Recommendations for the prevention and control of methicillin-resistant Staphylococcus aureus isolates (MRSA) in hospitals and other healthcare facilities

Empfehlung zur Prävention und Kontrolle von Methicillin-resistenten Staphylococcus aureus-Stämmen (MRSA) in Krankenhäusern und anderen medizinischen Einrichtungen

Abstract

The Commission for Hospital Hygiene and Infection Control (KRINKO) at the Robert Koch-Institute Berlin published the "Recommendations for Preventing and Controlling Methicillin-Resistant *Staphylococcus aureus* (MRSA) Strains in Hospitals and Other Medical Facilities" in the Federal Health Gazette in 1999 [1]. These recommendations were translated for the current edition of GMS Krankenhaushygiene Interdisziplinär by the German Society of Hospital Hygiene.
KRINKO's work is legitimated by § 23 para. 2 of the Infection Protection Act. Regarding the legal nature of the KRINKO recommendations, it should be noted that they are neither a formal act or an administrative regulation.
The KRINKO recommendations are instead an evidence-based consensus of particularly qualified experts. The consensus is reached by including the Federal States' authorities and all competent professional bodies and associations. This is to guarantee that the KRINKO recommendations reflect the state-of-the-art of medical science, and are met with a high degree of user acceptance. The recommendations are published in the Federal Health Gazette and on the RKI's Internet pages (http://www.rki.de/).

Keywords: MRSA, prevention, control, recommendations, Commission for Hospital Hygiene and Infection Control, Robert Koch Institute

Commission for Hospital Hygiene and Infection Prevention at the Robert Koch-Institute[1]

1 Berlin, Germany

Zusammenfassung

Die Kommission für Krankenhaushygiene und Infektionsprävention (KRINKO) beim Robert Koch-Institut Berlin) hat 1999 die „Empfehlungen zur Prävention und Kontrolle von Methicillin-resistenten *Staphylococcus-aureus*-(MRSA)-Stämmen in Krankenhäusern und anderen medizinischen Einrichtungen" im Bundesgesundheitsblatt veröffentlicht [1]. Diese Empfehlung wurde für die vorliegende Ausgabe von GMS Krankenhaushygiene Interdisziplinär von der Deutschen Gesellschaft für Krankenhaushygiene übersetzt.
Die Arbeit der KRINKO ist über den § 23 Abs. 2 des Infektionsschutzgesetzes legitimiert. Bezüglich des Rechtscharakters der Empfehlungen der KRINKO ist festzuhalten, dass es sich dabei weder um ein Gesetz noch um eine Verwaltungsvorschrift handelt.
Vielmehr stellen die Empfehlungen der KRINKO einen Evidenz-basierten Konsens besonders qualifizierter Fachleute dar, wobei die Konsensbildung unter Einbeziehung der Kompetenz der Bundesländer und aller zuständigen Fachgesellschaften und -verbände erfolgt. Damit soll gewährleistet werden, dass die Empfehlungen der KRINKO den aktuellen Stand der medizinischen Wissenschaft wiedergeben und auf hohe Akzeptanz bei den Anwendern stoßen. Die Empfehlungen werden im

Bundesgesundheitsblatt sowie auf den Internetseiten des RKI (http://www.rki.de/) veröffentlicht.

Recommendations

1 Introduction

Alongside the increasing importance of *Staphylococcus aureus* as a pathogen in nosocomial infections, resistance to a series of antibiotics has considerably and increasingly deteriorated. Methicillin-resistance in *S. aureus*, i.e. the insensitivity of the pathogen to so-called staphylococcal-efficient penicillinase-fast penicillins (isoxazolyl-penicillin), currently constitutes a resistance mechanism which is particularly problematic for clinical practice. Methicillin (oxacillin)-resistant *S. aureus* (MRSA, ORSA) strains are not only resistant to all β-lactam antibiotics (penicillins, cephalosporins and carbapenems) but also tend to demonstrate the phenomenon of multi-resistance, i.e. an insensitivity to substances pertaining to several antibiotic classes. Therapeutic options for MRSA infections are thus radically restricted, and MRSA infections are becoming a significant risk factor for patients concerned [2]. The spread of MRSA strains with additionally decreased glycopeptide sensitivity (vancomycin-intermediate *S. aureus* = VISA) as observed at present, especially in Japan and the US, would critically limit controllability of MRSA infections due to the loss of the therapeutic glycopeptide option [3], [4].

