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Review Article

Implementing the MRSA recommendations made by the Commission for Hospital Hygiene and Infection Prevention (KRINKO) of 1999 – current considerations by the DGKH Management Board

Umsetzung der MRSA-Empfehlung der Kommission für Krankenhaushygiene und Infektionsprävention beim Robert Koch-Institut – Kommentar der Deutschen Gesellschaft für Krankenhaushygiene

Abstract

In Germany, recommendations on dealing with patients who are colonised with methicillin-resistant *S. aureus* (MRSA) for the inpatient sector have been published in 1999 by the Commission for Hospital Hygiene and Infection Prevention (KRINKO). Some challenges arise with regard to the practical implementation of the KRINKO recommendations. These challenges do not principally question the benefit of the recommendations but have come into criticism from users. In this commentary the German Society for Hospital Hygiene (DGKH) discusses some controversial issues and adds suggestions for unresolved problems regarding the infection control management of MRSA in healthcare settings.

Keywords: MRSA, nosocomial infection, infection control

Zusammenfassung

In Deutschland wurde 1999 von der Kommission für Krankenhaushygiene und Infektionsprävention beim Robert Koch-Institut (KRINKO) die ‚Empfehlung zur Prävention und Kontrolle von Methicillin-resistenten *Staphylococcus aureus*-Stämmen (MRSA) in Krankenhäusern und anderen medizinischen Einrichtungen' publiziert. Die praktische Umsetzung dieser Empfehlung stellt das gesamte Behandlungsteam vor erhebliche Herausforderungen. Die mit der Umsetzung verbundenen Probleme stellen den Nutzen der Empfehlung nicht prinzipiell infrage, führen aber zu anhaltender Kritik von Seiten einiger Anwender. In diesem Kommentar thematisiert die Deutschen Gesellschaft für Krankenhaushygiene einige kontroverse Themen der MRSA-Empfehlung und ergänzt Vorschläge zur praktischen Umsetzung.

Schlüsselwörter: MRSA, nosokomiale Infektion, Infektionsprävention, Infektionskontrolle

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1. Introduction and scope of this commentary

Treating and dealing with patients who are colonised with methicillin-resistant *S. aureus* (MRSA) [1], [2] or suffer from nosocomial infections caused by MRSA, poses a particular challenge to all healthcare facilities, such as hospitals [3], specialist outpatient clinics, nursing homes [4], [5], [6], [7], [8], [9] and office-based primary care physicians [5], [10]. In Germany, recommendations on this topic for the inpatient sector have been published in 1999 by the Commission for Hospital Hygiene and Infection Prevention (KRINKO) [11], [12]. The contents of these recommendations do not differ essentially from comparable recommendations issued by other European countries [13] or US-American professional societies [14] / Centres for Disease Control and Prevention (CDC) [15], [16].

Regarding MRSA screening and isolating patients whose MRSA status has not yet been clarified, the specifications of the recommendations are not as strict as the "search

and destroy" policy in the healthcare system in the Netherlands [17], [18], a directly adjacent country with very low MRSA prevalence [19], [20], [21], [22], [23].
A commentary on the KRINKO recommendations was published in 2004 and provides information on patients with an increased risk of MRSA colonisation [11]. An updated version of this commentary was published in issue 42 of the *Epidemiologisches Bulletin* (2008). The aim of these commentaries is to provide on-site support to doctors in attendance, hospital infection control personnel, microbiologists and the administrative hospital management for establishing a local guideline for MRSA screening [24], [25], [26].
Some challenges arise with regard to the practical implementation of the KRINKO recommendations. These challenges do not principally question the benefit of the recommendations but have come into criticism from users. This criticism of the KRINKO recommendations [27], [28] especially refers to the following aspects:

1. Relativisation of the clinical meaning of MRSA ("MRSA is not an epidemic plague")
2. Single room isolation and special safety measures, such as wearing protective gowns and masks before entering the isolation room
3. Risk of inadequate medical care of MRSA-colonised patients due to isolation (surveillance of vital functions, regular status evaluations, diagnostic and therapeutic interventions)
4. Restricted mobility, social stigmatisation and psychological stress of isolated patients
5. Specific considerations on operations in MRSA-colonised or -infected patients
6. How to deal with nursing and medical staff who are MRSA carriers; necessity of decolonisation treatment of medical staff
7. Problems in pre- and post-inpatient care of MRSA-positive patients

These points are commented on by the German Society for Hospital Hygiene (DGKH) below.

