impermeable dressings.
- Linens should be changed and washed if they are soiled and on a routine basis.
- The patient's environment should be cleaned, using standard detergents, routinely and when soiled with body fluids.

B.2.2 Recommendations for Care in Community Units

There is no indication for routine screening before hospital discharge to home or to a community unit.	**Grade C**
The resident with MRSA should be encouraged to practice good hygiene and be assisted with this if their physical or mental condition makes this difficult.	**Grade C**
Isolation is not required as this may adversely affect rehabilitation of the resident.	**Grade C**
The staff of the receiving community facility and the GP should be informed before transfer of a patient who is MRSA positive. Carriage of MRSA is not a contraindication to the transfer of a patient to a nursing or convalescent home.	**Grade C**
Residents of community facilities colonised with MRSA should not be restricted from participation in social or therapeutic group facilities within the residence, if wounds are covered. If there is reason to think that they are shedding large numbers of bacteria (e.g. large wounds not contained by dressings, a tracheostomy with frequent coughing), or have been implicated in the development of infection in other residents, segregation may be necessary. Residential institutions should seek the advice of local Community/Public Health infection control before embarking on screening for MRSA.	**Grade C**
MRSA carriers will not normally require special treatment after discharge from hospital. If a treatment course still needs to be completed in particular circumstances the infection control team should advise on this.	**Grade B**

Routine facilities in all community residential care facilities should include adequate sinks, paper towels, etc, (as detailed in the SARI Hand Hygiene guidelines) and personnel should be educated on the use of invasive devices such as urinary catheters, feeding tubes, tracheostomies etc.

Grade D

Residents colonised or infected with MRSA should not be placed in rooms with debilitated, non-ambulatory residents at greater risk of becoming colonised or infected, if single rooms are available or if cohorting of patients with MRSA is possible.

Grade C

All lesions in deceased residents should be covered with impermeable dressings. Body bags are not necessary. There is negligible risk to relatives, mortuary staff, or undertakers as long as standard infection control precautions are followed.

Grade D

B.2.3 Patients with MRSA and skin ulceration or indwelling urinary catheters

A colonised resident who has open lesions should be in a single room if available and if this will not adversely affect the resident's rehabilitation.

Grade D

The colonised resident may join other residents for social activities in the sitting room, dining room and other communal areas provided their sores or wounds are kept covered with an appropriate dressing, preferably impermeable.

Grade D

Equipment with which the MRSA colonised resident has been in contact, such as a commode, should be cleaned with detergent and hot water. Chemical disinfection is not required.

Grade D

Cutlery, crockery, and healthcare-risk waste should be dealt with as per normal routine. No additional measures are required.

Grade D

Clothes and bedding should be machine-washed, preferably on a hot wash setting, or dry-cleaned if unsuitable for machine washing.

Grade D

B.2.4 Course of action if there is spread of MRSA infection in a community unit

It is important that community residential facilities have appropriate infection control arrangements for the management of a growing infection problem, such as MRSA. Isolation of patients/residents is generally not required, other than in exceptional circumstances.

Grade D

C   Conclusions

C.1   Overview of measures and their importance

The basis of measures to control the emergence and spread of MRSA are good professional practice, e.g. hand hygiene, adequate resources allocated to cleaning, early identification of patients with MRSA through selective screening, patient isolation and cohorting in hospital, prudent antibiotic use and specific measures to eradicate carriage, where appropriate. MRSA control measures should be seen in the context of an overall strategy to prevent infection in both acute hospitals and in community units.

There is not unaminous agreement that specific measures should be taken to control MRSA. Some would argue that MRSA control measures should be subsumed into general measures to control hospital-acquired infection because it is believed that these bacteria do not spread, are not particularly virulent and that measures specifically advocated to control MRSA may be counter-productive in terms of diverting energies away from other important aspects of infection prevention.(93-95) However, the SARI Infection Control Subcommittee disagrees with this minority view and believes that specific measures to control MRSA are justified. This conviction is based on the recent literature, which confirms the clinical significance of MRSA, e.g. additional difficulties in treating bloodstream infection.

The impact of MRSA depends on the patient population and their susceptibility to infection. Susceptibility to infection is greatest in acute hospitals, especially in critical care areas such as ICUs, but is much less in non-acute units such as long-stay community units. Consequently, the Subcommittee has endeavoured to adapt best practice to patient needs and to take cognisance of where the patient may be, i.e. in an acute hospital or in a long-stay community institution.

