

ORIGINAL ARTICLE

Antibiotics: MRSA Prevention Measures in German Hospitals

Results of a Survey Among Hospitals, Performed as Part of the MRSA-KISS Module

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SUMMARY

Background: In this study, we investigated the measures currently being taken in German hospitals to prevent infection with methicillin-resistant strains of *Staphylococcus aureus* (MRSA). To this end, we circulated a questionnaire among hospitals participating in the MRSA-KISS module. “KISS” in the name of this project stands for “hospital infection surveillance system” (in German, Krankenhaus-Infektions-Surveillance-System).

Methods: The questionnaire was sent to all MRSA-KISS participants. A study doctor visited a representative sample of hospitals to validate the responses. The study doctor checked the questionnaire responses with a systematic on-site interview of the contact person in each hospital, then evaluated the information contained in them by recording all of the MRSA patients who were present in the hospital on the day of the visit in a point-prevalence study (PPS).

Results: All 134 participants filled out the questionnaire. The screening of patients at risk on admission is an established part of the clinical routine in all of the surveyed hospitals, as are MRSA decolonization procedures. These preventive measures have been recommended for routine use in Germany by the Robert Koch Institute (RKI), the German counterpart of the Centers for Disease Control and Prevention). The surveyed hospitals also used further preventive strategies, including, for example, an alerting system for the identification, upon hospital admission, of patients with a known history of MRSA positivity (72%); pre-admission screening of all patients (13%); universal screening on admission in some hospital wards (19%); and the prophylactic isolation of patients suspected of having MRSA with pending microbiological test results (21%). 35 hospitals were visited for validation. Most of the responses in each hospital were internally consistent and adequately reflected the real situation on site. Less consistency was seen in responses regarding the detection of MRSA by clinical testing and the measures that were taken after MRSA was detected.

Conclusion: The surveyed hospitals are, in fact, implementing many of the RKI's recommendations, as well as other preventive measures against MRSA.

Hospital hygiene is currently the subject of much discussion in the media. Frequent mention is made of the Robert Koch Institute (RKI) guidelines, with the comment that these recommendations have not been implemented. The present article has been written with the aim of elucidating what the position actually is in terms of the implementation of infection prevention in German hospitals participating in the MRSA-KISS module.

Because of the increasing significance of antibiotic resistance, since 2001 it has been mandatory under §23 of the Infection Prevention Law for German medical facilities to record pathogens with special resistances and multiple resistances (1). In Germany, especially with reference to methicillin-resistant *Staphylococcus aureus* (MRSA) species, a significant rise was seen between 1999 and 2005 in the MRSA proportion of *S. aureus* blood culture isolates, from 9.4% to 19.5%. This figure continued to rise until 2005, to 21.4%, and in 2008 had returned to 19.5% (2).

Because of the continuing problems with MRSA species in hospitals, since 2003 the National Reference Center for Surveillance of Nosocomial Infections (Nationales Referenzzentrum für Surveillance von nosokomialen Infektionen, NRZ) has offered a module called the MRSA-KISS (Krankenhaus-Infektions-Surveillance-System, or hospital infection surveillance system). The aim of this is to enable all hospitals to compare their own surveillance results with those of other hospitals, and in consequence be stimulated to implement additional MRSA prevention measures (www.nrz-hygiene.de/surveillance/kiss/mrsa-kiss).

Registrations in the surveillance module increase year by year and currently (as at March 2010) stands at 300 hospitals (3). This module makes available to hospitals a recording method that takes account of the MRSA burden for the whole hospital and describes the management of patients with MRSA as part of this burden (4).

The aim of this study was to find out, by means of a questionnaire administered to MRSA-KISS participants, what infection prevention measures were being implemented in the hospitals.

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TABLE 1

Structural parameters in the hospitals (n = 134)

What category of hospital is it? (n = 134)		
Size	Number	Percentage
<300 beds	51	38.1%
301–600 beds	46	34.3%
>600 beds	37	27.6%
Category		
Teaching hospital / university hospital	32	23.9%
General hospital	75	56.0%
Specialized hospital	3	2.2%
Rehabilitation clinic	3	2.2%
Other	21	15.7%
Where is the microbiological diagnosis carried out? (n = 134)		
In the hospital's own laboratory	47	35.1%
Elsewhere	81	60.5%
Other	6	4.5%

Methods

To this end, a standardized questionnaire was developed that asked about all the measures recommended by the RKI (as at 2007) and any other additional measures being implemented (5). Data were also collected about structural quality (structural conditions in terms of personnel, physical space, and organization), screening and isolation measures, and decolonization.

The questionnaire was developed using an internet-based online survey tool. In February 2007, all 134 MRSA-KISS participants who up to that time had already delivered their data to the NRZ received an invitation to take part in this survey.

