Prevention of Antimicrobial Resistant Infections in the Hospital Settings of Europe

(Case study on methicillin-resistant Staphylococcus aureus (MRSA))

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<td>AMR</td>
<td>Antimicrobial resistance</td>
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<td>CDC</td>
<td>US Centres for Diseases Control and Prevention</td>
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<td>DK</td>
<td>Denmark</td>
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<td>EARS-Net</td>
<td>European Antimicrobial Resistance Surveillance Network</td>
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<td>ESAC-Net</td>
<td>European Surveillance of Antimicrobial Consumption Network</td>
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<td>ECDC</td>
<td>European Centre for Diseases prevention and Control</td>
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<td>EMA</td>
<td>European Medicines Agency</td>
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<td>EU</td>
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<td>HAI</td>
<td>Healthcare-associated infection</td>
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<td>HAI-Net</td>
<td>Healthcare- Associated Infections Surveillance Network</td>
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<td>HELICS</td>
<td>Hospitals in Europe Link for Infection Control through Surveillance</td>
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<td>IT</td>
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<td>MRSA</td>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
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<td>MS</td>
<td>Member States</td>
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<td>NL</td>
<td>The Netherlands</td>
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<td>PubMed</td>
<td>Public/Publisher MEDLINE</td>
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<td>PsycINFO</td>
<td>Psychological Information database</td>
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<td><em>S. aureus</em></td>
<td><em>Staphylococcus aureus</em></td>
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<td>SIMPIOS</td>
<td>Multidisciplinary Italian Society for the Prevention of Infections in Healthcare Organisations</td>
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<td>SWAB</td>
<td>Dutch Working Party on Antibiotic Policy</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>WIP</td>
<td>Dutch working group on infection prevention</td>
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Abstract

Antimicrobial resistant infections are one of the most important public health problems experienced by many of the hospitals in Europe. Although many prevention methods have been taken to control such infections, they still remain above 25% in more than one third of the European countries. Having national guidelines is perceived to be an effective measure in controlling such infections and it points out the importance given to this area by the national authorities of a country. However the evidence base for many of the recommendations in the guidelines varies between the countries which in turn could contribute to the differences in the MRSA infection rates of the countries. Therefore, this study analysed the current guidelines of Denmark, Italy and The Netherlands on one of the most prevalent healthcare-associated resistant infection methicillin-resistant Staphylococcus aureus (MRSA) in Europe. Additionally, the guidelines were also compared to the current evidences found on the five main prevention areas (antibiotic stewardship, screening, decolonisation, patient management and nursing staff workload) of MRSA control. Many of the recommendations provided by the guidelines of the countries were similar to each other and increasingly evidence-based. However differences were mainly noticed between the high (Italy) and the low MRSA prevalent countries (Denmark and the Netherlands) in their screening, isolation and antibiotic guidelines. The Netherlands, country with the lowest prevalence of MRSA had the simplest set of guidelines that were applicable in daily patient care situations. The analysis of the guidelines suggested that there is a relationship between the national MRSA guidelines and the increasing or decreasing prevalence rates of MRSA that in turn contributes to the premature mortality and economical impacts caused by MRSA. This study also points out the need for good scientific studies in some aspects of MRSA prevention in the healthcare settings e.g. regarding the isolation and screening practises and for a European wide collaboration in the area of resistant healthcare associate infection prevention among the member states.
Chapter 1: Introduction and background

1.1 Introduction

The European Centre for Diseases prevention and Control (ECDC) states that healthcare-associated infections (HAI) and antimicrobial resistance (AMR) are among the most serious public health problems of the 21st century, globally and in Europe (Eurosurveillance, 2010). Approximately more than 8-12% of the people in Europe suffer from adverse events while they are hospitalised mainly as a result of HAI (Council of the European Union, 2009). HAI also accounts for 37,000 deaths annually and, in addition, around 7 million Euros are spent on extra nursing care, treatment costs and for secondary operations every year (WHO, 2010). This troublesome state of HAI makes it one of the major issues regarding patient safety in Europe.

Currently, HAI is combined by the continuous emergence of multi-resistance bacteria in many healthcare institutions, which dramatically narrows the spectrum of effective antibiotics to a clinically challenging extent. According to the ECDC and European Medicines Agency (EMA) the direct costs (healthcare costs and productivity losses) resulting from AMR and HAI are around 1.5 billion Euros per year and are also attributable for around 25,000 deaths annually (ECDC, n.d). Approximately half of the healthcare-associated deaths are attributable to AMR. Understanding the importance of this issue, the Danish presidency of the Council of European Union 2012 has included AMR as one of the main priority areas to be tackled in 2012 (Danish presidency of the council of the European Union 2012, n.d). Further, with the introduction of the cross border care directive there has been an increase in the mobility of the patients seeking medical treatments outside their country of residence. Since these infections are not constrained by national boundaries they spread easily between and within the Member States (MS). Such increasing prevalence of drug resistant HAI also prolong the period of stay and increase the avoidable complications as well as the costs made by the patients for healthcare purposes by the patients. Thus more importance should be given to decrease the transmission of such resistant infections to ensure the safety and wellbeing of the population.

However, ECDC states that approximately 20-30% of these infections are preventable by intensive hygiene control programs in the healthcare providing institutions (ECDC, n.dd).
Therefore, this paper focuses on the prevention of AMR infections in the healthcare settings (especially hospitals) of European Union (EU) MS by taking one of the most prevalent antimicrobial-resistant bacterium, i.e. methicillin-resistant *Staphylococcus aureus* (MRSA) as an example.

### 1.2 Background

*Staphylococcus aureus* (*S. aureus*) is a Gram-positive bacterium\(^1\) that is present in the skin of around 30% of the human population and is also capable of surviving for several months in the environment (CDC, n.d; Grundmann *et al.*, 2006). Even though *S. aureus* is perceived to be a “harmless coloniser”, it can cause serious harm when it enters the blood or other tissues of the body on several occasions during care in the healthcare institutions, especially when invasive procedures such as surgery, injections, ventilation are performed (BBC, n.d). It can either cause normal skin infections or it can result in life-threatening infections such as bloodstream infections, surgical site infections and pneumonia. The term methicillin-resistant *S. aureus* (MRSA) is used to designate some *S. aureus* isolates that are resistant to one or more antibiotics of the methicillin group, which were initially used to treat *S. aureus* infections (BBC, n.d).

Due to the misuse or overuse of drugs in the recent years, the number of MRSA infections has increased. Currently, MRSA is responsible for numerous nosocomial\(^2\) and community-acquired infections and is the most important cause of antimicrobial-resistant infections worldwide. It accounts for 44% of all HAIs (around 150,000 patients per year) and 41% of extra days of hospitalisation that cost an additional 380 million Euros for in patient care in the EU (Eurosurveillance, 2010). Even though infections caused by MRSA are as aggressive as other infections, MRSA is more resistant to the treatments, which makes MRSA infections more difficult to treat.

Over the past few years, MRSA prevalence decreased in some of the European countries, but it still remains above 25% in more than one third of the EU countries as shown in figure 1.

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\(^1\) Gram-positive bacteria - Bacteria that retains the purple stain used in Gram's staining method. Gram-positive bacteria have thick cell walls that are sensitive to the effects caused by antibiotics or the immune cells of the body.

\(^2\) Nosocomial infection – infections acquired in the hospitals. The term “healthcare-acquired infections” is now preferred to include all infections occurring in healthcare.
Figure 1 – Prevalence of MRSA (percentage of MRSA among *S. aureus* isolates from blood cultures), Europe, 2010

Such increasing rates of infections have evoked fear and fuelled distrust among the patients regarding the quality of healthcare provided in the EU countries. Therefore, many of the healthcare consumers perceive MRSA infection as an evidence of poor quality of healthcare services in a country. This is an indication that MRSA infection is correlated with the levels of quality of care, outcome and patient safety within the healthcare institutions of EU countries. Due to these reasons, the EU institutions have taken many initiatives in the area of AMR and HAIs to guide the MS in reducing such infections. Since only they can bring a mutual understanding (with common principles and strategies) between the MS to combat this cross border threat.

1.3 Actions taken at the EU level to control MRSA

Article 168 of the Lisbon treaty states that high level of human health protection should be ensured in all the policies and activities by promoting cooperation between health services of the MS, protecting consumer safety and fostering availability and exchange of information and best practices (The Lisbon Treaty, n.d). The term “Consumers” in this article also
includes the patients as they receive healthcare services from the healthcare institutions such as the hospitals, nursing homes etc. The Commission communication (COM (2001) 333 final) on a community strategy on the prudent use of antimicrobial agents in human medicine was adopted by the Council in November 2001 in order to implement this article in the area of antibiotic resistance, (European Commission, 2001). This recommendation suggests the MS to implement strategies that reduce AMR and improve prudent use of antibiotics and requests the commission to assist the MS in sharing information, coordination and consultation and to report back to the Council on the progress of the MS on the issue of AMR.

Further, in April 2004 the European agency ECDC was established under the European parliament and Council regulation 851/2004 to strengthen Europe’s actions against infectious diseases especially in the filed of AMR and HAI (ECDC, 2004). The ECDC funds and coordinates three large networks namely, Healthcare-Associated Infections Surveillance network (HAI-Net), the European Antimicrobial Resistance Surveillance Network (EARS-Net) and European Surveillance of Antimicrobial Consumption Network (ESAC-Net) that collects data and coordinates the surveillance between the MS in the activities related to resistant healthcare-associated infections within Europe (ECDC, n.db), (ECDC, n.dc), (ECDC, n.de). These networks work in close collaboration with the national surveillance systems of the MS that collect reliable data from their clinical laboratories. The network currently includes 900 laboratories which serve over 1400 European hospitals treating approximately 100 million population of Europe (ECDC, n.db). The interactive database on the webpage of EARS-Net, helps to display the information regarding the incidence and prevalence of AMR within Europe that might be of help for various stakeholder groups such as the doctors, patients and policy makers (ECDC, n.da). Moreover, both networks also publish annual reports that include the current trends and conclusions which could be drawn regarding the current occurrence of AMR and HCAI and the antibiotic usage data in Europe.