The Subcommittee has specifically addressed the need to provide guidelines for community units, and not just for acute hospital units, and has also addressed the emergence of MRSA strains that may be less susceptible or even resistant to glycopeptides, e.g. vancomycin and teicoplanin. The effective implementation of measures to control MRSA will assist in helping to prevent the emergence of these strains in Ireland.

MRSA control measures should be a component of an institution-wide approach to optimal patient care. Success in controlling MRSA is possible, as the evidence from other countries such as the Netherlands shows, but to achieve this does require resources, i.e. adequate numbers of personnel, sufficient space and adequate facilities, and expertise locally in infection control, as well as the support and endorsement of health authorities. Furthermore, the general and specific measures implemented to control MRSA will, help contain the emergence and spread of other antibiotic-resistance bacteria, minimise adverse patient events in terms of hospital or institution-acquired infections, contribute to the containment of healthcare costs and finally, enhance the overall quality of patient care.

C.2   Future research and developments

The establishment of the National MRSA Reference Laboratory at St. James's Hospital has helped clarify the epidemiology of MRSA in Ireland but this needs to continue with sufficient resources to enable us to anticipate the arrival of new strains, especially those resistant to glycopeptide antibiotics.

Conventional methods of detection are slow, often taking up to 72 hours to confirm the presence of MRSA from a screening swab or a clinical specimen, and there is a need to evaluate in a clinical setting more modern detection methods, including molecular. A full review of laboratory methodology is required and this could occur jointly between relevant specialists in the North of Ireland and in the South, following on from the North/South Study of MRSA in Ireland, 1999.

Patients with confirmed or suspected MRSA require isolation and this often affects the efficient use of hospital beds and the health service generally. Studies are required to determine the true cost of MRSA in Ireland, i.e. laboratory costs to detect MRSA, additional length of stay in hospital of patients with MRSA, antibiotic utilisation to treat MRSA compared with MSSA infections, reduced flexibility in bed usage arising from patients with MRSA requiring isolation or cohorting, and the hidden costs borne by the individual patient.

Studies are necessary also on the transmission of MRSA and on the effectiveness of infection control interventions, and the outcomes of education and infection control strategies to prevent and reduce MRSA.

Current resources for the control of infection in hospitals and in community units are inadequate and additional investment such as the appointment of more microbiologists, infection control nurses and laboratory scientists, together with the provision of appropriate physical infrastructure, is required. This is likely to assist in the implementation of these guidelines, help contain hospital- and other healthcare-associated infection, and contribute to the more efficient utilisation of healthcare resources.

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Appendix 1: Summary of Guidelines for Hand Hygiene in Irish Health Care Settings

Guidelines produced by the SARI Infection Control Subcommittee

Category I: Recommended for implementation and supported by experimental, clinical or epidemiologic studies with a strong theoretical background.

Category II: Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.

Category III: Recommended based on experience of experts in the field.

1. Responsibility and accountability

• Corporate responsibility for implementation of these hand hygiene guidelines lies with the Chief Executive Officer (CEO) / Director of each health care institution. This responsibility includes involving the infection control team in project development, provision of adequate hand hygiene facilities in all clinical areas, provision of an adequate infection control resource to facilitate education, audit and implementation of guidelines. (III)

• The CEO / Director of each health care institution will be informed of the results of hand hygiene audits and attendance at education sessions by the Clinical Risk Management committee. (III)

• Hand hygiene must become a standard of quality care in health care institutions. (II)

• Hand hygiene is the single most important intervention to prevent transmission of infection and should be a quality standard in all health care institutions. (I)

• Senior health care workers (HWC's) such as consultants, nurse managers and managers in the allied health professional groups, catering, domestic and technical services, must act as role models and actively promote hand hygiene (II).

