

► **Keywords**

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Recall Screening for MRSA Prevention – an innovative approach from the Netherlands

Summary

Background: The Dutch Search & Destroy strategy against the methicillin-resistant *Staphylococcus aureus* (MRSA) has proven to be successful with a MRSA prevalence still below 1 %. However there are MRSA outbreaks, caused by MRSA carriers, who are missed in screenings and remain unrecognized. It was the aim of the present work to develop and test further innovative MRSA screening approaches with respect to their ability to detect unknown MRSA carriers.

Methods: From 2001 to 2005 three different screening approaches were implemented in the Atrium Medical Center in Parkstad Limburg. Strategy 1: patients had to fill in a questionnaire concerning an earlier stay in a foreign hospital, strategy 2: admission screening on ICUs, strategy 3: recall screening of discharged patients.

Results: The questionnaire helped to identify 227 patients from foreign hospitals, eight of whom were MRSA positive. From nearly 7000 patients who were screened for MRSA carriage on admission to the ICU 15 patients were MRSA positive. But none of the MRSA strains were related to any outbreak on the ward. Within the recall screening 37 further MRSA carriers could be detected among 1781 patients and those strains were indeed found to be associated with the respective outbreaks. Seven more strains were identified which were not involved in any outbreak.

Discussion: With respect to identifying previously unknown MRSA carriers recall screening yielded the best results. Therefore this approach is a fundamental tool for detecting unrecognized MRSA carriers, who do not belong to the usual patients at risk. By identifying previously unknown MRSA carriage, the recall screening prevents MRSA outbreaks, which could be induced by such unrecognized MRSA carriers on readmission to the hospital.

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Introduction

Search & Destroy Strategy

In the Netherlands the Search & Destroy strategy has to date proven to be immensely successful in the battle against methicillin-resistant *Staphylococcus aureus* (MRSA). Whereas the MRSA prevalence is in the meantime more than 50 % in some countries, it is less than 1 % in the Netherlands and, as such, continues to be very low [1]. As per the Search & Destroy strategy, regulations have been implemented providing for a Search for MRSA-colonised patients, consistent contact isolation of MRSA patients in hospital and ongoing Destroy (decontamination) measures to eradicate the bacterium in MRSA-positive patients.

Since 1981 all societies involved in infection prevention in the Netherlands have been organised under the direction of the Dutch Working Group for Infection Prevention (Werkgroep Infectie Preventie (WIP) www.WIP.nl). These societies are as follows: the Dutch Society for Medical Microbiology, Dutch Society for Microbiology, Dutch Society for Hygiene and Infection Prevention in Healthcare, Dutch and Flanders Society for Infectious Diseases. Already back in the 80s in response to the incipient MRSA threat, WIP drafted a guideline setting out a policy for dealing with methicillin-resistant *Staphylococcus aureus* (Policy for methicillin-resistant *Staphylococcus aureus*). The current version of the guideline (in Dutch language) can be consulted at www.WIP.nl [2, 3].

In the Netherlands a number of different interrelated approaches have been taken in the battle against MRSA, and these are supported by the government in that they are legally binding (Quality of Care Act [4]): 1. WIP MRSA guideline 2. MRSA surveillance coordinated by the Reichs Institute for Public Health and Environmen-

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tal Hygiene (Rijksinstituut voor Volksgezondheid en Milieu, RIVM, www.rivm.nl) and 3. Restrictive use of antibiotics as recommended by the Antibiotic Guidelines Working Group (Stichting Werkgroep Antibiotica Beleid, SWAB, www.swab.nl) [5]. This act is used also to verify compliance with MRSA regulations in hospitals, which are implemented by the statutory authorities for public health, as mandated by the Ministry of Health. The current MRSA regulations have been confirmed once again in a report issued in November 2006 by the Dutch Health Council [6].

The successes scored by Dutch hospitals in combating MRSA are due primarily to strict isolation of all patients with proven or suspected MRSA colonisation or infection. These patients are isolated as a precautionary measure until negative screening results have been obtained for them. The risk that a person is colonised or infected with MRSA can differ greatly.

According to WIP, a distinction is made in the Netherlands between four MRSA risk categories:

- Category 1: proven MRSA case
- Category 2: high MRSA risk (persons treated for more than 24 hours in a foreign hospital, with this hospital stay having taken place in the previous two months ago; persons who had undergone surgery or intubation, had a drain or catheter inserted; persons with skin lesions, furuncles or abscesses as potential MRSA portals of entry)
- Category 3 = moderately increased MRSA risk (former MRSA carriers; persons treated as inpatients in a foreign hospital more than two months ago and in whom no skin lesions can be detected)
- Category 4 = negligible MRSA risk (persons treated as inpatients in a foreign hospital more than two months ago, in whom no skin lesions can be detected and who have no risk factors such as chronic respiratory tract or urinary tract infection)

Strict isolation is needed for Category 1 and 2 persons. Samples are collected for culture from Category 3 patients, and from suspected cases in Category 4. However, precautionary isolation is dispensed with [2].