2. Commentaries issued by the DGKH

2.1. Is MRSA a significant infection-epidemiological pathogen?

Some critics of the KRINKO recommendations argue that MRSA is not an epidemic pathogen (Definition: highly contagious pathogen, which results in serious illnesses in the majority of people in case of a transmission), such as *M. tuberculosis*, *Y. pestis* or *S. typhi*, and deduce from this that standard hygiene measures are sufficient for controlling nosocomial spread. This allegation is misleading because

- the KRINKO recommendations [12] do not classify MRSA as an 'epidemic plague';
- the measures required for preventing nosocomial transmission of a certain pathogen are derived from possible transmission paths and not exclusively from its contagiousness (probability of transmission to people who come into contact with an infectious agent) or virulence (pathogen-specific property; describes the risk of illness for people who come into contact with the pathogen or are colonised) for otherwise healthy people.
- a pathogen, which is not an epidemic pathogen, is therefore by no means less dangerous to infected patients. As a matter of fact, far more patients die from nosocomial MRSA infections (e.g. pneumonia, sepsis) in Germany than from tuberculosis, the plague and typhoid as a whole [29].

MRSA is indeed not the cause of an epidemic plague but still of paramount epidemiological importance as is also shown by the following considerations.

2.1.1 Epidemiological development of MRSA infections since 1999

According to the results of the prevalence studies carried out by the Paul-Ehrlich Society for Chemotherapy (http://www.p-e-g.org/ag_resistenz/main.htm), the proportion of oxacillin-resistant *S. aureus* was less than 2% in 1990, 12.9% in 1995, 15.8% in 1998 [30], 20.7% in 2001 and 22.6% in 2004 [31]. Tiemersma et al. documented 8.5% MRSA in 1999, 18.5% in 2002, 19.6% in 2004, 20.6% in 2006 and 23.2% in 2008 in the EARSS database (European Antimicrobial Resistance Surveillance System; http://www.rivm.nl/earss/database/) [21].
The SARI project [32] highlighted the following MRSA rates for German intensive care units: 26.3% in 2001, 22.2% in 2002, 20.8% in 2003, 19.5% in 2004, 22.3% in 2005, 22.1% in 2006 and 20.3% in 2007. The Hospital Infection Surveillance System (KISS) collects data from more than 200 intensive care units (ICU) in Germany.
The prevalence of MRSA as a share of all *S. aureus* isolates within this collection system rose on average from 8% in 1997 to 30% in 2003; whereby the share of MRSA in primary *S. aureus* sepsis was at 37.8% and of nosocomial pneumonia at 21.5 % [20], [33]. In a current review, Gastmeier et al. [34] assume at least 14,000 nosocomial MRSA infections in Germany per year.
Whilst this data always refer to certain selected patient groups, a trend in the spread of MRSA in German clinics must be assumed; this trend has been constantly on the rise for many years now [3], [20]. Some studies, amongst others, of the University Hospital Heidelberg [35], reveal that the epidemically occurring nosocomial MRSA isolates are mostly a few PFGE-identical clones, which are, presumably, particularly well adapted to the hospital environment.
Given the increase in prevalence, it is not reasonable and irresponsible to fundamentally question the basic statements of the 1999 KRINKO recommendations [12]. Implementation of the KRINKO recommendations, which is

not pursued with the same consistency in all facilities [20], is the direct responsibility of hospital management and operators [36], [37], [38], the hygiene experts in charge, nursing and medical staff in attendance, and, in addition, should also be subject to health surveillance by the competent medical authority according to § 36 and § 23 of the German Infection Protection Act (IfSG) [39]. Numerous studies have proven that consistently implementing pertinent prevention and control concepts sustainably reduces the rate of MRSA transmissions and infections [16], [18], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [51], [52].