• Each and every HCW has a responsibility to prevent transmission of infection. (II)

• Breaches in adherence to hand hygiene procedures should be addressed within the Clinical Risk Management framework of the health care institution and consideration should be give to the introduction of sanctions for repeated offences. (III)

• The Infection Control Team (ICT) in liaison with ward managers should undertake audits of hand hygiene practice as part of the ongoing infection control audit process. The results of these audits should be referred to the Clinical Risk Management committee who will inform the CEO. (III)

2. Hand hygiene preparation

• Nails must be kept short and cut smoothly (II)

• Nail varnish (III), and/or false nails (I) must not be worn

• All wrist and hand jewellery (except plain wedding bands) must be removed (II)

• Shirts should have short or turn up sleeves (III)

3. *Social hand hygiene* with plain soap and warm water, or an alcohol hand rub product* which is used on visibly clean hands - indications for use

• When hands are visibly contaminated with dirt, soil or organic material (Always wash hands when visibly contaminated) (I)

• At the beginning and end of the work shift (III)

• Before and after each patient contact (II)

• After moving from a contaminated to a clean area during care of an individual patient (II)

• After removing gloves (I)

• After handling soiled equipment, materials or environment (II)

• Before preparing or handling food (I)

• After personal bodily functions such as blowing nose or using the lavatory (I)

4. *Antiseptic hand hygiene* with an antiseptic handwash agent, or alcohol handrub product* which is used on visibly clean hands– indication for use

• Before and after each patient contact in critical care units (II), those who are immunocompromised (III) or with large wounds or burns (I) and before entering units/wards with such patients (I)

• After all contact with patients on transmission based precautions and prior to leaving wards/rooms with such patients (I)

• When hands are inadvertently contaminated with a heavy microbial load such as foul or infectious material (I) . Always wash hands when visibly contaminated.

• Before performing invasive procedures as part of an aseptic technique (I)

   * An alcohol based product should only be used on visibly clean hands and is recognised as a superior hand hygiene product for almost every situation. Alcohol handrub products with added emollient reduce the risk of dermatological side effects Repeated use of alcohol-based products with added emollients may result in an excessive build up of emollient on the hands, and this may be reduced by periodic washing with soap and water.

5. *Surgical hand hygiene* with an antiseptic scrub or an alcohol based (60 – 70%) handrub product

• In addition to measures outline in 2 above, wedding bands should be removed (II).

• Remove debris from beneath nails using a sterile single use or autoclavable nail cleaner (II)

• There should be no nail bed injuries or inflammatory processes (III)

6. Choosing a Hand hygiene product

• The product should be deemed suitable for its intended use by the manufacturer, also by European and American Standards (I).

• A good quality liquid soap in conjunction with an emollient-based alcohol rub is highly recommended (I)

• Consideration should be given to the risk of dermatological side effects when choosing products (II)

• The volume and duration of an antiseptic scrub/wash/rub should be in accordance with the manufacturers instructions (I)

• Potential interactions between agents, if they are used sequentially, and with other skin care products or types of gloves used should be evaluated (II).

• Cost of hand hygiene products should not be the primary factor influencing product selection (I)

• Skin tolerance, fragrance and feel of product should be evaluated (II).

• The users should be actively involved in choosing an antiseptic hand hygiene agent, to maximise acceptance of the hand hygiene product (I).

7. Prevention and management of skin damage resulting from hand hygiene

• The Occupational Health Team (OHT) and ICT should work together in promoting safe hand hygiene products and the identification of vulnerable HCW (III)

• Health Care Management should promote the use of good quality hand hygiene products including alcohol handrub products with added emollient, good quality paper towels, powder free latex gloves, perfume free detergents and sensitising-preservative free creams/lotions (I)

• Dry hands thoroughly using a patting motion rather than rubbing to reduce friction of the skin. (III)

• Avoid prolonged use of gloves or using gloves when not required, examples include making beds which are not contaminated with blood or body fluids and washing patients (III)

• Seek input from the manufacturers regarding any known interactions between soaps or rubs (plain or antiseptic), skin care products, and gloves used, an important factor in influencing product selection (II).

• There should be access to occupational health expertise, and if required Dermatological referral, for the effective management of occupational dermatoses in the healthcare setting (III).

8. Hand hygiene facilities location and design

• The involvement of the ICT, medical consultants, senior nurse, managers and service engineers from the early stage of planning and in project design teams is essential (II)

• Handwash sinks should be independent of patients' and/or en-suite sinks (I)

• Handwash facilities should be positioned close to exit doors of isolation rooms, wards and units (II)

• Clinical institutions should aspire to installing at least one handwash sink per 4-6 beds in general open wards and a minimum of one sink per 1-3 beds in critical care areas (I)

• Handwash sinks should be available in all clinical areas; they should be centrally located and free from obstruction (II).