The intrinsic methicillin-resistance is based on the methicillin-resistance determinant which is integrated in the bacterial chromosome and carries the mecA gene encoding a modified penicillin-binding protein (PBP). This so-called PBP2a (PBP2') conditions the phenotypic correlate of methicillin resistance due to its lowered affinity for β-lactam antibiotics [5]. In case of doubt, the detection of the mecA gene by means of molecular biological methods (e.g. polymerase chain reaction (PCR)) confirms the MRSA character of an *S. aureus* isolate.

MRSA infections are an escalating problem within in-patient facilities all over the world. Aside from countries where the MRSA situation can barely be controlled any longer (amongst others, Japan, USA, Spain, Italy, France and England) with a share of between 20 and 60 percent MRSA, countries which have been able to restrict their MRSA incidences to a few percentage points as a result of strict control and prevention strategies (the Netherlands, Scandinavian countries) should also be noted [6]. Regarding Germany, two multi-centre studies with *S. aureus* isolates, which were carried out in the late eighties and early nineties give evidence of an alarming increase in the MRSA incidence from 3.7% and 1.7% to 8.0% compared with 1995 figures [7], [8], [9]. If *S. aureus* isolates from intensive care areas are examined separately incidence rates are, in fact, much higher reaching 10.4% and 13.5% [7], [8].

Staphylococcus aureus is of significance both as an important cause of infections acquired outside hospital (amongst others, endocarditis, haematogenous osteomyelitis, pneumonia) and especially nosocomial infections. However, it is also found in the physiological skin flora of humans where it primarily colonises the vestibules of the nose. Some 20% of the population is permanently colonised with *S. aureus* whilst approximately 60% is colonised intermittently. Starting from the anterior nares, the pathogen can spread to other areas of the skin (hands (!), axilla, perineal region and others) and mucous membranes (pharynx and others). MRSA is thus mainly transmitted from the rhinopharynx of the colonised/infected patient; further sources of infection are intertriginous skin areas, respiratory secretions, wound exudation and also blood in the case of bacteriaemiae [10], [11].

The particular situation of hospital hygiene in conjunction with the occurrence of MRSA is characterised by the primary transmission of MRSA through hands of medical staff, the possibility of months of persistence in case of nasal colonisations and/or infections with this pathogen as well as by high environmental resistance of *S. aureus*. The pathogen features high resistance to dryness and heat, and is viable in the inanimate environment (e.g. gowns, air, surfaces of devices, instruments, personal care products, hospital inventory etc.) for months [12].

Decisive measures for controlling MRSA situations include:

- early recognition and verification of MRSA strains;
- systematic (cohort) isolation of MRSA colonised/infected patients;
- extensive information and training of staff;
- strict adherence to general hygiene measures (hand disinfection (!), and others);
- eradication of nasal MRSA colonisation.

Further consequences for dealing with MRSA patients are avoiding invasive-diagnostic and operative (especially elective) procedures as far as possible and minimising transfer and transport. It is only through timely and adequate measures to control infection that transmissions of MRSA can be prevented, outbreaks of MRSA can be limited and/or the occurrence of endemic situations can be averted and, not least, additional costs for the facilities concerned can be avoided [13], [14], [15], [16].

The following recommendations of the Commission for Hospital Hygiene and Infection Prevention at the Robert Koch-Institute regarding the prevention of MRSA transmissions give detailed guidance on how to deal with MRSA in healthcare facilities. The recommendations have been classified according to categories [17].

2 General information (Category I B)

- Medical and other staff of healthcare facilities is to be trained to understand the importance of and know how to deal with MRSA colonised and/or infected patients,

and checks must be made to ensure that general and specific hygiene measures are adhered to.
• If an MRSA colonisation and/or infection is reasonably suspected or evident, the hospital hygienist, staff in charge of hygiene and the managers of the respective healthcare facility are to be informed imminently.
• Close contact with infectious diseases consultants is the prerequisite for optimum MRSA management.

3 Spatial-functional requirements of the accommodation of MRSA patients (Category I B)

• MRSA colonised and/or infected patients must be spatially separated from other patients, preferably in rooms with ensuite bathrooms and an anteroom. Doors are to be kept closed.
• Several patients with MRSA may be accommodated together (cohort isolation).