2.1.2 MRSA colonisation and risk of an MRSA infection

Patients colonised with MRSA run an increased risk of developing nosocomial MRSA infections [19], [53], [54]. Colonisation precedes infection with the exception of cases where MRSA is directly transmitted to a previously uncolonised patient with pre-existing risk factors (e.g. due to a lack in hygiene/antisepsis during change of dressing or when dealing with vascular catheters or respiration equipment) [55], [56]. According to a meta-analysis of Safdar et al., MRSA-colonised patients have a 4-fold increased risk of consecutive MRSA infection (OR 4.08, 95% CI_{95} 2.10–7.44) [57]. This is why it is necessary in the interests of patients possibly colonised with MRSA as well as for the sake of protecting other patients to

- examine the MRSA status of patients with certain risk factors [22], [23], [25], [58] and
- ensure that patients who are not colonised with MRSA ("MRSA-negative") do not come into direct or indirect contact with this infectious agent [26].

In order to avoid nosocomial transmissions, it is vital to ensure that patients with proven MRSA according to the KRINKO recommendations are consistently isolated and decolonised even if on-site resources are not sufficient for implementing prospective admission screening, and/or until such a screening has been established [14], [59], [60]. The nosocomial MRSA isolates detected in Germany do not constitute any risk for otherwise healthy people without particular co-morbidities and risk factors. (Community acquired (c-)MRSA isolates with particular virulence factors, such as the synthesis of the Panton-Valentine Leukocidin, need to be differentiated from this. These cMRSA strains have so far been very rare in Germany, and have above all occurred as triggers of regional epidemics. The development in the US during the last 10 years shows that an increase in cMRSA infections must probably be expected also in Germany. The preventive measures required in this context exceed the various aspects of control in healthcare facilities of the healthcare system by far but are not the topic of this commentary.)
The situation of patients with pre-existing co-morbidities and risk factors for nosocomial infections is totally different [19]. In case of an MRSA colonisation, at least one MRSA infection must be expected in up to 30% of such patients in clinical course [61]. According to the study of Thompson et al., the incidence of MRSA bacteriaemiae in intensive care unit patients with nosocomial MRSA transmission amounted to 20% (15%–25%) [61].
According to a survey on MRSA infections in paediatrics, published in 2003 [62], an average of 35% (16%–52%) of colonised patients developed an infection in the course of colonisation and within the context of outbreaks; within this context, the high ratio of publications on MRSA in pre-term infants that have received intensive care needs be taken into account [63], [64].
In a surgical intensive care unit, Vriens et al. were able to prove that MRSA was more easily transmitted to other patients and nursing and medical staff than MSSA [65]. Patients in orthopaedic [55], [66], and cardiac surgery departments [56] as well as dialysis patients [58], [67] in particular have higher complication risks after surgical interventions if they are colonised with MRSA.
For this reason, the risk of nosocomial transmissions of MRSA must be minimised in hospitals and other healthcare facilities by an evidence-based prevention and control concept in line with the Infection Protection Act's (IfSG) intended purpose, as described in § 1 paragraphs 1 and 2. Moreover, the attempt of decolonisation treatment is recommended for colonised patients (and patients with an MRSA infection alongside systemic antibacterial therapy) [12].

2.1.3 Morbidity and lethality

MRSA infections increase morbidity and mortality rates, especially in patients with pre-existing risk factors, as opposed to patients not suffering from an MRSA infection. This also holds true with regard to patients who have developed a nosocomial infection caused by methicillin-sensible *S. aureus* (MSSA) [68], [69], [70].
The lethality of MRSA infections is fundamentally determined by pre-existing conditions, a particular pre-disposition for serious infections and the infection actually involved (e.g. postoperative wound infection, infection of a chronic wound, skin and soft part infection, osteomyelitis, pneumonia with or without pre-existing artificial respiration, sepsis or endocarditis).
In the studies analysed by Cosgrove et al., which refer to patient groups treated after 1990, the lethality of predominantly nosocomially acquired MRSA sepsis ranges from 11% to 58% [70]. According to Patel et al. and with regard to intensive care patients, MRSA colonisation (adjusted odds ratio [OR], 3.7 CI_{95} 1.5–8.9; P=.003) and the onset of MRSA infection after the patient's discharge (adjusted OR, 7.6 CI_{95}, 2.48–23.2; P<.001) are linked to an increased lethality risk [62].
In a case-control study, Thompson et al. noted that lethality increased by 21.8% (8.0%–40.1%) in intensive care patients with MRSA sepsis [71].
Blot et al. were able to prove that MRSA sepsis results in 23.4% increased lethality, while MSSA sepsis did not have a significant independent influence on lethality rates [72].
In a multivariate analysis, Shurland et al. also confirmed