- Handwash sinks should be of adequate size to avoid splashing the surrounding floor and surround (I)

- Handwash sinks should be positioned so that there is adequate space for the operation of taps and the installation of hand hygiene products and towel dispensers above the sink (I)

- Taps should be hands free (I)

- Handwash sinks should employ mixer taps, to allow regulation of water temperature ((III)

- All sinks should be fitted with washable back splash with all joints completely sealed (II)

- Liquid hand hygiene products should be stored in closed containers and never topped up (III)

- Evaluate the hand hygiene product dispenser system, to ensure that it will function adequately and consistently deliver an appropriate volume of product (II).

- Alcohol handrub should be available at the bedside of each patient in critical care units and in each patient room/clinical room (II)

- The use of good quality disposable paper towels and hand lotions are recommended (II). Air dryers are not recommended (III).

- Waste bins should be hands free and institutions should aspire to purchasing bins, which close quietly (III).

9. Hand hygiene education and promotion

- Hand hygiene education must be a mandatory component on all clinical courses curricula with annual updates on commencement of clinical placements and must form part of the final clinical/professional examination (III).

- Mandatory attendance at hand hygiene education during the hospital induction programme is required followed by updates every one to two years (I)

10. Audit of compliance

- Audit of compliance with hand hygiene guidelines and hand hygiene facilities must be undertaken in all Health Care institutions as part of the overall infection control programme (I)

- The performance of audits at local ward or unit level is also recommended as part of the overall local ward/unit management programme (I).

- Audit of the amount of hand hygiene agents used may also be useful measurement of compliance (I).

Appendix 2: Laboratory methods of detection

This section describes some current approaches to the processing of specimens to detect methicillin resistant *Staphylococcus aureus* (MRSA). While these methods are for MRSA screening, certain specimens will also require additional routine culture. However, this is being reviewed in the UK and a specific group is required to address the laboratory detection of MRSA including molecular approaches.

	Media	Temp	Atmosphere	Time	Cultures read
Direct culture	Mannitol salt agar (MSA)with oxacillin 2mg/L	37°C	Aerobic	40 – 48 hours	Daily
	&/or				
If quinolone resistant strains are prevalent	Ciprofloxacin Baird Parker agar (cipro 8 mg/L)	70°C	Aerobic	40 – 48 hours	Daily
And / Or					
Enrichment culture	Nutrient broth containing 7% NaCl*	30°C	Aerobic	16 – 24 hours	N/A
	Then				
	Subculture to MSA with oxacillin 2mg/L	37°C	Aerobic	40 – 48 hours	Daily
	&/or				

Vancomycin / glycopeptide intermediate *S. aureus* (VISA / GISA) and hetero-resistant hVISA / hGISA:

The Centers for Disease Control Atlanta (CDC) requirements for definition of a glycopeptide intermediate *S. aureus* are as follows :

Technique	Results	Comment
Brain heart infusion agar containing 6 mg / L vancomycin	Growth after 24 hours	One or more colonies is a positive result; use *S. aureus* 5923 as negative control and *Enterococcus faecalis* ATCC 51299 as positive control
Broth microdilution	Vancomycin MIC 8 - 16 mg /L in Mueller Hinton broth	Hold test full 24 hours
Etest	Vancomycin MIC >- 6 mg / L on Mueller-Hinton agar	Hold test for full 24 hours

Glycopeptide resistant strains (GRSA) have MICs of vancomycin and teicoplanin > 32 mg/ L.

Appendix 3: Contact precautions

Patient placement
- Place patient in a single room (en suite facilities desirable). Where single room are available it is important to prioritise the need for use for isolation purposes.   Where a single room is not available cohort in room with patients with the same microorganism (example MRSA). Where placement in single room or cohorting is not achievable consider the patient population when determining patient placement. Consultation with infection control professionals is advised before placement

Gloves and hand hygiene
- Gloves are not required for entering an MRSA isolation room or cohort area/bed space. They are required as as outlined for Standard Precautions, that is for potential contact with blood and/or body fluids. Gloves are removed on completion of the task and before leaving the patient single room or bed space. Hand hygiene is performed immediately upon removal of gloves with an antimicrobial or a waterless antiseptic agent.
- Hand hygiene is performed using an antimicrobial or a waterless antiseptic agent before or/on entering room/bed space and prior to patient contact. It is imperative to perform hand hygiene again immediately before or on exiting the single room or bed space.
- Hand hygiene is performed in other circumstances as outlined in ' Guidelines for Hand hygiene in Irish Healthcare Settings' (SARI 2005).