An important element of the Search & Destroy strategy is also the MRSA detection methods designed and optimised on the basis of international standards [7].

All MRSA strains detected in the Netherlands are typed centrally at RIVM using international standards, and recorder there [8].

MRSA Spectrum

Between 2001 and 2005 MRSA screening at the Atrium Medical Centre revealed predominantly multilocus sequence type 5 (MLST 5) (formerly known as phage type III-323), also within familial chains of transmission [9, 10]. This strain has been detected already since 1997 but it is still unclear how it was introduced into the Netherlands. Further screening at RIVM using pulse field gel electrophoresis (PFGE) showed that this strain is identical to the “paediatric MRSA clone” from Portugal [11]. This MRSA strain has in the meantime spread at international level, and can be found, inter alia, in Poland, Columbia, Argentina and the USA. In our region it is seen increasingly as community-acquired MRSA (CA-MRSA) outside the hospital setting [9, 10].

Study Aim

“Unexpected” MRSA carriers are the main reason why other patients become colonised with MRSA and MRSA outbreaks can occur. These MRSA carriers are mainly persons who until then were known to be MRSA negative and who had no history of a stay in a foreign hospital or close contact with known MRSA carriers. Therefore more effective screening strategies are needed to better identify such MRSA carriers. This is the only way to ensure that MRSA will not spread further in Parkstad Limburg and in the entire Euregio-Maas-Rhein area, becoming endemic in this region [9, 10, 12].

The aim of this study was thus to devise innovative MRSA screening strategies and examine to what extent they lent themselves to effective identification of hitherto unknown MRSA carriers. To that effect, three different screening methods were implemented at the Atrium Medical Centre; these were based on long-term experiences of dealing with MRSA and on the WIP MRSA Guideline [2]:

Strategy 1: completion of a questionnaire regarding an earlier stay in a foreign hospital,

Strategy 2: screening on admission to intensive care units and

Strategy 3: follow-up examinations known as “recall screening”

The results of these preventive strategies are given below.

Materials and Methods

Atrium Medical Centre

The medical regional laboratory responsible for the Parkstad Limburg area is integrated into Atrium Medical Centre, which is a teaching hospital with 800 beds in the Heerlen district of Parkstad Limburg. It is situated at around 15 km from Aachen in the Euregio-Maas-Rhein (EMR) region and has a catchment area of some 250,000 persons. The regional laboratory also looks after nursing homes and medical practitioners in Parkstad Limburg.

MRSA Isolates

The present study took account of the results of isolates from a total of 219 MRSA carriers screened between 2001 and 2005 in the regional laboratory at Atrium Medical Centre. The detection methods and culture of isolates have already been described in detail in another publication [3, 9, 10, 11]. An enrichment broth was used to isolate MRSA, enabling a 25 % improvement in the detection of MRSA-colonised patients [13].

Screening Strategies

Strategy 1: questionnaire on stay in a foreign hospital

Using a simple questionnaire as from 2001, patients were asked on admission about any previous stay in a foreign hospital [14]:

1. Stay in a foreign hospital? (yes/no)
2. Duration of stay of more than 24 hours (yes/no)
3. Surgical procedures (yes/no)

Strategy 2: screening for MRSA on admission to intensive care unit

The intensive care unit (ICU) is a high-risk zone for transmission of MRSA. Screening on admission for multiresistant microorganisms, including MRSA, was introduced following epidemic outbreak of multiresistant *Acinetobacter baumannii* in 2001 [15]

Strategy 3: Recall screening of already discharged patients since 2003

If MRSA outbreaks occurred in the hospital, as from 2003 apart from the relevant

hospital patients those patients who had already been discharged were asked to present for MRSA screening. Patients affected by this recall screening included those who had been treated as inpatients parallel to or during a 3-5 week period prior to identification of an MRSA-positive patient in the respective department. These persons were requested in writing or by telephone to visit the hospital epidemiologist or infection control physician so as to take part in MRSA screening. Persons who for medical reasons were unable to comply with this request were screened in their homes. Recall screening was aimed at obtaining a comprehensive picture of MRSA contamination chains and at identifying any other MRSA-colonised hospital patients.