Finally the Council recommendation on patient safety including prevention and control of HAI 2009/ C151/01 was adopted on the 9th of June 2009 (Council of the European Union, 2009). The recommendation aims to promote the quality of patient safety and prevent the occurrence of adverse events in healthcare institutions across the European MS. The recommendation also encourages the MS to implement and improve national or regional strategies related to the prevention and control of HAI, and to establish a national surveillance system that provides systematic and reliable data on the occurrence of HAI in
the country. Although such steps have been taken by the EU institutions, handling problems related to patient safety is mainly the responsibility of the MS (Council of the European Union, 2009). Therefore, it is vital to analyse the initiatives taken by the MS to tackle this European problem.

It is crucial to have evidence-based guidelines on MRSA at a national level. As guidelines could be defined as a written summary of actions that have proven effective at preventing and controlling diseases and they also indicate the priority given to a certain area by the national authorities. In 2002 the World Health Organization (WHO) stated that such guidelines should aim to reduce the risk of transmission by taking into account the best available scientific evidence and should allocate resources for organising control and prevention programmes in the healthcare institution, for surveillance systems and training and research in this area (WHO, 2002). According to the recommendations provided by the Joint Working Party of the British Society of Antimicrobial Chemotherapy, the Hospital Infection Society and the Infection Control Nurses Association published in the Journal of Hospital Infection (from now onwards will be referred to as Coia et al.) there are five main areas that policies should focus on to prevent and control healthcare related MRSA infections (Coia et al., 2006).

These are:

1. Antimicrobial stewardship to prevent inappropriate use of antibiotics
2. Screening
3. Decolonisation
4. Patient management
5. Nursing staff workload and MRSA transmission

However, many of the countries have gaps in fulfilling these requirements. Hence, this study examined the existing national strategies of the Netherlands (NL), Denmark (DK) and Italy (IT), as well as on these five areas to control transmission of MRSA in healthcare settings in these countries. These countries were chosen due to their similarities and differences in MRSA prevalence rates as seen in figure 1 (DK and NL being the low prevalent and IT being the high prevalent country). This would enable to determine if these rates reflect the similarities and differences observed in their national guidelines which would in turn help to archive the main objective of this study. In addition the choice of the countries was also
dependant on the geographical location of the countries (to compare the impact nosocomial infection has on west, north and south gradient countries).

1.4 Research objective

The main objective of this study was:

To identify the possible association between existing national guidelines on healthcare-associated MRSA and their possible effects on the prevalence of MRSA infections in the respective MS.

Thus the hypothesis of this study was that differences in the content of national guidelines to control transmission of MRSA in healthcare settings are associated with different MRSA prevalence rates in the MS.

1.4.1 Research questions

The main research question was:

Could the content of a national guideline on healthcare-associated MRSA in a country explain MRSA prevalence rates and trends of these rates in the country?

In order to answer the main research question the following sub questions were developed:

1. Which guidelines currently exist in the selected MS regarding the risk of MRSA transmission in healthcare settings of the selected MS? (taking into consideration of the five main areas of prevention recommended by Coia et al. (2006))

2. What is the impact of these national guidelines on
   
   a. Trends of MRSA infections (2000-2011) of the selected MS?
   
   b. Mortality rates related to healthcare-associated MRSA?
c. Economic impact of MRSA in the MS?

3. Which country guidelines could be used as 'good practice'?

1.5 Research setting

This research was conducted during the internship at the Standing Committee of European Doctors (CPME) in Brussels, Belgium. CPME is a political organisation that works in close collaboration with the national medical associations of the European MS on patient safety issues and it mainly aims to achieve the highest quality healthcare for all patients in Europe. Moreover, CPME is also a member of the technical advisory board of the ECDC and contributes its expertise in developing AMR infection policies at a European level. Thus the issue of AMR- HAI and its consequences to the health of the patients in Europe are in line with the current working agenda of the CPME.
Chapter 2 – Methodology

2.1 Research method and data collection

Initially a basic literature review was conducted. This method uses available data obtained from a research that has already been performed by other institutions in the area of AMR infections in the healthcare settings of Europe (Polit & Beck, 2004). Secondary data was collected from the organisations such as the WHO, ECDC and other European organisations (such as EU Prevent) that are currently involved in research on HAIs and AMR prevention. Such a search was initially conducted in order to obtain a general overview of the MRSA situation in the European region and the selected MS.

Afterwards a more extensive systematic literature review was conducted with the help of databases, such as Public/Publisher MEDLINE (PubMed), Psychological Information database (PsycINFO) and Springer link. The main intention of this literature review is to provide an overview of the current preventive measures used in the hospitals to prevent and control the transmission of MRSA in the hospitals and to analyse the MRSA situation in the selected MS. Keywords such as ‘MRSA’, ‘staphylococcus aureus’ ‘infections’, ‘hospitals’, ‘prevention’, ‘antibiotic’, ‘stewardship’, ‘screening’, ‘decolonisation’, ‘isolation’, ‘barrier precautions’, ‘hand hygiene’ ‘patient transfer’, ‘nurse staff’, ‘workload’, were used in combination to get efficient results (please see Appendix 1 for details). Further, to increase the chances of finding the relevant information, variants of these keywords were also used with the help of thesaurus or MeSH terms as the keyword in the databases might differ from the ones mentioned above.

The data on the outcomes measures (MRSA trends, mortality rates and economical impact in the countries) were collected from various databases. For example the European Antimicrobial Resistant Surveillance Network (EARS-Net) of the ECDC was used to retrieve information on the current prevalence rates of MRSA in each country. In addition the national databases of the institutions involved in MRSA surveillance and prevention in the selected MS were also used to retrieve information on the economical impact of HAIs. Besides the databases mentioned above, data was also collected from the reports and surveys conducted by various European and international level non-governmental organisations.
2.2 Results of the literature search

Articles written in English and published between January 2000 and April 2012 were included in the study. The initial result of the database search was a total of 1687 articles (see Appendix 1 for detail) and an additional 10 articles were found during the hand review. However, only a limited number of studies were included in the paper (see appendix 2 for the studies included) due to the restrictions in the searching process as mentioned in table 1. The relevance of the articles was first assessed by their title and abstract and then the chosen articles were analysed in depth.

<table>
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<tr>
<th>Inclusion criteria</th>
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<tr>
<td>Studies related to healthcare acquired MRSA</td>
<td>Studies related to community acquired MRSA, live stock MRSA and other HAIs.</td>
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<td>Only studies performed in the acute care settings (hospitals).</td>
<td>Studies performed in long term care facilities and other facilities (nursing homes).</td>
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<td>Studies only fell under the five key prevention areas mentioned by Coia et al. (2006) (antibiotic stewardship, screening, decolonisation, patient management and nursing staff workload)</td>
<td>Studies including other prevention measures</td>
</tr>
<tr>
<td>Out come measures only related to mortality rates and economical impact of hospital acquired MRSA.</td>
<td>Other outcome measures related to MRSA</td>
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Table 1- Inclusion and exclusion criteria of the studies included

Further, to receive the appropriate and up-to-date guidelines of the MS, national institutes in charge of hospital related infections were contacted or the published guidelines were directly obtained from their web pages. These institutions were,

1. The Dutch working group on infection prevention (WIP) for the Dutch guidelines;
2. The Danish Health and Medicines Authority for the Danish guidelines;
Chapter 3: Definitions and concepts

It is crucial to have a standard definition in order to compare and evaluate the performance or surveillance reports of a healthcare institution with another or with the national data of a country. Therefore, this chapter aims to explain the definitions of the two main terms “HAI” and “AMR” used in this paper.

3.1 Healthcare-associated infections (HAIs)

The Council recommendation on patient safety (2009), including the prevention and control of HAIs suggests that HAIs “are diseases or pathologies related to the presence of an infectious agent or its products in association with exposure to healthcare facilities or healthcare procedures or treatments” (Council of European Union, 2009).

The WHO states that HAI “is an infection occurring in a patient during the process of care in a hospital or other healthcare facility which was not present or incubating at the time of admission.” (WHO, n.d).

The US Centre for Disease Control and Prevention (CDC) defines HAI as “the infections that occur more than 48 to 72 hours after admission and within 10 days after hospital discharge.” (Agency for Health Research and Quality, 2007)

All the above mentioned definitions describe HAIs as an infection which develops during or just after the stay in a healthcare institution. However, in comparison to the CDC definition, the definitions from the Council and the WHO do not specify the time interval of the disease development. Moreover, the term “healthcare-associated infection” also known as “nosocomial infections” refers not only to the infections occurring in the acute care facilities such as the hospitals but also in the long term healthcare facilities such as the nursing homes.
3.2 Antimicrobial resistance (AMR)

The WHO states that AMR “is resistance of a microorganism to an antimicrobial medicine to which it was previously sensitive.” (WHO, n.d) which suggests that disease causing organisms (such as the viruses, bacteria and some parasites) develop a gene being resistant to antimicrobial medicines such as the antibiotics which were previously used to treat bacterial diseases. The organism’s resistance to antibiotics is triggered by misuse or over use of the antibiotics. Therefore, the standard treatments for the diseases become ineffective and the diseases continue to spread among the population.
Chapter 4: MRSA transmission and prevention in the hospitals

4.1 Modes of transmission

In order to understand the prevention methods used to control MRSA bacterium in the hospitals, first the paths by which the bacterium is transmitted should be identified. The MRSA bacterium spreads via four main modes in a healthcare institution:

- Direct contact transmission
- Indirect contact transmission
- Droplet transmission
- Air borne and environmental transmission

4.1.1 Contact transmission

➤ Direct contact

MRSA is primarily transmitted by direct contact with the infected or colonised person, most frequently when the hand of the healthcare worker is directly contaminated by the infected or colonised patient (Rohr et al., 2009). This bacterium is more easily transmitted in a healthcare setting as a result of close person-to-person contact. Therefore, places such as intensive care units are among the highest risk areas of MRSA transmission as the contact between the medical staff and the infected patients is frequent.