Aprons/gowns
- In addition to wearing disposable aprons or gowns as outlined for Standard Precautions, wear a disposable apron when entering the MRSA single room and for contact with the patients direct environmental surfaces (example, within a curtain space) in a cohort situation. The purpose of the apron is to minimise risk of transfer of MRSA to staff clothes, which may have come in contact with potentially contaminated environment such as beds, curtain, lockers or equipment within the room or cohort environment. Subsequently the risk of transmission to other patients from contaminated staff clothes is reduced (for the same reason sitting on patients beds is not recommended).
- A non-sterile disposable gown may be required for very close and more extensive contact; advice on this should be obtained from local infection control teams.

Patient care equipment/supplies
- Dedicated equipment should be used where possible.
- Only take essential equipment and supplies into the room. Do not stock pile.
- All patient care equipment/supplies must be effectively cleaned and disinfected before use on another patient.

Documentation
- Documents and charts should not be taken into the room.

Patient transport
- Movement of patient should be limited to essential purposes only (examples, tests, procedures or treatments). If in doubt contact your local infection control team. Receiving departments are required to clean and disinfect surfaces and equipment that come into contact with the patients.
- During actual transportation between departments it is important to maintain patient confidentiality, As the patient is not normally in direct contact with surrounding environmental surfaces or the staff members cloths during actual transportation, aprons or gloves <u>are not</u> required, unless directed under standard precautions.

Environment
- Good quality daily cleaning of the environmental surfaces is essential to reduce the level of MRSA on environmental surfaces. On termination of isolation/cohorting or discharge of the patient terminal cleaning is required (walls and ceilings not part of a terminal clean).

Application

- All healthcare workers and visitors entering a single room or cohorted areas/bed space should adhere to contact precautions irrespective of task being performed.

Adapted from the CDC guidelines 'Contact Precautions' (1996) excerpts from, Guidelines on isolations precautions in hospitals (www.cdc.gov/ncidid/hip/isolat/isolet.htm/)

Appendix 4: Summary of recommendations from the SARI Hospital Antibiotic Stewardship Subcomittee

Identify key personnel to drive antibiotic stewardship programmes	Microbiologist/ID physician	Key responsibility for planning and administration of local stewardship initatives	
	Clinical Pharmacist	Planning and administration of local stewardship initatives. Implementation of stewardship programmes. Antibiotic use liaison. Antibiotic consumption surveillance.	
	Hospital administrator	Identifying antibiotic stewardship as strategic goal and key component of clinical governance.	
Establish Drugs and Therpeutics Committee	Consider hospital size/activity	Local, on-site committee for large hospitals, shared committee for smaller hospitals	
Consider Antibiotic Advisory Committee	Consider hospital size/activity	Only required for larger hospital, otherwise can be part of D & T Committee's function	
Ensure allied processes in place	Prevention of infection	Infection control policies and procedures	Particular attention to prevention of device-related infections
		Appropriate patient and staff vaccination programmes	
	Local surveillance	Antibiotic resistance	Local feedback of resistance data to prescribers
	Include clinical outcomes, wherever possible	Antibiotic consumption	Local data feedback and periodic prescribing audits
Optimise clinical management of infections	Diagnosis	Evidence-based clinical diagnosis	Clinical algorithms, appropriate use of radiological diagnostics etc.
		Evidence-based laboratory diagnosis	Standardised susceptibility testing, interpretative reporting, restrictive reporting etc.
	Therapy	Evidence-based empiric therapy	Guided by local written policy: should include detailed treatment algorithms, not just "which drug for which bug".
		Pathogen-directed therapy	Therapy guided by results in light of clinical picture ("treat the patient, not the lab result"). Encourage discussion with local microbiologist or ID physician.
	Prophylaxis		Optimise surgical and other antibiotic prophylaxis
Hospital drug formulary	Antibiotic formulary	Written formulary for all hospitals	Formulary subject to regular (at least annual) revision. Consider regional formulary for smaller hospitals.
		Consider restricting the use of antibiotics with high resistance potential	Consider restricting use to specific indications, or by specific specialties. Consider requiring prior approval, by microbiologist or ID physician, for use of restricted agents.