Results

Between 2001 and 2005 the regional laboratory at Atrium Medical Centre in Parkstad Limburg detected a remarkably high number of different MRSA isolates from in- and outpatients from the surrounding region. From a total of 219 MRSA-positive persons, 41 different PFGE types were identified, with the two MLST types 5 (47 %) and 8 (18 %) being the most predominant. The MRSA isolates were identified in in- and outpatients from the hospital, from patients treated in doctors' surgeries as well as from visitors to rehabilitation centres and residents of nursing homes. Among the 41 different MRSA types, 7 Panton-Valentin leucocidin (PVL) positive PFGE types of MRSA, i.e. typical community-acquired MRSA (CA-MRSA), were also identified. However, these were not identified among any of the MRSA strains isolated from pig farmers (Wassenberg 2007, personal commentary). Details of MRSA typing results from the Euregio-Maas-Rhein region can be found in a publication by Deurenberg et al. [12].

Questionnaire on stay in a foreign hospital

Using this questionnaire, it was possible between 2001 and 2005 to identify a total of 227 patients who had been referred from foreign hospitals (between 35 and 72 of some 25,000 patients per year). Of these 227 patients, 8 were MRSA positive (between 1.7 and 6.6 % per year, on average 3.5 %). Conversely, of the patients

with a lower MRSA risk (WIP Categories 3 and 4), fewer than 1 % were MRSA positive. Hence MRSA prevalence was less than 1 % in respect of the number of patients admitted each year. The main 'MRSA countries of origin' were other EU Member States (Germany, Belgium, France, Austria, Spain, Italy) as well as the non-EU Member States Turkey, Syria, Morocco, USA and Indonesia. Around one quarter of patients came from German healthcare institutions – but not all were from the neighbouring federal state of North Rhine-Westphalia.

Screening on admission to an intensive care unit

Of the some 7,000 patients screened since 2001 on admission to an ICU, 15 (0.21 %) were MRSA positive. None of the MRSA strains were implicated in an MRSA outbreak.

Recall screening

Table 1 shows the results of recall screening at Atrium Medical Centre since its introduction in 2003 up to 2005. During that period 8 MRSA outbreaks occurred, following which 1,781 persons participated in recall screening, corresponding to a quota of 94 %. Patients who declined recall screening were classified as suspected MRSA carriers and, in the event of re-admission, they were isolated until a negative MRSA result was obtained. Most patients who did not comply came from outside the Euregio-Maas-Rhein region.

Recall screening helped identify, apart from the total of 69 MRSA carriers already identified on the corresponding hospital wards in association with an MRSA outbreak, a further total of 37 other MRSA carriers who were colonised with the respective outbreak strains – thus increasing the "detection efficiency" by 55 %. Recall screening also helped occasionally identify other MRSA isolates in addition to the outbreak strains. For example, within the framework of the recall screening a total of 7 MRSA strains were identified in patients who had already been discharged (0.38 %) and which were not related to the outbreaks on the wards. Hence MRSA prevalence was 2.5 % in the recall group.

Moreover, 2 further MRSA isolates were found on the wards themselves during 20 screening rounds of 800 patients.

The outbreak strains belonged primarily to MLST types 5 and 8.

Of the some 9,600 patients screened either in relation to an MRSA outbreak on the respective ward or in the context of recall screening or on admission to the ICU, a total of 24 (2 (ward) + 7 (recall) + 15 (ICU)) MRSA carriers were found, all of whom were colonised with strains other than the outbreak strains (0.25 %; range 0.21–0.38 %).

Discussion

"Unexpected" MRSA carriers are the main reason why other patients become colonised with MRSA and MRSA outbreaks can occur. The aim of this study was to devise innovative MRSA screening strategies and examine to what extent they lent themselves to effective identification of other hitherto unknown MRSA carriers. To that effect three different screening methods were implemented at the Atrium Medical Centre.

One strategy meant that using a questionnaire patients were asked on admission about any earlier stay in a foreign hospital. Using this approach it was possible between 2001 and 2005 to identify among the total 227 patients who had already been treated earlier in a hospital a further total of 8 other MRSA carriers (on average 3.5 %). Patients who, on the basis of the questionnaire, were thought to have an increased MRSA risk were isolated in single rooms as a precautionary measure and, as such, did not pose any further risk of MRSA outbreak. Fewer than 1 % of patients with a low MRSA risk (WIP Category 3 and 4) were MRSA positive. These findings are comparable with those of other Dutch screening measures which found an MRSA prevalence of 4.7 % among such patients [16]. Bearing in mind the Dutch MRSA regulations the question now arose as to the threshold value above which countermeasures should be taken. In the recently published "One Percent Doctrine" by Suskind a breakpoint of 1 % is proposed [17]. Accordingly, in the case of patients who had been treated as inpatients in a foreign hospital and could be assigned to WIP Category 3 and 4, and hence have an expected MRSA prevalence of less than 1 %, preventive isolation of such patients at a later timepoint can by all means be justified.