➤ Indirect contact

Although person to person contact is the main mode of transmission, the spread of MRSA can also be indirect. This occurs when the bacterium is transferred from an infected patient to another through a contaminated object or person. Such objects or persons are regarded as the intermediate transmission vectors (American Hospital Association, 1979). For instance when a healthcare personnel is infected by touching a door knob which was previously contaminated by an infected patient.
4.1.2 Droplet transmission

The droplet transmission is another form of direct contact. It occurs when the droplets carrying infectious microorganisms of an infected patient are directly transferred from the respiratory track of the infected person to the mucosal surface of the susceptible individual (CDC, 2007). The droplets are generated when the infected individual sneezes, coughs or talks. This transmission occurs over a short distance, which shows the relevance of facial protection (such as masks) when an infected individual is approached.

4.1.3 Air borne and environmental transmission

It has been proven that *S. aureus* is able to survive for various periods on surfaces and dusts (American Hospital Association, 1979). Even though there is no direct evidence of environment acting as a secondary reservoir for the MRSA infection, recent studies have suggested that the environment of colonised or infected patients serves as a potential reservoir in certain circumstances in the hospital (Al-Hamad *et al.*, 2008; Talon, 1999). For instance, in the intensive care and burn units of the hospital, environmental transmission of MRSA could be the important route of transmission and air borne transmission occurs during the treatment of tracheotomised patient with MRSA pneumonia (CDC, 2007). Another study conducted by Boyce *et al.* (1997) confirmed that contact with the environment of the infected individual was sufficient enough to contaminate the gloves of healthcare personnel without having contact with the infected patient (Boyce *et al.*, 1997).

The upcoming chapter discusses some of the studies conducted in the recent years that analyses the evidences found on the five main prevention areas of MRSA control.

4.2 MRSA prevention areas recommended by Coia *et al.* (2006)

The study by Coia *et al.* (2006), has recommended five priority areas to focus on during preventing the transmission of MRSA in hospitals (Coia *et al.*, 2006). The following sections describe these areas in detail.
4.2.1 Antimicrobial stewardship - inappropriate use of antibiotics

Inappropriate use of antibiotics plays an important role in promoting antibiotic resistance. Over use, miss use, under dosage and the use of broad-spectrum agents promotes the spread of antibiotic resistance. In most circumstances, glycopeptides antibiotics, in particular vancomycin⁴ and teicoplanin⁵ are prescribed to patients for the treatment of MRSA infections in the healthcare institutions (Jones et al., 1997; French, 2010). However, long-term exposure to such antibiotics has been strongly associated with the development of glycopeptide-resistant S. aureus (Westh et al., 2004). A quasi-experimental study conducted in the Côte de Nacre University Hospital in France, showed a significant reduction in MRSA prevalence (18% reduction) when the use of fluoroquinolone antibiotics⁵ was reduced (Charbonneau et al., 2006). Thus, therapies with these antibiotics should only be prescribed when it is proven to be suitable and prolonged use of such a therapy should be avoided at all times (Liebowitz, 2009). Such resistance also increases the risk of cross infections, delay in effective treatments and increase the use of less effective more toxic and expensive drugs during the treatment sessions (French, 2005). Therefore, studies conducted by Doron et al. (2011) and Coia et al. (2006) have emphasised the importance of including antibiotic stewardship in the national guidelines of healthcare-associated MRSA of a country (Doron et al., 2011; Coia et al., 2006). This also illustrates the need for prescriber education on the appropriate dosage and duration of antibiotics to ensure best results for the treatment or prevention of infection (Doron et al., 2011; Rivera et al., 2011).

4.2.2 Screening

Having an active screening program in the hospitals is essential for identifying the MRSA carriers who are capable of spreading MRSA in the hospitals. According to a study performed in four hospitals in the Netherlands, the MRSA carriers had three fold increase risk in acquiring FMRSA infections than the non-carriers (Wertheim et al., 2004). Therefore, a

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³ Vancomycin – An amphoteric glycopeptide produced by Streptomyces orientalis and was accessible since the mid 1950s.
⁴ Teicoplanin- A glycolpeptide antibiotic created by the bacterium Actinoplanes teichomyceticus. Normally used as a less toxic alternative to vancomycin in treating infections caused by gram positive bacteria such as S.aureus.
⁵ Fluoroquinolones – Any group of antibiotics which are florinated derivatives of quinolones, that are effective against bacterial activity.
screening programme including specific measures for both patients and healthcare professionals should be implemented in the hospitals.

- **Screening of patients**

High-risk units of the hospital and patients in particular should be screened more often and on time of admission than the others (Coia et al., 2006). Such high risk individuals include

  - patients who were previously infected with MRSA;
  - patients who are transferred from another hospitals (especially if they are from the hospitals with high MRSA infections);
  - patients who are admitted frequently to the healthcare institutions;
  - patients who received treatment from another country with high prevalence of MRSA;
  - patients with urinary tract infections, ulcers, surgical wounds etc.;
  - residents who are in the areas of high MRSA prevalence.

Moreover, in order to identify the presence of the bacterium, skin lesions, wounds, urine and the sputum of those who cough should be sampled. Further, within the neonatal units of the hospitals the umbilicus of the infant should be checked at a regular interval. A routine (weekly or monthly) screening of patients in high risk units should also be arranged according to the local prevalence rates of MRSA. Such special units in the hospitals include: intensive care, burn, transplantation, neonatal care, cardiothoracic, orthopedic, trauma unit.

- **Screening of healthcare staff**

Screening of the staff in the hospital should only be performed if new carriers in a ward are found despite the active control measures. According to the recommendations provided by the Coia et al. in such circumstances the staff should be inquired about skin lesions (Coia et al., 2006). The staff with such skin lesions should first be screened with nasal swabs and then treated by the occupational health department of the hospital. However if the staff have prolonged carriage sites other than their nose (for example in their ears or throat) then they should be directed to the appropriate specialist for management. Moreover, they should also be advised to schedule a follow up screening with the particular specialist according to the protocols of the hospital (Coia et al., 2006).
Both the healthcare staff and the patients colonised with MRSA bacterium are recommended to screen at least three times at weekly intervals before they are perceived to be at low risk of spreading MRSA. This is due to the delay in MRSA acquisition and its presence being detected by screening samples. Additionally, the hospitals that work close to one another and exchange a large number of patients among each other (especially the ones in the cross border region) should agree upon common and effective screening measures that can be linked to the control measures in both the healthcare facilities. However, screening of MRSA in the hospital itself is not the answer to reduce the transmission. Such screening practices should be followed by effective decolonisation measures by the healthcare staff of the hospital.

### 4.2.3 Decolonisation

The main goal of decolonisation is to decrease the shedding of MRSA which in turn minimises the risk of infection and transmission to other patients. In order to understand the decolonisation interventions of MRSA the difference between colonisation and infection are first described. An infection according to the American hospital association is “the entry and development or multiplication of an infectious agent in the body of a person”. However, colonisation or contamination of MRSA on the other hand is defined as “the presence of living infectious agents on exterior surfaces of the body or on apparel or on soiled articles” (American hospital association, 1979). During the infection, development of symptoms (inflammatory reactions) could be observed, whereas in colonisation they would not appear. Even if there are no symptoms, such colonisations act as a potential “reservoir” for infections. According to CDC, 30% of the human population are asymptomatically colonised with *S. aureus* in their nose and or other parts of their body (CDC, n.d). The figure 3 shows the likelihood of MRSA colonisation in particular areas of the individual.
Probability to discover MRSA in a colonised patient is highest at the nose with almost 100% and lowest at the hairline and the genitals with 20% (Kluytmans et al., 1997). However decolonisation of the nose itself will not reduce the transmission of MRSA, as the study conducted by Rohr et al. (2003) showed that 19% of all cases that were detected in the hospital were not nasal carriers. In addition this study also proved that around 11-23% of all MRSA infections in the hospital setting could be reduced by considering other areas of decolonisation (Rohr et al., 2003). According to Coia et al. (2006) decolonisation procedure of MRSA mainly refers to the use of agents such as shampoo, body wash or ointment that helps to minimise or eliminate carriage of MRSA in the body of an individual (Coia et al., 2006). The recommendations on MRSA decolonisation by Coia et al. (2006) are divided into three main areas, decolonisation of the nose, throat and the skin of the patient.

**Nasal decolonisation**

The patients who are given prophylaxis due to their operation should always undergo the decolonisation procedure. In order to complete this procedure Coia et al. (2006) suggest
applying mupirocin\(^6\) 2% three times a day in the inner surface of the nostrils of the patient for five days continuously (Coia \textit{et al.}, 2006). The review conducted by van Rijen \textit{et al.} (2008) confirmed that use of mupirocin ointment would reduce a significant number of \textit{S.aureus} infections in the hospital (van Rijen \textit{et al.}, 2008). In addition, study conducted by Bode \textit{et al.} (2010) also proved that decolonisation with mupirocin in combination with rapid screening can reduce MRSA infections in a hospital by approximately 60\% (Bode \textit{et al.}, 2010). On the other hand, many studies have stated that prolonged use of mupirocin can lead to development of resistance. Therefore, treatment should only be given for five days maximum (Cookson \textit{et al.}, 2011; Miller \textit{et al.}, 1996). Nevertheless, nasal decolonisation should always be accompanied by decolonisation interventions in other parts of the body (skin, throat, etc) in order to reduce MRSA effectively.