increased mortality rates in adults, mostly old and multimorbid patients with MRSA bacteriaemia compared to patients with MSSA bacteriaemia [73].
Mortality of MRSA infections was between 11% and 38% in paediatric and neonatology intensive care patients [62], and 16.5% according to the largest study available on this topic [74].
It is reasonable to assume that significantly more than 5000 people die from acute complications or direct consequences of nosocomial MRSA infections in Germany per year despite the possibilities of antibacterial and intensive care treatments available today.

2.1.4 Expenses

Numerous studies document prolonged periods of hospitalisation as a result of MRSA infections [43], [69]. This is linked to higher medical expenses (compared with patients without such an event and also compared with patients acquiring an MSSA infection). Respirator time is significantly longer in patients with nosocomial MRSA pneumonia compared to those with MSSA pneumonia (17 days vs. 6 days; $p<0.01$) [75].
Some studies have revealed that the financial expenditure invested in MRSA prevention (screenings and control) is cost-effective [76] and results in even lower overall costs for the medical treatment unit [42], [43], [77], [78]. Implementing a prevention plan geared towards the KRINKO recommendations in clinical practice primarily involves additional investments. For this reason, it is vital that the key decision-makers of hospital administrations and the medical head office are actively involved in establishing instructions for MRSA surveillance, prevention and control and that they provide proper support for both the nursing and medical staff as well as the hygiene experts in its implementation [26], [79], [80].

2.1.5 Consequences in public

Hospitals that do not have a written concept of MRSA prevention and control which is firmly implemented and geared towards the specifications of the KRINKO recommendations will be answerable to the healthcare authorities and are at risk of coming under public pressure in the event of an MRSA outbreak. As can be seen from situations where there is an outbreak of nosocomial infections, a decline in patients must be expected if patients lose confidence in the safety of hygiene strategies of the respective hospital. This particularly applies if safety measures are not already preventively implemented, and are instead consistently implemented in the event of an outbreak due to a fundamental misinterpretation of the importance of MRSA.
Since comprehensive information on MRSA is freely available today, via Internet for instance, and many patients and their relatives actively read up on it, a constant increase in legal actions taken by patients with nosocomial MRSA infections against hospital operators must be factored in. The patients involved are now also represented by their own pressure groups aiming to improve the protection of patients against nosocomial infections in hospitals, and are billing doctors in attendance for the tremendous follow-up costs resulting from complicated pathogeneses.
The economic damage caused by legal consequences and negative publicity can thus be substantial, leading to a drop in referrals from physicians in private practices or other healthcare facilities and can wreak lasting damage on the hospital's public profile [81].
Hospitals which actively implement a concept (established with foresight) for hospital hygiene and infection prevention according to the KRINKO's recommendations and also provide the structural-organisational and personnel prerequisites for this purpose are protected against these consequences. Moreover, they can positively communicate their investments in the fields of quality assurance and patient safety to the public. The number of patients, who thoroughly read up on these quality features of a hospital before selective hospitalisation is constantly increasing.

2.1.6 MRSA and glycopeptide consumption in hospitals

MRSA prevalence in clinics and hospitals is linked to the consumption of glycopeptide antibiotics, to the extent that significantly more glycopeptides are prescribed in hospitals with high MRSA prevalence [82], [83], [84], [85]; this again increases the selection pressure for glycopeptide-resistant enterococci [86], [87], another multiresistant pathogen of nosocomial infections.
Documentation of the MRSA status of a patient is of paramount importance for the empirical therapy of nosocomial infections (with or without vancomycin?) [88]. In this context, it is also important to note that the treatment of an MSSA infection with vancomycin is not considered optimal therapy [89].