4 Protection against contamination (Category I B)

• Rules of hand hygiene are to be strictly observed (even if disposable gloves are used) (see Guideline for Hospital Hygiene and Infection Prevention, Appendix 5.1 “Hand Hygiene”) [18].
• The gown must be changed and a mask covering mouth and nose must be worn when entering the patient room. The protective gown exclusively reserved for dealing with MRSA patients must remain in the room or anteroom, and be placed in appropriate laundry bags at the end of the shift at latest. The mask covering mouth and nose is to be worn in order to protect staff. It has to be discarded as waste in the patient's room or the anteroom when leaving the room.
• Disposable gloves are required if contact with contaminated materials, objects, devices and instruments is possible. They have to be put on before entering the patient's room and must be discarded as waste in the patient's room or anteroom when leaving the room.
• Visitors and staff not belonging to the ward must be asked to abide by the necessary protective measures. The measures are to be explained to such persons if necessary.
• Transport and/or transfer within and outside the ward and/or facility are to be avoided and limited to cases where it is strictly necessary (see Points 11 and 12).

5 Disinfection and cleaning (Category I B)

• Surface disinfection (wet disinfection) is required at least daily for near-patient areas (bedsteads, bedside tables, wet areas, door handles and the like); if required, it must be extended to other surfaces susceptible to contamination (see Guideline for Hospital Hygiene and Infection Prevention, Appendix 6.12 [18] “Housekeeping and Surface Disinfection”).
• All contact surfaces of equipment used on patients (e.g. heads of ultrasonic scanners, ECG electrodes and cables) must be wet disinfected with agents of the DGHM/VAH's list after this equipment has been used and before it is removed from the room.
• Stethoscopes, thermometers and the like are to be used in a patient-related manner and are to be disinfected immediately after use.
• All instruments (scissors, clamps, forceps etc.) used on patients are sent for disinfection. In case of central disinfection, instruments must be transported in closed receptacles.
• Dishes are cleaned routinely (it is advisable to use an automatic cleaning device) or discarded.
• Laundry and textiles of MRSA patients are collected and discarded in the patient room or anteroom in adequate laundry bags. Washing is carried out with an approved laundry disinfection method according to the DGHM/VAH's or RKI's guideline [19], [20].

6 Waste disposal (Category I B)

MRSA-containing material and waste which could be contaminated with MRSA, are to be disposed of as waste pertaining to Group B. They are disposed of according to the hygiene plan but at the end of a working shift at latest (fact sheet on how to avoid and dispose of waste from public and private health service facilities [18], [20]).

7 Interventions in patients (Category I B)

• Necessary diagnostic and minor therapeutic interventions should be performed in the patient room as far as this is reasonable.
• Elective and invasive-diagnostic procedures should as possible be avoided.
• Operative procedures in MRSA colonised and/or infected patients should be handled as per operations of the C Group, and are to be conducted in the operational units provided. In case of operation wards which are not provided with such a unit, the operating schedule should be structured in such a way that interventions in MRSA colonised or infected patients are conducted at the end of operation programmes. In each case, disinfection measures must be carried out immediately after the intervention according to the Guideline for Hospital Hygiene and Infection Prevention, see Appendices 5.1 and 4.3.3 “Hygiene Requirements in Operations and other Surgical Procedures” [18].

8 Screening (Category I B)

• It is not necessary to routinely examine patients or medical staff for MRSA.
• Screening should be conducted in patients (swabs of vestibules of the nose and, where applicable, of the pharynx, the perineal region and of wounds)

- who are readmitted and have a known MRSA anamnesis;
- who are admitted and transferred from facilities with known endemic and/or presumed MRSA occurrence; such as burn centres, dialysis facilities, nursing homes and from countries with high MRSA prevalence (e.g. Southern and Eastern European countries, USA, Japan, England).

• In case of accumulative evidence of MRSA in several patients (>2), that can be linked in terms of space and time, attempts should be made to perform genotyping (e.g. using pulsed-field electrophoresis). In case of clonal identity, screening should be conducted by means of swabs of the vestibules of the nose and the pharynges of all patients of the treatment unit concerned as well as of the medical staff members that have had direct contact with the MRSA patients.