\textbf{\textit{Throat decolonisation}}

The treatment for patients with throat colonisation should be prescribed according to the advice of the microbiologist with suitable monitoring. This procedure should only be considered when there is evidence that the MRSA out break in the hospital is caused by the contribution of a throat carrier. Such a treatment should also be limited to one course as the repetition of the course could develop undesirable side effects. The throat decolonisation intervention should always be combined with both nasal and skin decolonisation interventions. Even though there has been very limited evidence for antiseptic gargles, it may be used to decrease the level of infection.

\textbf{\textit{Skin decolonisation}}

As proven in the study conducted by Cookson \textit{et al.}(2011), Coia \textit{et al.} (2006) also recommends skin decolonisation with body wash or shampoo containing 4\% chlohexidine\(^7\) 7.5\% povidone-iodine\(^8\) or 2\% triclosan\(^9\) for effective results (Cookson \textit{et al.}, 2011; Coia \textit{et al.}, 2006). In addition, the study conducted by Rohr \textit{et al.} (2003) also showed that using the above mentioned solutions can reduce the MRSA infection by a 56.3\% after 24-48 hours and 68\% after seven to nine days of treatment (Rohr \textit{et al.}, 2003). Even though

\footnotesize{\textsuperscript{6} Mupirocin - A drug used to treat infections caused by bacteria and other microorganisms and is derived from \textit{Pseudomonas fluorescens}  
\textsuperscript{7} Chlohexidine - A liquid antiseptic that is effective on both Gram-positive and Gram-negative bacteria. Mostly used for skin cleansing and decolonisation.  
\textsuperscript{8} Povidone-Iodine complex - Mixture of povidone and iodine, used as an antiseptic for the skin and mucosal surfaces.  
\textsuperscript{9} Triclosan- is an antibacterial agent effective against gram Gram-positive and Gram-negative bacteria. Mostly used as a detergent in soaps and deodorants.}
there is only a very limited amount of data available on the development of resistant to such solutions both the study conducted by Milestone et al. (2008) and the review conducted by Coia et al. (2006) advises that skin decolonisation interventions should be limited to five days (Milstone, 2008; Coia et al., 2006).

Moreover, the journal also states that patients with previous skin problems such as eczema should be treated for their underlying skin conditions before undergoing MRSA decolonisation interventions. In such circumstances skin decolonisation with Oilatum\textsuperscript{10} is recommended, however, advice of the dermatologist should always be considered before the initial treatment.

4.2.4 Patient management

Patient management in a hospital setting is described as placing the infected patients in an appropriate place and taking initiatives such as general hygiene practices, isolation measures and environmental protection measures to minimise the transmission and infection of MRSA in the healthcare institution. Thus Coia et al. (2006) suggest five areas that should be taken into consideration when patient management is concerned.

- **Isolation techniques**

Isolation of a patient depends on the level of risk and the number of facilities available at the hospital. However it should be made sure that the isolation is in a closed area and the details of this area should be clearly defined (such as a single room accommodation or cohort areas with clinical hand washing facilities). Further, none of the studies found during the literature search including the review conducted by Coia et al. (2006) proved that the single room isolation was better than cohort isolation (Coia et al., 2006). A one year perspective study conducted in the three general intensive care units of two teaching hospitals in London showed that moving the MRSA infected person from the intensive care to single rooms or cohort isolated in an open bay did not reduce cross infections (Cepeda et al., 2005). Nevertheless an important limitation related low hand hygiene compliance along the health-

\textsuperscript{10} Oilatum – is normally used as a bath additive that should be prescribed by the dermatologist for effective in eradication of the gram positive bacterium in the skin of an individual.
care staff in the study was observed which might have influenced the results of MRSA transmission in the settings (Cepeda et al., 2005).

Moreover, in order to minimise the spread of the bacterium, the door of the isolation room should be kept closed at all times, especially during changing of bed covers or during chest physiotherapy treatments as it generates Staphylococcal aerosols. Visitors to the isolation room should also be requested to adopt the precaution measures and they should only enter after the nurse in charge has given them permission and proper instructions. In addition to the verbal explanation a short description of isolation precautions should also be displayed in a common place (Coia et al., 2006).

➢ **Hand hygiene**

In order to avoid cross infections high standards of hand sanitisation should be ensured at all times during the isolation procedure. The hands of the person who comes in contact with the patient should be decontaminated either by washing them thoroughly or applying hand rub containing 70% of alcohol. This procedure should be repeated before and after the person comes into contact with the contaminated individual. Similar to the guidelines by WHO on hand hygiene, various studies have also confirmed the efficacy of alcohol hand rub in reducing MRSA transmission in hospitals (Johnson et al., 2005; Mahamat et al., 2007; WHO, 2009). Especially, a review conducted by Sorka et al. (2010) proved that there was a significant correlation (r = 0.78) between an increase in alcohol hand rub use among the healthcare staff and a reduction in MRSA infections in the hospital (Sorka et al., 2010).

➢ **Barrier precautions**

Most of the studies analysed during the literature review had varying results in the MRSA rates when contact precautions were used. For instance two of the studies conducted by Huskins et al. (2011) and Trick et al. (2004) showed that there was no differences observed in the MRSA rates when contact precautions such as gloves and gowns were used (Huskins et al., 2011; Trick et al., 2004). In contrast, the controlled trial conducted by Bearman et al. (2007) proved that 37% healthcare workers who did not wear gloves contaminated their hands whereas the contamination rate was only 5% among those who did (Bearman et al., 2007).
Studies conducted by Hayden et al. (2008) and Safdar et al. (2006) also confirmed that wearing barrier precautions was highly helpful in preventing MRSA contamination in the hospitals (Hayden et al., 2008; Safdar et al., 2006). As none of the studies have evaluated the negative effects in using such precautions it could be concluded that the use contact precautions such as gloves and gowns are to some extent protective against the direct contamination of MRSA to the healthcare staff (especially when the staff or the visitor comes into contact with the body fluids or contaminated dressings of the infected individual). Thus the healthcare staff and the visitors who come into direct contact with the MRSA infected patient (by helping them with the bath etc) should wear a disposable gown whereas the visitors with less contact (example – shaking hands) do not have to.

Moreover, the use of gloves should always be combined with the use of alcohol hand rub as a study conducted by Matsumoto et al. (2012) in a Japanese hospital stated that 42% of the healthcare workers who had indirect contact with the patients (who only touched the surface of the infected patient’s room) contaminated their gloves with MRSA (Matsumoto et al., 2012). In addition according to Coia et al., if the patient is undergoing certain procedures such as chest physiotherapy where there are chances of the patient generating staphylococcal aerosols it is vital for the healthcare staff to put on masks.

Cleaning and decontamination

As mentioned in chapter 3 MRSA is able to survive in the environment for a long period of time (approximately 30 days), which points out the relevance of dust minimisation and proper disposal of contaminated linen and waste in the hospitals. Instruments and equipments in the room should not be reused by any other than then patient himself. If they are reused then it should be made sure that such equipments are properly decontaminated with the standard procedures. The bed used by the infected patient may need specialist cleaning depending on the treatment the isolated patient has received and the curtains and linen should be considered contaminated. Therefore, they should be removed and laundered properly on a regular basis if they are reused. Furthermore, a study conducted in the intensive care unit in the University of Maryland medical centre in the United States showed that the detection frequency of MRSA and VRE organisms in the gloves or the gowns of the healthcare workers was 18% (Snyder, 2008). Another recent study conducted by Morgan et al. stated that 21 out of the 152 (13.8%)
healthcare staff contaminated their barrier precautions (gloves and gowns) during their interaction with the patients (Morgan et al., 2012). Therefore, such barrier precautions should immediately disposed in an appropriate manner after use and should not be reused by the healthcare workers. Further, all such wastes (including the used barrier precautions) collected from the isolation rooms should be labeled as clinical waste before they are disposed according to the national guidelines or the local hospital policies.

Many previously conducted studies have illustrated the importance of strategies that evaluate the quality of hospital cleaning in a proper manner. Most of the hospitals consider the visual assessment method to evaluate the quality of cleaning. However, a previous study conducted in a hospital showed that after cleaning, 82% of the ward sites were considered to be clean using the visual method, whereas the microbiological assessment proved only 30% to be clean (Talon, 1999). Moreover, the new admissions in the ward should only be admitted after a thorough environmental decontamination procedure (Griffith, 2000).

Transfer and discharge of patients

Various studies have proved that transferring a patient from a healthcare setting to another increases the risk of MRSA transmission (Barnes et al., 2011; Lee et al., 2011; Jerningan et al., 1995). However, in certain circumstances the transfer becomes compulsory, especially if they are in need of other aspects of care. Therefore, transfers of infected or colonised patients should be very cautiously monitored with regard to the dressing of the patients and the healthcare staff. If the patient is transferred within the hospital (from one department to another) the staffs who are involved with the patient should always cover their nose and mouth with a mask and wear a disposal gown to protect their clothing. Both of these clothing should be disposed after the transfer and should be labelled as clinical waste and the equipments such as trolleys used by the patients should also be decontaminated properly before reuse (Coia et al., 2006).

4.2.5 Nursing staff workload and MRSA transmission

Another important area that has been identified as a priority to control MRSA is the amount of work assigned for the infection control nursing staff. Many studies have identified the
direct association between the differing levels of nursing workload and the rates of HAIs (mostly MRSA infections) in the hospital wards. For example, according to the study conducted by the Medical University of Warsaw the nurses in the hospital were less likely to perform hand hygiene procedures as their work load increased (Garus-Pakowska, 2011). Another study conducted by Voss et al. (1997) showed that the clinical workload demands of nurses reduced the time for them to perform routine infection control procedures which in turn increased the transmission of microorganisms among the patients (Voss et al., 1997).