2.2. Are the measures demanded by the KRINKO recommendations medically and economically justified?

2.2.1. Single room isolation

Numerous studies have been published since the KRINKO recommendations were published. According to these studies' findings, it is still justifiable to recommend accommodation in single rooms (or in common rooms in case of cohort isolation) (Cat. IB) [16], [40], [41], [42], [43], [44], [90], [91]. Single room isolation provides the best guarantee for consistently implementing all required measures for preventing and controlling further spread of MRSA.
The nursing and medical staff, especially in specialised departments treating very seriously ill or immunosuppressed patients, face the almost daily challenges in clinical practice that construction and functional issues

pose; and personnel-organisational resources do not allow for consistent single room isolation [92].
This problem is further exacerbated by the lack of funds for building and refurbishment activities, under manning [93], [94], [95], increasing prevalence of multi-resistant infectious agents (MRSA, VRE; multi-resistant *Gram*-negative pathogens) and a rise in the number of intensely immunocompromised patients [83], [96].
Since a whole set of measures is always implemented in prevention and control [97], the single contribution of individual components in the multi-barrier concept against nosocomial MRSA spread has not yet been proven by prospectively randomised trials. However, a meta-analysis published in 2004 concludes that implementation of the barrier measures recommended by CDCs is to be continued [98].
The same goes for a survey published by Aboelela et al. in the *American Journal of Infection Control* in 2006 [99]. Moreover, the authors of this study present the prerequisites for scientifically sound, randomised controlled trials in a much differentiated manner and in relation to the importance of individual hygiene measures in the multi-barrier concept. Such trials require an interdisciplinary study committee comprised of nursing scientists, clinicians, infectiologists, microbiologists, hospital hygienists, statisticians and administrative staff; all of which goes hand in hand with considerable expense and manpower requirements (estimated monocentric magnitude: at least 50,000 Euro; multicentric: several hundreds of thousands of Euro) and are only convincing and meaningful if compliance with the respective hygiene measures in both comparison groups is systematically and continually supervised.
Such trials are not practically feasible in treatment centres of German universities given the extremely limited financial and human resources.
Since no patient must receive worse medical care due to his/her colonisation or infection with a multi-resistant pathogen (see Point 2.3), nursing and medical staff are routinely forced to implement different forms of contact isolation instead of single room isolation [14].
In this respect, it has to be noted that:

- The operators of hospitals must take into account the increasing prevalence of multi-resistant infectious pathogens (MRE) and the increasing share of stationary treated patients with risk factors for nosocomial infections, and must significantly increase the single-room ratio in the long term (to 50% and more) so as to effectively guarantee necessary single room isolation.
- The nursing and medical staff should reach a written agreement with the responsible hospital hygienist on special measures of contact isolation for patients who are colonised or infected with multi-resistant pathogens and cannot be treated in a single room owing to limited resources; this agreement should be countersigned by the medical director and the director of administration [79], [100].

The study published by Cepeda et al. in 2005 [101] does not provide a valid answer to the question of whether it makes sense to isolate MRSA-colonised or -infected patients in single rooms in ICUs. Besides many other methodical deficits, hand disinfection compliance of 21% as observed by the authors annuls the effect of all additional measures.
Also, the findings of the monocentric observational study published by Nijssen et al. in 2005 [102] are neither appropriate for underpinning an IA nor an IB recommendation. It is especially unacceptable in ethical terms that nursing and medical staff was not informed about an MRSA case which was detected in the course of this study. This information can be life-saving for patients if systemic infection occurs, which needs to be treated with an MRSA-effective antibiotic as early as possible.

2.2.2 Special safety measures, such as wearing protective gowns and masks covering mouth and nose before entering the room