9 Decolonisation of MRSA carriers

9.1 Patients (Category I B)

• MRSA colonised patients should be decolonised with antibacterial agents whose clinical efficacy is proven for this application.
• For decolonising nasal MRSA colonisations, it is recommended to apply Mupirocin nasal ointment (into both vestibules of the nose and three times daily over a period of at least three days). Nasal sanitation usually also reduces colonisation in other parts of the body.
• Alternatively and especially in case of a Mupirocin resistance, preparations with antiseptic agents or other locally applicable antibiotics with proven efficacy (e.g. Bacitracin) may be used.
• For decolonising an MRSA colonisation of the skin, antiseptically active soaps and solutions with proven efficacy are recommended for whole-body and hair washing if the skin is intact.
• For preventing recolonisation, bed linen, clothing and personal care utensils (face cloths and the like) are to be changed daily, especially after antiseptic whole-body washing, during sanitation measures. Personal objects (spectacles, razors, toothbrushes etc.) are to be left in the room and disinfected and/or exchanged.

9.2 Staff (Category II)

• MRSA carriers among staff should not treat and nurse patients until decolonisation has been proven. Decolonisation is to be recommended in the event of an MRSA colonisation (see 9.1).
• For efficiency checking, control swabs are to be taken according to the localisation three days after the decolonisation measures have been concluded at the earliest. If no more MRSA is detected in these control swabs staff may return on duty in direct patient care. Further checks are to be arranged after ten days, one month and three months after the end of the therapy.

10 Lifting isolation (Category I B)

Isolation can be lifted for MRSA colonised and/or infected patients if MRSA-negative swabs confirm successful decolonisation on three successive days, and three days after the treatment has been concluded at the earliest.

11 Measures for transfer and transport within the hospital (Category I B)

• Transportation of patients with MRSA should be limited to clinical situations where it is strictly required.
• The target facility has to be informed of the MRSA colonisation/infection in the patient in advance, so it may take necessary protective measures.
• If possible, the patient should be bathed or washed antiseptically (including hair) immediately before transport.
• Transportation should take place on an individual basis, with fresh bed linen and/or hospital clothing or cover.
• Wound infections or lesions are to be covered tightly.
• Patients with nasopharyngeal colonisation must wear a mask covering mouth and nose.
• Transport staff and staff of the medical speciality departments involved must put on fresh protective gowns and gloves in case of close contact with MRSA patients, and disinfect their hands after contact with MRSA patients. The protective gowns and gloves used are to be discarded properly after transportation and/or contact with patients.
• Contact of the MRSA patient with other patients is to be avoided.
• Treatment and/or examination measures for MRSA patients should preferably be moved to the end of the daily schedule; contact surfaces are to be disinfected afterwards (see Point 5).
• All contact surfaces of the transportation device and/or vehicle are to be disinfected directly after transportation (see Point 5).

12 Additional measures for transferring patients to other hospitals and/or facilities (Category I B)

• Each transportation of MRSA patients should only be authorised in the event of very strict and well-founded indications.
• The target facility is to be informed on the MRSA colonisation/infection before MRSA patients are being transferred. MRSA findings must be noted down in the accompanying documents which must be clearly marked accordingly. In particular, information on up-to-date MRSA screening findings must be transmitted.
• If MRSA is only detected upon the patient's admission to the target facility, the facility where the patient was previously admitted needs to be informed.
• Hygiene requirements need to be taken into account when MRSA patients are being transported.

• In the event of nasal and/or oropharyngeal MRSA colonisation in the patient, sanitation should be performed with an antibacterial agent whose clinical efficacy has been proven for this application (see Point 9.1).
• The accompanying personnel must wear disposable gloves and protective gowns if direct contact with MRSA patients is to be expected (see Point 4).
• Upon admission to the target facility, the patient must be isolated spatially until further control tests for MRSA colonisation are negative. Cohort isolations instead of individual isolations are a possibility in larger facilities where endemic occurrences of MRSA are already present (see Points 3 and 10).
• It is compulsory for the accompanying personnel to hygienically disinfect their hands after transportation (see Point 4).
• If known patients are admitted and/or readmitted they need to be isolated first of all, and examinations for MRSA are to be carried out. Isolation needs to be maintained until MRSA colonisation and/or infection can be ruled out (see Points 3 and 10).