Further, according to a study conducted in the Medical intensive care unit of the University of Geneva Hospitals in Switzerland, lower staffing levels was associated with around 50% of increased risk of HAIs and it also stated that 26.7% of all HAIs could be avoided if the nurse to patient ratio was maintained at >2·2 (Hugonnet et al., 2007). This means that if there are 22 patients in a critical ward section there should be around 10 nurses assigned to control these wards to reduce the transmission rate by a 26.7%. Therefore, adequate amount of nursing staff should be employed in order for the infection control guidelines of the hospital to be effective. In addition to the number of staffs, their level of experience, working conditions and availability of adequate resources to perform infection control procedures should also be taken into consideration by the infection control team when responding to MRSA outbreaks in the hospital environment.
Chapter 5: MRSA situation and guidelines in the selected countries

This chapter analyses the national guidelines of the countries and their impact on the MRSA rates in the country using three outcome indicators. By doing so the chapter intends to answer the first and the second sub-questions of this research, by focusing on the,

- MRSA trend from 2000 – 2010
- Economical impact associated with healthcare acquired MRSA
- Mortality rates associated with healthcare acquired MRSA

5.1 The Netherlands (NL)

5.1.1 MRSA guidelines in NL

The prevalence of MRSA infections in the NL (1.2%) is remarkably low compared to the neighboring countries such as Germany (20.8%), Belgium (20.5%) and France (21.6%) (ECDC, 2011). In order to maintain such a low level of MRSA infections in the hospitals the Dutch working party on infection prevention (WIP) published national guidelines on MRSA in hospitals in 2007 (WIP, 2007). These guidelines reflect the ‘search and destroy policy’ that has been followed over 10 years to prevent and control MRSA in the healthcare settings of the NL. The official set of guidelines was initially introduced in 1989 when the MRSA infections were first detected in the hospitals of the NL (WIP, 2007).

According to the guidelines an epidemic of MRSA is defined as when two or more patients in a hospital are infected or colonised by the same strain of MRSA and measures for both patients and healthcare workers are provided based upon their risk categories. These risk categories include:

Category 1 – Proven MRSA carrier
Category 2 – High risk of being a carrier
Category 3 – Increased risk of being a carrier
Category 4 – No increased risk of being a carrier

In addition to the risk categories, the guidelines contain seven other sections that include treatments of infected patients, measures related to staff and patients etc. Furthermore,
besides the general guidelines, NL also has specific guidelines on hospital isolation procedures “Strict isolation” and guidelines on cleaning, disinfection and sterilisation of the room prepared by WIP and antibiotic prescription of MRSA infections prepared by the Dutch Working Party on Antibiotic Policy (SWAB) (WIP, 2006; WIP, 2004; SWAB, 2007).

5.1.2 MRSA situation in NL

➢ Trends in MRSA prevalence in the NL

The MRSA percentage from the blood cultures in the NL has been varying over the years, from 2000-2010. To be more specific, as shown in figure 3, in the year 2000 the MRSA prevalence was only 0.3%. However, the MRSA rates reached its peak in 2007, where around 2% of the population was infected but after the introduction of healthcare-associated MRSA guidelines in the same year, a steep decrease could be observed from the year 2007 (2%) to 2008 (0.7%) by a 1.3%. Again from the year 2008 onwards there has been an increasing trend in the MRSA rates but this is still considered lower than in many of the neighboring countries as stated previously.

Figure 3 – Prevalence of MRSA (Percentage of MRSA among S. aureus isolates from blood cultures), The Netherlands, 2000-2010 (ECDC, n.d)
Mortality rates related to MRSA

A research conducted by Wertheim et al. (2004) in four Dutch hospitals indicated that the hospital related mortality (directly related to MRSA) among the patients infected with MRSA bacterium was approximately 20% (Wertheim et al., 2004).

Economic impact of MRSA in NL

A study conducted by the Vriens et al. (2002) suggested that the strict implementation of the guidelines on MRSA in the NL from the year 1991-2000 accounted for a total of 6 million Dutch guilders which is equivalent to around €2,800,000 (Vriens et al., 2002). In addition, a recent four year study conducted in the University Hospital of Maastricht from the 2000 till 2004 which only has around 0.7% prevalence of MRSA showed that the annual costs of MRSA search in the hospital accounted for 1,383,200 Euros and the prevention and treatment costs of MRSA infections were 2,736,762 Euros. However, it also confirmed that even if the MRSA prevalence in this hospital reaches 8%, prevention costs would be still lower than the costs of treating the patients (Nulens et al., 2008).

5.2 Denmark (DK)

5.2.1 MRSA guidelines in DK

The Danish national board of health set up a steering group and an expert group in 2004, which in 2005 submitted to the board the draft recommendation on controlling healthcare acquired MRSA infections in DK. After considering the economical and legal issues the board adopted the recommendation in 2006 (Sundhedsstyrelsen, 2008). The main objective of these guidelines is to maintain a low incidence level of MRSA infections in the healthcare settings of DK. This 60 pages document, include chapters on various areas such as screening, infection control precautions and treatment (Sundhedsstyrelsen, 2008). Furthermore, the document also includes guidelines for both acute care facilities and long term care facilities such as the nursing homes and out patient clinics on prevention and treatment of MRSA (Sundhedsstyrelsen, 2008).

Moreover, similar to the Dutch guidelines the Danish ones also have listed a number of risk situations that should be taken into account while screening a patient or healthcare staff for MRSA infections (e.g. patients previously diagnosed with MRSA, admitted to a room with an
MRSA positive patients etc). These screening guidelines especially focuses on the patients who had been treated in other countries as it has been proven that MRSA infections in DK are mostly transmitted from the patients who had acquired the infection in other countries (Sundhedsstyrelsen, 2008).

5.2.2 MRSA situation in DK

➤ Trends in MRSA prevalence in DK
The prevalence of MRSA has been varying in DK over the last 12 years. For instance from 2003 to 2006 there was an increase by 1.1% in hospital acquired MRSA isolates in blood cultures and from 2006 to 2007 there was a steep decrease in the rates by 1% . This decrease could be related to the introduction of the MRSA healthcare associated guidelines that were adopted in 2006. Again, the rates of MRSA were at a peak in 2009 where MRSA isolates were found in 2.1% of the population. However, as figure 5 shows, these numbers have been decreasing from the year 2009 onwards.

![% of MRSA in Denmark](image)

*Figure 4 – Prevalence of MRSA (Percentage of MRSA among *S. aureus* isolates from blood cultures), Denmark, 2000-2010 (ECDC, n.d)*
- **Mortality rates related to MRSA**

The figure below shows that there has been a steep decrease in the mortality rates of healthcare-associated MRSA rates from the year 1960 where the infection rates were more than 40%, till the year 1999 where it reached 17.8%. However, rate of infections have stabilised over the last years as the mortality rate in the year 2007 was 18.2% and in 2008 18.9%. The report also states that 77.1% of these deaths are directly related to MRSA whereas the rest are indirectly linked to the bacterium.

![Figure 5 – Mortality rates related to MRSA in the Denmark from 1980 – 2008 (Statens Serum Institut, 2008)](image)

- **Economic impact of healthcare related MRSA**

During the literature search performed for this research, no studies were identified that evaluated the economical impact of MRSA in DK. However many of the studies published in DK on MRSA were in Danish, due to the language barriers such studies were not included in the study.

5.3 **Italy (IT)**

5.3.1 **MRSA guidelines of IT**

The recommendations for controlling the spread of MRSA in the hospital settings of Italy have been developed by the board of Italian Multidisciplinary Society for Prevention of Infections in Healthcare Facilities (SIMPIOS) in 2005 (SIMPIOS, 2005). The document
consists of a brief description of MRSA and twelve recommendations (on screening, decolonisation, hygiene practises barrier precaution, etc) to prevent MRSA transmission in this hospital.

5.3.2 MRSA situation in IT

➢ Trends in MRSA prevalence in IT
Even though the infection rates of MRSA have been decreasing in the healthcare settings of IT in the recent years, it still remains one of the high burden countries for MRSA infection in Europe. In 2000, around 44.5% of the population was infected with MRSA whereas in 2010 this number has decreased to 36.5%. It should be noted that the Italian guidelines were introduced in 2005. Even though there was a slight increase from the year 2005 to 2006, there was a steep decrease from the year 2006 onwards that might explain the influence of the guidelines in the rates of MRSA in the country.

![Graph of MRSA prevalence in Italy, 2000-2010](image)

Figure 6- Prevalence of MRSA (percentage of MRSA among *S. aureus* isolates from blood cultures), Italy, 2000-2010

➢ Mortality rates related to MRSA
In Italy, a national surveillance, performed in 2004 by National Institute of Health (ISS) in 50 hospitals, showed that almost 500,000 patients (5–7% of all patients admitted in hospitals or
other healthcare facilities) develop HAIs and 15,000 die annually. Antibiotic-resistant bacteria, including MRSA, cause over 50% of these infections (European Hospitals, 2009).

- **Economic impact of hospital related MRSA**

During the literature search there were no studies identified that evaluated the economical burden of MRSA infection in Italy. Further, there is also a need for studies that evaluate the economical benefit of the MRSA guidelines of Italy.

### 5.4 Comparison of guidelines

The following section of the paper compares the national healthcare-associated MRSA infection guidelines of the three above mentioned countries (NL, DK and IT) under the five prevention areas mentioned by Coia et al (WIP, 2006; Sundhedsstyrelsen, 2008; SIMPIOS, 2006). This comparison was performed to identify the gaps in the guidelines the areas recommended by the studies analysed during the literature search. The summary of the comparison is presented below in Table 2 (See Appendix 3 for detail).