MRSA is able to persist in the inanimate environment of patients for weeks and even months after [103], [104], [105], [106], [107], [108], [109].
Patients who are being treated together with an MRSA-colonised patient in the same room run an increased risk of MRSA transmission [110], [111]. MRSA is not just transmitted to staff or other patients by direct contact with the patient but also by contact with contaminated objects or surfaces in the patients' environment [104], [110], [112], [113], [114], [115]. This is why preventing nosocomial MRSA transmission requires a great deal more in terms of personnel for routine environment disinfection [104], [109], [116], [117], [118]. Methods of applying detergents without added disinfectants instead of adequate surface disinfectants make a sizeable contribution to spreading MRSA on all “seemingly clean” surfaces [119].
Regarding MRSA-positive patients, the pathogen is most frequently found in the vestibules of the nose; a relevant share, however, also colonises other parts of the body, e.g. underarms (15%–25%), perineum (30%–40%) and hands and forearms (40%) [104]. In the case of some patients, an ongoing colonisation of the gastrointestinal tract can ensue, especially after an antibacterial therapy (disturbed colonisation resistance) [120], [121], [122], [123], [124]. MRSA is also found significantly more frequently on the skin of gastrointestinally colonised patients [125]. If these patients develop diarrhoea for other reasons (e.g. antibiotic-associated), massive contamination of the patient environment with MRSA might ensue [2].
Outlets of drainages, stomata, catheters and chronic wounds are also reservoirs of lasting colonisation. Surfaces of the inanimate environment in the isolation room are significantly more frequently contaminated in the case of patients with perineal MRSA colonisation [126].
The tenacity (resistance to unfavourable environmental factors) and spreading tendency of nosocomial MRSA

isolates make it unsuitable to consider the MRSA colonisation of a patient statically and on the basis of a single swab series because the number of colonised areas can change daily.
For example, an "only nasally" colonised patient who catches a cold in hospital or coughs for other reasons (asthma, COPD, smoker), can become the starting point of massive MRSA contamination to the environment without a mask covering mouth and nose.
Many people often unconsciously touch their noses and thus possibly contaminate their hands and subsequently their environment with MRSA. If a mask covering mouth and nose is always worn outside the isolation room (in addition to hygienic hand disinfection) the probability of such a "hygiene error" is decreased.
In addition, a significant part of MRSA-colonised patients is not able to consistently stick to the required hygiene measures [127]. Problems in terms of compliance with hand hygiene [128], [129], [130], [131], [132], [133], [134] or the use of disposable gloves [135] arise again and again, even in case of well-trained and experienced nursing or medical service staff. In this context, it is unrealistic to act on the assumption of the ideal of a well-informed, judicious and cooperative patient who immediately and completely grasps all barrier measures and is able to consistently implement them [127], [136], [137].
There is an increased likelihood that nursing scrubs will be contaminated if additional, patient-related protective gowns are not worn [84], [104], [116], [138]. Since certain zones of nursing scrubs and objects [139] (bags, pagers, computers, ball-pens etc.) frequently come into contact with hands [140], [141], [142], [143], [144] in clinical practice, a pathogen might be secondarily transmitted from contaminated nursing scrubs to the hands of nursing and medical staff. Moreover, MRSA can be transmitted through droplet infection in case of nasal or pharyngeal colonisation or infections of the deeper respiratory tract. This by no means only applies to patients with infections of the upper airways or tracheostoma, although the risk is significantly increased in these situations [84].
Protective gowns stored in the room can be contaminated with MRSA before use. In this respect, it is advisable to store fresh protective gowns in front of the isolation room, in the sluice area or in a specific "MRSA carriage" [40], and to put on the protective gown and the mask covering mouth and nose before entering the isolation room and dispose of them when leaving the room.
Staff who wear a mask covering mouth and nose in the isolation room/(area), dispose of this mask when leaving the room/(area) and subsequently disinfect their hands have a reduced probability of unconsciously touching their own nasal mucosa with contaminated gloves.
Without discussing all specific shortfalls in conception and implementation in detail, it is merely worth noting that neither the examination on "droplet precautions" [145] published by Mangini et al. in 2007 nor the randomised monocentric trial on wearing protective gowns [146] published by Grant et al. in 2006 meet the method requirements of a sound and convincing scientific study regarding all these important problems and questions. For this reason, these papers should on no account be quoted as if their conclusions were scientifically proven facts.

2.2.3. Specific considerations on operations in MRSA-colonised or -infected patients

- The question of when a patient will be operated is answered by the medical indications for the operation, and not the MRSA colonisation status.
- Elective operations should always be postponed if sufficient time for a promising decolonisation attempt is available.
- Necessary diagnostic and smaller therapeutic interventions can also be performed in procedures rooms – instead of isolation rooms – if firmly established procedures controlled by the hospital hygienist and hygiene experts for prevention and control (including subsequent disinfection) are guaranteed.
- Disinfectant intermediate cleaning is extended to the patient-remote area (floors, not walls) in case of probable release of MRSA during the operation to the environment (e.g. MRSA colonisation or infection in the operation area). Before preparing the new operation drying of the disinfectant must be awaited.
- The operating team must go through the airlock again in case of probable contamination of the surgery team's scrubs (including a change of shoes).