Table 1: Yield of MRSA in recall screenings* of already dismissed clinical patients (pts) from the Atrium Medical Center Parkcity after MRSA outbreaks.

| Year | No. of MRSA outbreaks (Patients on ward with MRSA) | Patients recalled | No. of persons with „outbreak“ MRSA strain | No. of persons with other MRSA strains** | Percentage of other MRSA strains (%) |
|------------------|--|-------------------|--|--|--------------------------------------|
| 2003 | 1 (25) | 600 | 3 | 3 | 0,5 |
| 2004 | 4 (27) | 613 | 16 | 4 | 0,7 |
| 2005 | 3 (17) | 568 | 18 | 0 | 0 |
| Gesamt 2003–2005 | 8 (69) | 1.781 | 37 | 7 | 0,38 |

* Started 2003, outbreaks before 2003 not included.

** Other MRSA types detected than responsible for the specific outbreak.

When screening was introduced on admission to ICUs as from 2001 it was possible to identify for around 7,000 patients an MRSA prevalence of 0.21 %. This proportion is well below that of 6.9 % identified by Lucet et al. In that prospective multicenter trial of the around 2,400 patients screened in 14 French ICUs, a total of 162 MRSA carriers were identified [18].

We therefore deem the use of selective active MRSA screening for patients in a high-risk area such as the ICU as beneficial because, after all, other studies too, e.g. that conducted by Huang et al., showed that active monitoring can demonstrably reduce the incidence of MRSA infections [19]. Best example: following the introduction of MRSA screening no further MRSA outbreaks occurred in one of our ICUs, whereas in previous years three MRSA outbreaks had been reported there.

Nonetheless an MRSA prevalence of 0.25 % in patients admitted to the ICU is 8-fold higher than the MRSA prevalence of 0.03 % (3 MRSA carriers from a total of 9,859 patients) identified by Wertheim et al. during a general MRSA admission screening in 4 Dutch hospitals between 1999 and 2000 [20]. In a regional study conducted by the healthcare authorities the MRSA prevalence in the population of Parkstad Limburg was 0.08 % (2 MRSA carriers among 2,500 persons) [21]. This low MRSA prevalence is attributable to successful Search & Destroy policies and restrictive use of antibiotics [1, 2, 5]. One can only speculate as to the reason for the difference (0.25 % vs 0.08 and 0.03 %) versus the general population. It is possible that this was due to the average older age of the hospital population [22], which can be associated with a higher MRSA incidence [7] (Figure 1).

The recall screening approach was particularly successful at identifying hitherto undiscovered MRSA carriers: in addition to the 69 MRSA-positive patients identified in the respective department following an outbreak, it was possible to discover during recall screening 37 further MRSA carriers who had already been discharged from hospital. These findings demonstrate that conductance of recall screening constitutes a beneficial and innovative approach in the battle against MRSA. After all, if an MRSA outbreak is discovered suddenly and unexpectedly on a ward – as was always the case in our outbreaks – the index patient will have generally already left the hospital, but without knowing that he/she is an MRSA carrier.

Recall screening also meant that it was possible to discover other MRSA strains in the persons invited to take part in screening, but which were not related to an outbreak; a total of 7 such cases were identified between 2003 and 2005.

Had recall screening not been carried out, with the MRSA-positive persons continuing to be undiscovered, and if such patients were to be readmitted at a later date, 44 cases would possibly have been unwittingly introduced into the hospital. Hence recall screening helped prevent 44 potential new MRSA outbreaks.

As regards the number of newly discovered MRSA carriers, recall screening proved to be the best of the three strategies because with 44 newly discovered cases in addition to the known 67 MRSA carriers this contributed to a 65 % increase in the number of MRSA cases discovered.

All three approaches described have proved successful in their own right. Patients who could be identified as having an increased MRSA risk on the basis of the

questionnaire were isolated in single rooms as a precautionary measure and, as such, could no pose a risk of an outbreak. Following screening on admission to the ICU it was possible to reduce further spread of MRSA compared with previous years and prevent outbreaks. Recall screening proved to be the most important mechanism for identifying hitherto unknown MRSA carriers who, since they did not belong to the general population of risk patients, would probably not have been identified otherwise and would have given rise to MRSA outbreaks in the event of readmission to hospital.