| Therapeutic guidelines | → | Antibiotic guidelines | → | Surgical prophlaxis guidelines | → | Stress key principals: timing (at induction of anaesthesia), number of doses (generally single dose), choice of agent (narrowest spectrum, based on local data). Involve local surgeons in development and review of guidelines. |

Empiric therapy guidelines → Stress key principals: thorough clinical assessment, rational use of laboratory and radiological diagnostics, choice of agent based on local data, early review of empiric therapy, seek expert advice if needed. Involve local clinicians in development and review of guidelines.

Point of prescribing interventions

Access to expert advice → 24 hour access to microbiology/infectious disease expertise. Encourage prescribers to seek advice, where needed.

Antimicrobial order forms → Consider use of dedicated order forms for prophylactic and therapeutic antibiotic prescribing → Electronic prescribing should be considered, if possible, and linked to prescribing decision support.

Mandatory stop dates → Antibiotic orders must be rewritten after a given number of days to encourage review of therapy. → Consider mandatory microbiology/ID consultation for therapy exceeding mandatory stop dates.

Formulary substitution/oral switch → Substitute formulary agents for non-formulary agents and oral for parenteral agents, where practicle. → Should reduce adverse drug reactions. Cost savings may help to pay for other stewardship initiatives.

Pharmaceutical promotion

Ethical promotion of antibiotics → Promotion should be in line with IPHA code of marketing practice

Promotion in line with local formulary/policies → Consider requirement for prior approval of promotional activities by D&T or antibiotic committee

Education of health professionals

Undergraduate education → Principles of rational antibiotic use taught to all health professionals in training.

Postgraduate education → Frequent continuing education, using multiple interventions (face to face, printed materials etc.)

Use problem-based teaching methods wherever possible. Focus on clinical relevance and real-life situations. Focus on clinical algorithms and communication techniques, not just "what drug for what bug".

Appendix 5: Responses to consultation request

A draft version of this document was circulated for consultation to a wide range of professional and other bodies. The following organisations and groups submitted comments in response to the consultation request:

Cork University Hospital, Infection Control Team

Royal College of Physicians of Ireland, Faulty of Occupational Health Medicine

Irish College of General Practitioners

Health Services Executive Western Area (collated from consultation with a range of locations and professionals within the HSE Western Area)

Adelaide-Meath-National Children's Hospital, Tallaght, Infection Control Team

Mater Misericordiae Hospital, Dublin, Infection Control Team

Mid-Western Health Board, Infection Control Team and Department of Public Health

Department of Health and Children, Health Promotion Office

Shield Health Incorporated

HSE South Eastern Region, Infection Control Team

University College Hospital Galway, Infection Control Team

The following individuals also submitted comments:

Ms Nellie Bambury (Infection Control Nurse Specialist)

Ms Marina Burd (Infection Control Nurse Specialist)

Prof Mary Cafferkey (Consultant Microbiologist)

Dr Jim Clair (Consultant Microbiologist)

Prof Martin Cormican (Consultant Microbiologist)

Ms Rita Dempsey (Dublin Institute of Technology)

Dr Geraldine Corbett-Feeney (Consultant Microbiologist)

Ms Eilish Creamer (Infection Control Nurse Specialist)

Prof John Flynn (Consultant Microbiologist)

Ms Elizabeth Forde (Infection Control Nurse Specialist)

Dr Anne Gilleece (Consultant Microbiologist)

Dr Michael Gunn (Department of Agriculture)

Ms Ann Higgins (Infection Control Nurse Specialist)

Dr Rosemary Hone (Consultant Microbiologist)

Mr Simon Hunter (Hunter Apparel Solutions)

Ms Lenora Leonard (Infection Control Nurse Specialist)

Ms Mary McCarthy (Department of Health and Children, Chief Nursing Officer)

Ms Pam O'Callaghan (Infection Control Nurse Specialist)

Dr Brian O'Connell (Consultant Microbiologist)

Dr Darina O'Flanagan (Director, Health Protection Surveillance Centre)

Ms Ann O'Reilly French (Infection Control Nurse Specialist)

Ms Teresa Sexton (Infection Control Nurse Specialist)