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>NL</th>
<th>DK</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antimicrobial stewardship</strong></td>
<td>+</td>
<td>Not explicitly mentioned</td>
<td>-</td>
</tr>
<tr>
<td><strong>Screening</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population screened</td>
<td></td>
<td>Defined risk categories</td>
<td>Risk groups (not defined)</td>
</tr>
<tr>
<td>Collection of screening samples</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Nose</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Other areas</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td><strong>Decolonisation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>(Only in high risk wards)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single room isolation</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Single room /cohort isolation</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td><strong>Hand hygiene</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol based hand rub</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Barrier precautions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Table 2 – Comparison of the national MRSA guidelines in the three countries

<table>
<thead>
<tr>
<th></th>
<th>Gown</th>
<th>+</th>
<th>+</th>
<th>+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Cleaning and decontamination</td>
<td>Environmental cleaning</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Cleaning of the objects in the room</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Patient transfer</td>
<td>Notification to the receiving department</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Precautions during transfer</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Nursing staff workload</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nurse training</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

+ Guidelines present, - No guidelines.

- **Antimicrobial stewardship - inappropriate use of antibiotics**

NL as previously mentioned has a separate antibiotic policy prepared by the SWAB and that has been mentioned in the guidelines. The document comprises details on patient characterises, dosage and duration of treatment for MRSA infected individuals whereas the Italian guidelines have not mentioned them in their guidelines. The Dutch guidelines also emphasise the importance of combination therapy as it is more efficient and has a lower risk of developing resistance. The Danish guidelines have explicitly mentioned the names of the antibiotics that might cause resistance, but they have not mentioned the details on the dosage, duration or on the prescription criteria of such antibiotics.

- **Screening**

All three countries have implemented screening programmes for certain risk groups comprising patients with previous infections or colonisation etc. The Dutch and the Danish have specifically defined risk categories or groups in their guidelines whereas the Italian guidelines have not mentioned details about the risk groups to be screened.

Moreover, in addition to the risk categories mentioned by the *Journal of healthcare infection*, the Dutch guidelines also states that the healthcare workers who have been working abroad should be screened for MRSA infections. Both these countries emphasise the need to screen patients and staff who have been abroad as MRSA is mostly found in people who had acquired the infection from other countries. This highlights the need to adjust the guidelines...
according to the country situation and its needs. Even though NL and DK have extended their criteria to find MRSA infected or colonised individuals during their admission to the hospitals, the IT guidelines in contrast have further narrowed down the criteria: the IT guidelines recommend screening the patients who fall under the risk categories only if they are in the high risk wards. This targeted approach in screening for MRSA in the hospitals shows the limited resources allocated for MRSA prevention in the country.

Moreover, differences in the locations of collecting screening samples were also observed in between the guidelines of the high prevalent (IT) and low prevalence countries (NL and DK). According to the Italian guidelines samples are only collected from the nose of the patient whereas in the other countries the samples were also collected from multiple areas (nose, groin, etc).

➢ Decolonisation
The guidelines of NL and DK states that all MRSA carriers (both patients and healthcare staff) should be decolonised and both the countries have similar decolonisation procedure as it has been recommended by Coia et al and several other studies in chapter 4. This includes the use of mupirocin intranasally three times per day for five days and total body wash with chlohexdine solution. Whereas in Italian guidelines only carriers (patients) in the high risk wards are suggested to under go the decolonisation procedure and again the details of the procedure (on how to perform and the duration of the procedure) has not been explained in the guidelines.

➢ Patient management

• Isolation practices
The Danish and the Dutch guidelines, as mentioned by Coia et al, state that the patients infected with MRSA should be assigned to single rooms where the risk of transmission is minimal. While the Italian guidelines agree to the above mentioned recommendation it also suggests that the infected patients could be placed with other infected patients, which might be of help if there are limited facilities in a hospital settings.
• **Hand hygiene**
  All three countries have emphasised the importance of hand hygiene practices and have preferred using alcohol based hand rubs over the traditional hand hygiene practices (using soap and water) in their guidelines. In addition to the hand disinfection solutions DK and NL have also described, how and when the hand hygiene practises should be conducted.

• **Barrier precautions**
  In all three guidelines both healthcare workers and visitors are obliged to use gloves and gowns during close contact with the patients or any objects related to the patient (linen, clinical waste, wheelchair etc) whereas the masks are suggested only when the patient is at risk of spreading aerosols droplets. However, the Dutch and the Danish guidelines specify the situations in which staff or a visitor should use these barrier precautions whereas the Italian guidelines do not. In addition to this the guidelines of NL have also stated that during the strict isolation of MRSA infected people the head of the visitor or healthcare staff should be covered by a head-covering whereas in the other two countries no such requirement was stated.

• **Cleaning and Decontamination**
  All three countries have mentioned environmental decontamination in their guidelines. DK and IT have described these procedures in their general hospital related MRSA guidelines whereas NL has included a separate guideline on this area named “Hospitals - strict isolation”. Moreover, both DK and NL have described the particular places (equipments used by the healthcare staff, door knob etc) and procedures of decontamination in their guidelines whereas the IT guidelines have not.

• **Patient transfer**
  The guidelines of the three countries have stated that when a patient is shifted from one department to another in a hospital, the staff in the receiving department should be alerted about the situation and necessary precautions should be taken. The Dutch and the Danish guidelines further describe the
barrier precautions that should be taken by the healthcare staff who are involved in the transfer of the patient and the measures that should be taken by the staff before, during and after the transfer.

- **Nursing staff workload**

  Even though many studies have proven the efficacy of including guidelines on employing adequate amount of staff for infection control in a hospital none of the three countries have included them in their guidelines.
Chapter 6: Discussion and conclusion

6.1 Discussion

The findings of the situation analysis conducted in chapter 5 showed that a steep decrease in MRSA rates in the blood cultures was observed in both NL (by 1.2%) and DK (by 1%) directly after the introduction of the national guidelines on MRSA. In addition even though there was a slight increase in the MRSA rates of IT initially, a sudden reduction (by 5.3%) was observed approximately 2 years after the introduction of the guidelines. With the help of these findings it can be suggested that the introduction of such evidence based national guidelines on MRSA in general, could have an influence in decreasing the rates of healthcare acquired MRSA in a country.

However, the comparison of the guidelines also conducted in the previous chapter showed that the national guidelines of these countries were based on different levels of evidence from the ones discussed in chapter 4. In addition many of the evidence-based recommendations were only included in the guidelines of the countries with low prevalence of MRSA (DK and NL) whereas only a few of the such recommendations were included in the guideline from IT, a country with a much higher prevalence of MRSA. For example, during the comparison of the guidelines, a difference was observed on the body areas screened for MRSA between the countries. The Italian guidelines suggest collecting screening samples from the nose of an individual whereas the other two countries have also included other parts of the body such as the throat, skin and wounds. Even though the probability of finding MRSA is highest in the nostrils of a person (as shown in figure 3), it should be noted that MRSA colonisation can also occur in other areas of the body such as the throat, axel, groin, etc. A study conducted by Omuse et al. (2012) at a hospital in Kenya showed that even though the MRSA prevalence of the hospital was around 18%, none of the patient was a nasal carrier of MRSA, which emphasises the importance of screening other areas of a patient to increase the chances of finding individuals who are colonised with MRSA (Omuse et al., 2012). Even though one might argue that such procedures might cost more, as previously discussed, the Dutch study by Nulens et al. (2008) proved that implementing such early prevention measures only costs a fraction of the costs of the treatment of MRSA infections and would yield more long-term benefits, both at an individual and societal level (decrease in premature mortality, decrease in
the number of days in hospital, possibly increase healthy years and in productivity) (Nulens et al., 2008).

Differences were also noticed for the isolation guidelines of the countries. The Danish and the Dutch guidelines have recommended single room isolation while the Italian guidelines have recommended cohort isolation of MRSA positive patients. Even though single room isolation has been recommended by most of the studies analysed during the literature review, the efficacy of this recommendation has not been evaluated in any. In general, the Italian guidelines as seen in chapter 6 are too broad and do not specify the details of,

- the risk situations of the patients to be screened;
- the antibiotics that should be prescribed and the duration of the treatments;
- how and when to perform:
  - hand hygiene practices,
  - cleaning and decontamination procedures,
  - disposal of clinical waste.

These differences might result in different treatment or prevention regimens which would lead to undesirable consequences. The Danish and the Dutch guidelines include many aspects of care, comprise specific details of each procedure and reflect the needs of the country, which may contribute to the low incidence of MRSA rates in these countries. For example, both countries screen people who received treatment from abroad (as the infection is mostly brought into these countries from abroad) and people living near farms or farmers (due to the increase of livestock MRSA in both countries).

In addition, these countries (DK and NL) have implemented the guidelines earlier and in a more systematic manner than in IT and the two countries also report among the lowest antibiotic prescribing of all European countries. For example, for the primary care sector, NL and DK report an antibiotic consumption of 11.4 and 16.0 Defined Daily Doses (DDD) per 1,000 inhabitants and per day, respectively, whereas IT reports 28.7 DDD per 1,000 inhabitants and per day in IT (ESAC, 2009). These large differences reflect the strict antibiotic guidelines in both DK and NL. Moreover, from the situation analysis conducted in chapter 5, it was also noticed that both the low prevalent countries had lower percentage of mortality (around 20% in both NL and DK) among the MRSA infected patients whereas IT the mortality among the MRSA infected were around 50%. This could be due the differences in the prevention and treatment guidelines of the countries as mentioned above.
Further, when the guidelines of the two low prevalence countries (NL and DK) were compared with each other, the Dutch guidelines were more precise, clear and easy to use in daily patient care situation than the Danish guidelines. Since they had separate guidelines on isolation procedures, antibiotic policies, cleaning, disinfecting and sterilising the rooms of the patients, in addition to the general guidelines (WIP, 2006; SWAB, 2007; WIP, 2004). Additionally, the Dutch guidelines were also updated on a more regular manner (last update in 2012) than both the Danish (last update in 2008) and the Italian guidelines. Updating the guidelines is important as knowledge on prevention practices changes continuously and including these new evidences found would contribute in lowering the MRSA rates in the country (Coia et al., 2006).