It is probable that an MRSA outbreak can never be fully ruled out at Atrium Medical Centre with its annual some 25, 000 admissions and a catchment area of 250,000 persons, unless a general MRSA admission screening is introduced, as practised in our ICU since 2001 for all multiresistant bacteria.

What is the outlook for MRSA in the Netherlands for the future?

For more than 20 years now a successful policy was been implemented with the Search & Destroy strategy, resulting in an MRSA prevalence of less than 1 % which is still very low compared with other European countries [1]. This is good enough reason to adhere to this MRSA strategy and continually develop this further in line with the latest research findings [6]. Extending MRSA screening to other MRSA risk groups, such as patients with open wounds, appears to be by all means justified. This would probably contribute to further increasing the number of positive MRSA results. However, this would also entail further rounds of screening on the wards. An in-depth cost-benefit analysis

is needed before contemplating other preventive strategies.

A new scenario has been witnessed in recent years in the Netherlands – just as in the Scandinavian countries [23]: the majority of MRSA patients no longer have links with foreign hospitals and outbreaks of MRSA infections are no longer confined to hospitals, but rather are being seen increasingly to have their source in the general population, with it not being always possible to identify MRSA risk factors. The new challenge comes in the form of community-acquired MRSA (CA-MRSA). The increase in PVL-positive cases of MRSA among healthy patients in the community now means that CA-MRSA is being increasingly introduced into hospitals and nursing homes, giving rise to outbreaks in such settings. Measures have already been discussed on how to prevent intrafamilial CA-MRSA spread through early detection of transmission [24]. Apart from the occurrence of PVL-positive MRSA clusters in the population [1], non-typable MRSA strains among pig farmers are causing a problem [25], in particular in rural regi-

ons of the Brabant province where there is a large number of pig farmers.

The results of a project carried out in another part of Euregio are no doubt being eagerly awaited: the MRSA-net Twente/Münsterland Euregio Project. This is aimed at setting up a German-Dutch network as a basis for a joint quality project involving healthcare workers in both countries and at coordinating a strategy for combating and preventing MRSA [26].

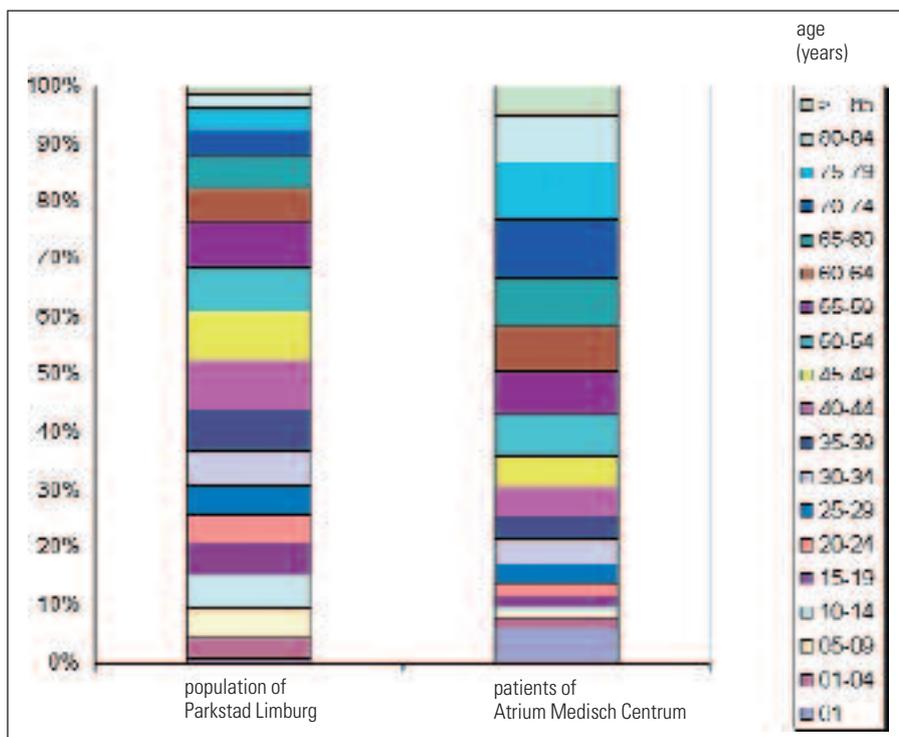
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Conflict of Interest

None declared.

Figure 1: Age distribution of general population inhabitants of Limburg Parkcity Rhine-Meuse Euregio versus clinical admissions in the regional hospital (Atrium Medical Center Parkcity).



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