2.3. Do MRSA patients get worse medical/nursing care?

An oft-cited study by Stelfox et al. [147], and also other studies [148] has suggested that patients who were isolated due to a colonisation or infection with multi-resistant pathogens

- are less frequently monitored and examined [149];
- show more complications in clinical course; these complications could possibly be prevented in case of better continuous care.

These problems and the associated ethical questions are not specific to MRSA [150], [151], [152]. When interpreting the aforementioned studies it has to be considered though that they are merely observational studies without intervention. Yet, section 7 of the KRINKO recommendations needs to be specified for ethical reasons:

- On principle, colonisation or infection with a multi-resistant pathogen must not result in patients receiving worse medical care and being denied medically indicated diagnostic and therapeutic measures.
- Hospitals treating MRE-colonised or -infected patients must create the structural-organisational and staff requirements such that the necessary medical surveillance and care is also guaranteed for patients who must be isolated for reasons of infection prevention.

- The recommendations for performing diagnostic procedures in an MRE-colonised patient in the isolation room must not result in an increased risk of undesired complications or worse surveillance of vital functions during or after the intervention.

2.4. Do the isolation measures result in restrictions in mobility, social stigmatisation and psychological stress of patients?

Patients who are isolated in an isolation room or in a correspondingly marked area due to an MRSA colonisation or infection

- are restricted in their mobility;
- run an increased risk of social isolation and stigmatisation;
- are exposed to additional psychological stress [153];
- are possibly unhappy with medical care.

These aspects of the utmost practical importance are not discussed in the KRINKO recommendations of 1999. In an observational study, increased anxiety and depression scores in isolated patients (because of MRSA or VRE) were found after just one week [154]. The authors of this investigation point out that it is merely an observational study without intervention.
They quote studies from the field of protective isolation within the context of allogeneic stem cell transplantations; these problems were anticipated in these studies and could be alleviated by suitable interventions.
Reference to studies discussing psychological stress of patients and relatives in the course of the SARS epidemic [155], [156] is not appropriate in this paper because separating patients from their relatives (or even separating children from their parents) is not necessary in case of an MRSA colonisation.
The following measures can be helpful:

- Cooperative, judicious and mobile patients should be allowed to leave the isolation room, e.g. to go for a walk in the clinic's garden, after a written agreement has been made and a consultation with a physician has taken place. It is self-evident that direct or indirect contacts with other patients must be avoided.
- In case of nasal or pharyngeal colonisation, the patient must wear a mask covering mouth and nose when leaving the room. All MRSA-colonised wounds must be covered meticulously with an adequate, liquid-proof dressing.
- A specific treatment plan should be set up in conjunction with the hospital hygienist (hygiene experts) for patients who need physiotherapy treatment which cannot be given in the isolation room. The risk of transmitting MRSA can be minimised by subsequently thoroughly wet disinfecting all potentially contaminated surfaces with an approved disinfectant and by adhering to special safety measures, both seen to by the physiotherapists.
- Isolation rooms for patients who can otherwise unrestrictedly communicate with their fellow patients and relatives should be equipped with a telephone, with radio, and with television but it has to be ensured that control panels can be regularly disinfected.
- Transparent face protection shields instead of the usual mask covering mouth and nose should be developed for treating children and other patients who notably rely on non-verbal communication (reassuring and friendly signals, such as smiling etc.); these shields must protect against droplet infections.
- Physicians and nurses explaining the necessity of isolation should also actively address the problem of additional psychological stress.
- When calculating the necessary working time with patients, medical staff should allow for extra time for talking to patients.
- The indication for professional psychological care of selected patients is given by the doctors in attendance.

The risk of social stigmatisation can be reduced by:

- Marking the room's door with the information “intensive care” (the following safety measures must be adhered to, visitors should report to the ward staff...) instead of a warning sign which publicly communicates the patient's colonisation state without permission.
- Information material informing patients and relatives about the meaning, transmission paths and required prevention and control measures of MRE [157].
- Computer-aided automated alerts can be used in clinics with a digital patient documentation system for immediately isolating patients with known or highly likely MRSA colonisation upon the patients' admissions in such a way that patients must not be transferred from a common room during their hospitalisation [158], [159].