Such large differences and similarities observed on the levels of evidence, clarity and specificity between the hospital acquired MRSA guidelines of the high and the low prevalent countries suggests that there could be a relationship between the content of the national MRSA guidelines and the increasing or decreasing prevalence rates of the MRSA infection rates in a country. Therefore, the hypothesis of this paper that the differences in the national guidelines to control the transmission of MRSA in healthcare settings are one of the main causes of varying MRSA prevalence rates in the MS is accepted. Further these findings also enable to answer the main research question of this paper, “Could the content of a national guideline on healthcare-associated MRSA in a country explain MRSA prevalence rates and trends of these rates in the country?”.

Even though the Dutch guidelines on hospital acquired MRSA are perceived as the good practice among the three country guidelines, during the past years there has been an increase in the healthcare-associated MRSA infections in NL as seen in figure 4. This might be due to two reasons,

1. The guidelines have not been implemented properly by the healthcare institutions of NL (Vos et al., 2009);
2. The increase in the livestock- and community-acquired MRSA infection rates in the country.

Therefore, it is important to make sure that such evidence based guidelines are implemented properly by the MS. This is also suggested when comparing data on MRSA prevalence from EARS-Net with data on the existence of national MRSA guidelines from the Hospitals in Europe Link for Infection Control through Surveillance (HELICS) project in 1999.
Figure 7 - Comparison of % of MRSA in a country and having national guidelines for controlling MRSA (EARS-Net and HELICS, 1999)

As shown in the figure 7 out of the 15 countries, none of the countries that did not have national guidelines had a percentage of MRSA below 5% which suggests the necessity of having evidence-based national MRSA guidelines. However, only half of the countries that had national MRSA guidelines had a percentage of MRSA below 5%, which suggests that having evidence-based national MRSA guidelines is one element but is, in itself, not enough to prevent transmission of MRSA infection.

Moreover, The 5 year study conducted by Vos et al at a large university medical centre in the NL proved that rigorous implementation of the guidelines helped to maintain a low incidence of MRSA in the healthcare setting (Vos et al., 2009). Thus strict implementation of the guidelines is essential as abandonment of the guidelines would lead to greater MRSA prevalence. Further, from the situation analysis conducted in chapter 6 it is visible that increasing prevalence would further increase pre-mature mortality rates which in turn would decrease economical benefits. However, it should be noted that implementation of these guidelines can also be affected by several other factors such as political interest, hospital structures and limited resources (healthcare workers, space for isolation, etc) for prevention, cultural differences and attitude of the population towards patient safety practises.
Limitations

One of the limitations of the study was that translation of the Italian guidelines was performed by a web-tool and back translation of the guidelines was not performed due to resource restriction. In addition, the research was performed during a four-month internship at the CPME. Within this short period, the evidences related to MRSA national guidelines from the year 2000-2011 were collected and the country guidelines were compared. Due to resource limitations and to respect the limit of 10,000-12,000 words of this paper, only the guidelines on healthcare-associated MRSA of three countries were analysed in depth.

6.2 Conclusion

This study represents a first step in the comparative analysis of national MRSA guidelines in Europe and could serve as the basis for a larger study including all EU countries. One essential part of such European study would be the translation of national MRSA guidelines into English to allow proper comparison. Despite its limitations, this study suggested a relationship between the differing levels of evidence, specificity and clarity of the national guidelines and prevalence of MRSA in the countries. The study also suggested that the guidelines should be multifaceted, (by including different methods of prevention) use innovative pathways and should regularly be updated to be successful. Even though having a national guideline is important, the guideline in itself is not sufficient to prevent MRSA transmission in the countries. Proper implementation of such guidelines is influenced by other factors such as the hospital structure and available resources and facilities (e.g., isolation facilities, beds). Therefore, the guidelines should be designed and adjusted according to the country situation and available resources and studies related to the economical impact of implementing these guidelines should be performed in order to evaluate the effectiveness of the policy in a country. Finally, a stronger inter-sectoral and European-wide collaboration is essential to ensure a long-term prevention of healthcare-associated MRSA as the transmission of this multidrug-resistant bacterium does not respect national borders.
Chapter 7: References


Cepeda, J.A., Whitehouse, T., Cooper, B., Hails, J., Jones, K., Kwaku, F., Taylor, Lee., Hayman, S., Cookson, B., Shaw, S., Chris, K., Singer, M., Bellingen, G., & Wilson,


ECDC. (n.d.c). *European Surveillance of Antimicrobial Consumption Network (ESAC-Net)*. Retrieved April 26th, 2012, from:


http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19688


Reference for the Figures


## Appendix 1

### Search index

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### Appendix- 2

**Studies included**

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<td><strong>Antimicrobial stewardship</strong></td>
<td>Charbonneau <em>et al.</em>, 2006; Coia <em>et al.</em>, 2006; Doron <em>et al.</em>, 2011; French, 2005; French, 2010; Jones <em>et al.</em>, 1997; Liebowitz, 2009; Rivera <em>et al.</em>, 2011; Westh <em>et al.</em>, 2004</td>
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<tr>
<td><strong>Screening &amp; Decolonisation</strong></td>
<td>Coia <em>et al.</em>, 2006; Cookson <em>et al.</em>, 2011; Kluytmans <em>et al.</em>, 1997; Bode <em>et al.</em>, 2010; Miller <em>et al.</em>, 1996; Milstone, 2008; van Rijen <em>et al.</em>, 2008; Rohr <em>et al.</em>, 2003</td>
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<td><strong>Isolation</strong></td>
<td>Cepeda <em>et al.</em>, 2003; Coia <em>et al.</em>, 2006</td>
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<td><strong>Hand hygiene</strong></td>
<td>Johnson <em>et al.</em>, 2005; Mahamat <em>et al.</em>, 2007; Sorka <em>et al.</em>, 2010;</td>
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<td><strong>Cleaning and decontamination</strong></td>
<td>Griffith <em>et al.</em>, 2000; Morgan <em>et al.</em>, 2012; Snyder, 2008; Talon, 1999</td>
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<td><strong>Transfer of patients</strong></td>
<td>Barnes <em>et al.</em>, 2011; Jerningan <em>et al.</em>, 1995; Lee <em>et al.</em>, 2011</td>
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<td><strong>Nursing staff</strong></td>
<td>Garus-Pakowska, 2011; Hugonnet <em>et al.</em>, 2007; Voss <em>et al.</em>, 1997</td>
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### Appendix -3

Comparing the guidelines

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<tbody>
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<td><strong>Antimicrobial stewardship inappropriate use of antibiotics</strong></td>
<td>Combination of treatments not just one. Section four of the guidelines on the treatment of MRSA patients refers to another documents on the SWAB guidelines for treatment</td>
<td>Only promotes prudent use of antibiotics but doesn’t mention the dosage of antibiotics or the prescriptions that should be given to the patients. However a state which antibiotics MRSA is resistant to which implicitly mentions the prudent use of these antibiotics. Not explicitly mentioned</td>
<td>-</td>
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<table>
<thead>
<tr>
<th>Drug 1</th>
<th>Drug 2</th>
</tr>
</thead>
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<tr>
<td>Doxycycline 200 mg x daily</td>
<td>First dose: rifampicin 600 mg 2 x daily; in case of intolerance: tetracycline 500 mg x daily</td>
</tr>
<tr>
<td>Tazobactam 200 mg x daily</td>
<td>Rifampicin 600 mg 2 x daily</td>
</tr>
<tr>
<td>Clindamycin 600 mg x 3 x daily</td>
<td>Recommendation of Study group</td>
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<tr>
<td>Chloramphenicol 500 mg x 2 x daily</td>
<td>Recommended</td>
</tr>
<tr>
<td>Ciprofloxacin 500 mg 2 x daily</td>
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<td>Fucidic acid 500 mg x 3 x daily</td>
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<tr>
<th><strong>Screening</strong></th>
<th><strong>Patients and staff are divided into four risk categories</strong></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1. Proven MRSA carrier</td>
</tr>
<tr>
<td></td>
<td>2. High risk of being a carrier</td>
</tr>
<tr>
<td></td>
<td>3. Increased risk of being a carrier</td>
</tr>
<tr>
<td></td>
<td>4. No increased risk of being a carrier</td>
</tr>
</tbody>
</table>

In case of doubt, experts in the hospital (clinical microbiologist, infectious disease specialists or hospital hygienist) should be involved in the classification into a risk category. (WIP, 2007)

<table>
<thead>
<tr>
<th><strong>Risk situation of patients:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Has previously been diagnosed with MRSA</td>
</tr>
<tr>
<td>- MRSA positive person in household or other person in the immediate surroundings</td>
</tr>
<tr>
<td>- Lives in or visits daily at a nursing home department (or similar, e.g. institution servicing the disabled) with an MRSA outbreak</td>
</tr>
<tr>
<td>- Admitted to a room with an MRSA</td>
</tr>
</tbody>
</table>

Organize courses dedicated to medical / nursing / technical / OTA / OSS on the problem of multidrug-resistant microorganisms and the various preventive measures be adopted, in different levels of operation:

a. Starting from the wards at highest risk: intensive care, dialysis, other high-incidence wards.8. Organize, with the microbiology laboratory, a system for rapid identification and management of
<table>
<thead>
<tr>
<th>Patients</th>
<th></th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Number of screening cultures depends on the method used in the laboratory</td>
<td>positive patient</td>
<td>suspected outbreaks of MRSA / VRE.</td>
</tr>
<tr>
<td>- Patients with wounds should be given additional attention</td>
<td>- Admitted to a ward or department during an MRSA outbreak</td>
<td></td>
</tr>
<tr>
<td>- Samples are cultured from nose, throat, faeces, sputum, urine, lesions</td>
<td>- Has been admitted to or has received invasive outpatient treatment (e.g. placement of iv-line, drain, indwelling catheter, dialysis, surgery) at a foreign hospital (for the remaining Scandinavian countries and the Netherlands, precautions are as for admission in Denmark)</td>
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<td></td>
<td>- The staff who had the closest contact with patient if the MRSA contaminated patient should be screened if the patient was only in the hospital for a short period (10 days) of time (Ring investigation)</td>
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</tr>
<tr>
<td></td>
<td>- If the patients are in for a longer period of time then samples from all staff in the</td>
<td></td>
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</table>

Staff

- The extensiveness of the investigation among staff depends on the findings at the
- The staff who had the closest contact with patient if the MRSA contaminated patient should be screened if the patient was only in the hospital for a short period (10 days) of time (Ring investigation)
- Health personnel who regularly participate in transfer of patients with an increased MRSA infection risk, or who regularly work abroad (commuter personnel), an individual agreement concerning the testing frequency should be made with the microbiology department.