13 Measures regarding discharge (Category I B)

• Patients should be discharged if their clinical state makes it possible; as the case may be in spite of MRSA colonisation.
• The outpatient physician giving further treatment must be informed beforehand and should be advised on what additional hygiene measures are sensible and might need to be put in practice.
• Patients should be educated that there is no risk for healthy contact persons (those at risk are, for example, contact persons with open wounds or eczematous skin, immunosuppressed people). Handing out an information leaflet is recommended (see below).

These recommendations were drafted in a working group by G. Peters (head of the working group), K. Becker, F. Kipp (Münster); of the RKI: D. Heuck, A. Nassauer, G. Unger and W. Witte, by order of the Commission for Hospital Hygiene and Infection Prevention at the Robert Koch Institute (RKI) in Berlin.

Information leaflet for MRSA patients

Name of the patient:
Date:

During your stay in hospital, test results have showed you are carrying a bacterium which is known as MRSA (methicillin-resistant *Staphylococcus aureus*). Simple colonisation with this bacterium poses no problem to you, however, there is a risk that these bacteria can work their way from your skin or nasal mucosa into a wound and thus into your body. This could cause an MRSA infection. It is also possible that these bacteria are transmitted to other people (hospital patients and persons with skin lesions), and trigger infections in these people. For these reasons, we would ask you to observe the following instructions to stop your MRSA colonisation.
We will inform your family doctor about your MRSA colonisation. If required, he or she will prescribe further necessary antibacterial and disinfectant preparations, which, for the time being, we will give you to take home with you. Your doctor might also arrange for bacteriological check-ups for excluding your MRSA colonisation.

Application of antibacterial and disinfectant preparations

Nose ointment: Turixin®
Introduce an amount the size of a match-head into each nostril with a cotton swab or your little finger three times daily for ... days. Afterwards pinch your nose and subsequently massage it with thumb and index. Hands must be disinfected afterwards.

Hand disinfectant:
Antiseptic soap:
Antiseptic shampoo:

For daily use, please use the aforementioned antiseptic and disinfectant products instead of your usual personal hygiene products. After use, always rinse with plenty of water. If skin irritation should still occur, seek immediate medical attention from your family doctor. A fresh towel and fresh underwear and bedclothes must be used each time after bathing or showering, including after hair washing. Changed underwear and bedclothes must then be subject to a thermal (80 to 90 °C) or chemo-thermal washing procedure. You should only use towels, face cloths and other toiletries for your own personal use. They must be changed daily, and/or disposable, i.e. single-use, articles must be used.

What does your colonisation mean for people that come into contact with you at home?

The MRSA bacterium constitutes no risk to healthy people in the outpatient and domestic areas; you may socialise with these people as usual.
An infection with MRSA might break out only where contact occurs with people that have open wounds or skin eczema. This is why you should avoid particularly close and intimate contact with these people during your MRSA-carrier state. The same goes when dealing with people at your home who provide professional nursing services for patients in a hospital.