Patients' satisfaction with their medical care does not depend on the question of whether they are isolated or not, if the necessary extra time is considered in structural and organisational terms and if management is purposeful and far-sighted [160]. On the contrary, clinical experience often shows that patients properly cared for in this context feel particularly safe and experience the extra time allocated to them as positive [161].
It basically makes sense to instruct patients as partners in preventing nosocomial infections and also recommend hygienic hand disinfection to them (the same being applicable to nursing and medical staff) [137].

2.5. How to deal with medical and nursing staff who are MRSA carriers

According to a current survey [162], medical and nursing staff are more frequently colonised with MRSA [114], [118], [163] and are more often involved in nosocomial transmissions than originally thought [164]. The authors

identify 18 studies, in which transmission from asymptomatic, MRSA-colonised staff to patients was proven with molecular biological typing methods, and 26 studies, in which such a transmission was very likely in epidemiological terms.
The hospital hygienist in charge, the clinic management and the on-site occupational health officer must decide on the necessary procedure regarding staff screening for MRSA. It might not make sense to limit staff screening to symptomatic staff.
Nurses and orderlies often feel more responsible for individual patients assigned to them than medical staff. They often want to be tested themselves if "their patients" have been found to have MRSA. This shows strongly developed hygiene awareness. Testing should thus be made possible after consultation of the hygiene experts. The same survey [162] makes further important information accessible:

- 5% of all MRSA-positive staff (48 of 942 examined staff with available information) fell ill with an MRSA infection themselves.
- In addition to nose swabs, pharynx swabs are required to safely exclude MRSA colonisation [165], [166], [167].
- The success rate of an antiseptic decolonisation treatment combined with mupirocin nose ointment is excellent for medical staff (90% after 5 days; 93% after 10 days Mupirocin plus oral antibiotics, e.g. rifampicin and cotrimoxazole or doxycyclin). Additional benefits of supplementary preventive treatments with certain antibiotics (according to in vitro sensitivity testing, e.g. rifampicin, cotrimoxazole) have to be carefully weighed up against undesired effects to be expected.
- In case of some staff, underlying diseases, such as chronic sinusitis [168], otitis externa [169] or chronic hand eczema [170] need to be treated concomitantly to obtain long-term decolonisation.
- The domestic area (including certain pets) should be included in the respective intervention strategy [171], [172], [173], especially in case of staff who cannot be treated successfully.

The question of whether it is reasonable to temporarily release MRSA-colonised staff from near-patient activities during a decolonisation treatment must be decided on the job in a written standard, the drafting of which should include all relevant occupational groups including clinic management and administration.
Absenteeism must not be declared as "sick leave" in this context, and the costs for the decolonisation treatment of staff are to be borne by the hospital.
Since under manning of nursing staff is itself an independent risk factor for MRSA transmission in the context of outbreaks [94], [174], staff released from their duties must be temporarily replaced by additional staff.
If this is not possible MRSA-colonised staff should exclusively nurse MRSA-colonised patients – after another intensive briefing regarding the necessary barrier measures – until they have successfully been decolonised themselves.

2.6. Problems in the pre- and post-inpatient care area

Since not all MRSA-colonised patients have been successfully treated by the end of their hospitalisation [10], and the duration of inpatient treatment of patients is declining as a whole, more and more MRSA-colonised/-infected patients are discharged to outpatient care or to other treatment facilities (e.g. old people's homes and nursing homes) [4].
Further medical treatment of these patients is provided by physicians in private practices or specialist outpatient clinics, and many of these people are cared for by outpatient nursing services [175].
The special costs that are incurred by eradication treatment [176], microbiological follow-up or the extra time in outpatient care of MRSA-colonised or -infected patients have not been creditable so far. This funding void also affects MRSA screening of patients with increased risk of MRSA colonisation before elective inpatient hospitalisation [26], [78] as well as MRSA screening of family members of MRSA-positive patients. In this field, urgent action is needed by the legislators and cost-bearers of outpatient medical care.

Notes

Conflict of interest

None of the authors declares a conflict of interest.

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