Patients and staff

- All patients and health personnel who have experienced an above mentioned risk situation within the previous twelve month period should be tested for MRSA.
### Collection of screening samples

Samples are cultured from the nose and throat and any skin lesions such as eczema.

The following places are swabbed with cotton or carbon swabs:
- nose
- throat (tonsils)
- perineum (for in-patients)

Furthermore from any:
- Sores
- skin affections such as eczema or psoriasis
- IV entry or drainage sites
- Probes
- urine, provided the patient has an indwelling catheter
- tracheal secretion, provided the patient is intubated

Samples are only collected from the Nose

### Decolonisation
*(Nasal, Throat, Skin)*

- Mupirocin nasal ointment three times daily for five days

- During treatment skin and hair must be washed daily with a disinfecting soap (Chlorhexidine soap in a 40 mg/ml solution or betadine shampoo 75 mg/ml), preferably in the shower (not the bathtub).

- Daily clean underwear, clean clothing, clean washcloth and towels. On days 1, 2 and 5 of the cure, put clean bedclothes on the bed. When the patient goes to bed at night, he must wear clean underwear or pyjamas during treatment.

- If active skin lesions

The treatment includes both the index person and the people surrounded by him/her regardless of their MRSA status.

Before the actual eradication therapy may be initiated, the treatment of any clinical MRSA infections or individual risk factors in the infected person and others in the immediate surroundings shall be concluded.

**Eradication treatment:**

The treatment has a minimum duration of 5 days and includes the following:

- Application of mupirocin nasal ointment in both nostrils 3 x daily.

- Daily full-body wash including shampooing of the hair with chlorhexidine hydrochloride soap

Consider decontamination with topical antibiotics in-patient wards where there is high risk of transmission of MRSA colonized patients or disease. Not usually treated with systemic antibiotics colonized patients.

Nasal swabs only in high risk areas.

Decontamination with topical antibiotics in-patient wards where there is high risk of transmission of MRSA colonized patients or disease.
<table>
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<th>Decolonisation of all carriers</th>
<th>All staff but patients only in high risk wards</th>
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<tr>
<td><strong>Isolation</strong></td>
<td>A category 1 or 2 patient must be cared for in strict isolation, in accordance with the WIP guideline ‘Isolation measures’.</td>
<td>To reduce the risk of MRSA spreading to other patients, isolation should be maintained:</td>
<td>To promote the widespread use of alcohol-based preparations in 70% (with or without antiseptic) for hand hygiene</td>
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<td></td>
<td></td>
<td>- For all MRSA positive patients until a negative test result is produced</td>
<td>Establish corporate guidelines on isolation precautions for patients with identification of MRSA and / or VRE. These must include at least: Appropriate decontamination of environmental surfaces in the case of patients positive for VRE.</td>
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<td>- Any patients who have been in a risk situation within the past 2 months</td>
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are present, treat them first – if necessary in consultation with a dermatologist.

- In the presence of intestinal or rectal carriage, experience with oral administration of aminoglycosides and glycopeptides is limited. Because of the risk of development of resistance against these important therapeutic drugs, this is not recommended.

For asymptomatic throat carriers, additional systemic antibiotics treatment may be needed. Systemic treatment should only be initiated after consulting the Clinical Microbiology Department and after resistance determination.

**Patients**
Specimens should be taken on day 7, 14 and 21 (minimum intervals) after conclusion of the treatment. Three batches of negative swabs are required.

**Staff**
Personnel are subject to one additional examination on day 1 (on one extra day including the three negative swab batches required).

Follow-up visits after 3-12 months provide additional assurance that the person is MRSA free.
<table>
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<tr>
<td><strong>Gloves</strong></td>
<td>- Gloves are put on before entering the room.</td>
<td>- Gloves should be worn in connection with any contact with the patient, equipment, inventory, soiled linen and waste.</td>
</tr>
<tr>
<td></td>
<td>- Long-sleeved protective clothing is put on before entering the room.</td>
<td>- Visitors should use gloves when participating in the care.</td>
</tr>
<tr>
<td><strong>Gowns</strong></td>
<td>- A mask is put on before entering the room.</td>
<td>- Use a surgical mask: during contact with patients with respiratory MRSA infection Consider using a surgical mask:</td>
</tr>
<tr>
<td></td>
<td>- The type of mask (EN 149-2001, FFP1 or FFP2) depends on the microorganism. A</td>
<td>- to avoid inhalation of</td>
</tr>
</tbody>
</table>
### Other

- Head covering must be worn in the event of strict isolation for MRSA.

### Cleaning and decontamination

- The room and the anteroom are cleaned daily and before a new patient is admitted to the room.
- Medical and nursing material that has been in the room must be cleaned and disinfected.
- Materials that cannot be cleaned and disinfected must be disposed of.
- The room is disinfected in accordance with the procedure described in the WIP guideline ‘Cleaning, disinfection and sterilisation of rooms, furniture and objects’.
- Cleaning personnel should use protective equipment in line with the care personnel.

**Daily cleaning:**
- the room should be cleaned after all other programmed activities
- contact points (e.g. door knobs, bed guards, water taps, toilet seats, toilet flush buttons, bell cord, and light and equipment switches) should be disinfected using a suitable disinfectant
- other horizontal surfaces in the room (bed, bedside table, chairs, tables, equipment) and the bath/toilet should be cleaned using standard cleaning agents
- floors should be washed
- the cleaning utensils should be left in the room and any cloths used should be sent to the laundry or discarded

**Appropriate decontamination of environmental surfaces in the case of patients positive**
<table>
<thead>
<tr>
<th>Patient movement</th>
<th>Final cleaning (suspension of isolation):</th>
<th>Define the mode of transmission of the patient positive for MRSA / VRE to all service personnel and departments / facilities where the patient is transferred.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The transport service and the department to which the patient is being taken must be informed of the isolation and any measures to be taken in advance.</td>
<td>- clean room and any inventory and equipment and the bath/toilet with standard cleaning agents</td>
<td></td>
</tr>
<tr>
<td>- The patient is transported with clean clothing and clean bedding.</td>
<td>- subsequently disinfect the bed, bed table, chairs/tables, equipment points mentioned above</td>
<td></td>
</tr>
<tr>
<td>- The patient wears a surgical mask to prevent contamination of others during transport (only for airborne transmission).</td>
<td>- wash the floors</td>
<td></td>
</tr>
<tr>
<td>- The department receiving the patient must take the same measures as described here.</td>
<td>- disinfect/wash pillow and duvet</td>
<td></td>
</tr>
<tr>
<td>- notify the receiving department</td>
<td>- mattress covers should be cleaned and disinfected; alternatively the mattress may be sent for low pressure autoclave sterilization or be discarded</td>
<td></td>
</tr>
<tr>
<td>- make sure that examination and treatment take place late in the day and with no other patients present</td>
<td>- any other fabric should be sent to the laundry.</td>
<td></td>
</tr>
<tr>
<td>- transport the patient directly to the examination or treatment room</td>
<td>- wash the floors</td>
<td></td>
</tr>
<tr>
<td>- avoiding stop-overs in waiting facilities</td>
<td>- disinfect/wash pillow and duvet</td>
<td></td>
</tr>
<tr>
<td>- make sure that the patient wears clean clothes and that the bed is newly made before transport</td>
<td>- mattress covers should be cleaned and disinfected; alternatively the mattress may be sent for low pressure autoclave sterilization or be discarded</td>
<td></td>
</tr>
<tr>
<td>- ensure that any dressings are tight fitting and show no signs of soaking through</td>
<td>- any other fabric should be sent to the laundry.</td>
<td></td>
</tr>
<tr>
<td>- the patient should disinfect his or her hands when leaving the room</td>
<td>- wash the floors</td>
<td></td>
</tr>
</tbody>
</table>
- in case of respiratory infection the patient should wear a surgical mask
- immediately before the transport wipe down any bed guards and ends with a suitable disinfection agent because this is done, the porter (ambulance personnel) and any other accompanying personnel do not need to wear PPE during transport, but must disinfect their hands after the transport; in case of direct patient contact (e.g. lifts) protective equipment should be worn as stipulated
- the treatment section should abide by the same guidelines as the bed ward

<table>
<thead>
<tr>
<th>Nursing staff workload and MRSA transmission</th>
</tr>
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<tbody>
<tr>
<td>-</td>
</tr>
</tbody>
</table>