References

1. Empfehlung zur Prävention und Kontrolle von Methicillin-resistenten Staphylococcus aureus-Stämmen (MRSA) in Krankenhäusern und anderen medizinischen Einrichtungen: MItteilung der Kommission Krankenhaushygiene und Infektionsprävention am RKI. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz. 1999;42:954-8. DOI: 10.1007/s001030050227
2. Peters G, Becker K. Epidemiology, control and treatment of methicillin-resistant Staphylococcus aureus. Drugs. 1996;52 Suppl 2: S50-4. DOI: 10.2165/00003495-199600522-00011
3. Hiramatsu K. Vancomycin resistance in staphylococci. Drug Resist Updat. 1998;1:135-50. DOI: 10.1016/S1368-7646(98)80029-0
4. Robert Koch-Institut. Erstes Auftreten von MRSA mit verminderter Glykopeptidresistenz in Deutschland nachgewiesen. Epidem Bull. 1998;18:123.
5. Berger-Bächi B. Expression of resistance to methicillin. Trends Microbiol. 1994;2:389-93. DOI: 10.1016/0966-842X(94)90617-3
6. Voss A, Milatovic D, Wallrauch-Schwarz C, Rosdahl VT, Braveny I. Methicillin-resistant Staphylococcus aureus in Europe. Eur J Clin Microbiol Infect Dis. 1994;13:50-5. DOI: 10.1007/BF02026127
7. Voss A, Machka K, Lenz W, Milatovic D. Vorkommen, Häufigkeit und Resistenzverhalten von Methicillin-Oxacillin-resistenten Staphylococcus-aureus-Stämmen in Deutschland. Dtsch Med Wochenschr. 1992;117:1907-12. DOI: 10.1055/s-2008-1062528
8. Witte W, Kresken M, Braulke C, Cuny C. Increasing incidence and widespread dissemination of methicillin-resistant Staphylococcus aureus (MRSA) in hospitals in central Europe, with special reference to German hospitals. Clin Microbiol Infect. 1997:3:414-22. DOI: 10.1111/j.1469-0691.1997.tb00277.x
9. Kresken M, Hafner D. Prävalenz der Antibiotikaresistenz bei klinisch wichtigen Infektionserregern in Mitteleuropa: Bericht über die Ergebnisse einer multizentrischen Studie der Arbeitsgemeinschaft "Resistenz" in der Paul-Ehrlich-Gesellschaft für Chemotherapie e.V. aus dem Jahre 1995. J Chemother. 1996;5: 225-30.
10. Boyce JM. Strategies for controlling methicillin-resistant Staphylococcus aureus in hospitals. J Chemother. 1995;7 Suppl 3:S81-5.
11. Kluytmans J, van Belkum A, Verbrugh H. Nasal carriage of Staphylococcus aureus: epidemiology, underlying mechanisms, and associated risks. Clin Microbiol Rev. 1997;10:505-20.
12. Heuck D, Braulke C, Lauf H, Witte W. Analysen und Schlußfolgerungen zur epidemischen Verbreitung von Methicillin-resistenten S. aureus. Zbl Hyg Umweltmed. 1995;198:57-71.
13. Heuck D, Witte W. Maßnahmen zur Verhütung von MRSA-Übertragungen - eine Empfehlung aus epidemiologischer Sicht. Chemother J. 1994;3:61-5.
14. Working Party Report. Revised guidelines for the control of methicillin-resistant Staphylococcus aureus infection in hospitals: Report of a combined working party of the British Society for Antimicrobial Chemotherapy, the Hospital Infection Society and the Infection Control Nurses Association. J Hosp Infect. 1998;39:253-90. DOI: 10.1016/S0195-6701(98)90293-6
15. Casewell MW. New threats to the control of methicillin-resistant Staphylococcus aureus. J Hosp Infect. 1995;30 Suppl:S465-71. DOI: 10.1016/0195-6701(95)90050-0
16. von Eiff C, Becker K, Peters G. Verhalten beim Auftreten von methicillinresistenten Staphylococcus-aureus- und glykopeptidresistenten Enterokokken-Stämmen. Hyg Med. 1998;23:354-9.
17. Exner M, Kistemann Th, Unger G, Hansis M, Nassauer A. Zukünftige Präventions- und Kontrollstrategien in der Krankenhaushygiene. Hyg Med. 1999;24(7/8):280-303.
18. Robert Koch-Institut. Richtlinie für Krankenhaushygiene und Infektionsprävention, Loseblattsammlung (einschl. Anlagen). Stuttgart: Fischer; 1998.
19. Deutsche Gesellschaft für Hygiene und Mikrobiologie. Liste der von der Deutschen Gesellschaft für Hygiene und Mikrobiologie als wirksam befundenen Desinfektionsverfahren (Stand 1.1.1999). Wiesbaden: mhp; 1999.
20. Länder-Arbeitsgemeinschaft Abfall (LAGA). Merkblatt über die Vermeidung und Entsorgung von Abfällen aus öffentlichen und privaten Einrichtungen des Gesundheitsdienstes. Bundesgesundhbl. 1992; 35(Sonderheft):30-8.
21. Liste der vom Robert Koch-Institut geprüften und anerkannten Desinfektionsmittel und -verfahren: 13. Ausgabe (Stand 15.6.1997) und Nachträge. Berlin: Robert Koch-Institut; 1997.

Please cite as
Commission for Hospital Hygiene and Infection Prevention at the Robert Koch-Institute. Recommendations for the prevention and control of methicillin-resistant Staphylococcus aureus isolates (MRSA) in hospitals and other healthcare facilities. GMS Krankenhaushyg Interdiszip. 2009;4(1):Doc01.

This article is freely available from
http://www.egms.de/en/journals/dgkh/2009-4/dgkh000126.shtml

Published: *2009-04-09*