To test the answers, 35 hospitals were randomly selected for an on-site validation visit. For this, hospitals were stratified according to hospital size (number of beds) and region. For validation, the questionnaire was systematically checked by the study doctor and the contact person at the hospital concerned in an on-site interview, and evaluated by means of a point prevalence study on the basis of the MRSA patients present on that day.

For the descriptive statistics, absolute and relative frequencies were calculated. In addition, the median and pooled arithmetic mean were determined, for in clinical studies being carried out in several centers the mean across all the centers is of interest as well as the means of each individual center. Quartiles Q1 (25th percentile) and Q3 (75th percentile) were also determined.

Results

Out of 134 MRSA-KISS participants invited, all (100%) completed the questionnaire. The participating hospitals are spread out over the whole of Germany. *Table 1* shows the structural parameters of the hospitals, and the MRSA rates are given in *Table 2*.

Tables 3a and *3b* show the complete list of questions about various prevention measures together with the answers.

The results of on-site validation in the 35 randomly chosen hospitals are shown in *Table 4*.

The answers to most questions (11 out of 13) agreed very well with on-site reality (90% to 100%). This was confirmed in the validation, and hence it can be assumed that the answers of the checked group are representative of all participants.

The good agreement is also evidenced by the point prevalence study (*Table 5*). Among the 35 hospitals visited, a total of 148 MRSA patients in 30 hospitals were receiving inpatient treatment on the day of the validation visit (giving an overall average of 4 MRSA patients per hospital) and their management was recorded systematically for the study.

According to the RKI recommendations, in Germany MRSA patients should be treated in isolation in single-bed rooms if possible, or else cohorted with other MRSA patients in multi-occupant rooms (5). When direct contact occurs between medical personnel and the MRSA patients, protective gowns, gloves, and a surgical mask covering nose and mouth should be worn. The hands must be disinfected with an alcohol-based hand rub before entering and after leaving the isolation room.

Other possible ways to contain and control MRSA within hospitals are decolonization measures carried out on the MRSA patient. These include treatment with topical antibiotics such as mupirocin, for application in the anterior nares (three times daily for at least 3 days), and washing the patient with antiseptic soap solutions.

The hospital survey showed that many of these recommendations were being put into practice, as was confirmed by the point prevalence study.

In clinical routine, only a small number of MRSA patients are identified, because microbiological analysis is usually performed only when clinically indicated—i.e., when bacterial infection is suspected (6). How many clinically inapparent MRSA colonizations are actually represented in a reservoir for possible nosocomial spread of infection is so far unknown.

To prevent MRSA transmission, it is necessary to recognize this reservoir, so that prevention measures such as, e.g., contact isolation of the patient and any decolonization measures can be instituted as soon as possible. This can be done by the use of screening tests, by which is meant taking nares cultures from the sites of predilection (nares, pharynx, and any wounds) to identify colonized patients. Usually particular patient groups are regarded as possible reservoirs. For this reason, the recommendations by the Commission for Hospital Hygiene and Infection Prevention (Kommission

TABLE 2

MRSA rates in the participating hospitals (n = 133) 2006*¹

Measure	Calculation basis	Mean ⁺²	Q1 ⁺³	Median	Q3 ⁺⁴
Overall incidence density	Number of MRSA cases per 1000 patient days	0.89	0.39	0.68	1.1
Incidence density of nosocomial MRSA cases	Number of nosocomial MRSA cases per 1000 patient days	0.27	0.13	0.21	0.33
Average daily MRSA burden	Number of inpatient MRSA-patient days per 100 patient days	1.4	0.56	1.08	1.72
MRSA-days-associated nosocomial MRSA rate	Number of nosocomial MRSA cases per 1000 inpatient MRSA-patient days	18.9	14.3	20.7	27.0

*¹ The data from one participating hospital could not be included for the reference values; ⁺² pooled arithmetical mean; ⁺³ quartile 1 (25th percentile); ⁺⁴ quartile 3 (75th percentile)

für Krankenhaushygiene und Infektionsprävention, KRINKO) at the RKI, first published in 1999, were expanded in 2004 in a commentary on selection of risk patients for screening (7). Among others these risk groups include patients who

- have a known history of MRSA;
- have been in contact with other MRSA patients;
- need long-term care;
- require dialysis;
- have chronic wounds;
- have indwelling catheters;
- have burn injuries.

Here, too, the answers to the question about whether routine screening was carried out in accordance with the recommendations showed that these are being implemented in almost all participating hospitals.

In addition to implementing these recommendations, additional screening—e.g., as a standard procedure on admission to a ward—is carried out by more than 80% of the hospitals surveyed. More than 25% of the hospitals have established other policies of screening, such as weekly screening of inpatients or outpatient screening performed by a primary care physician. Almost 20% of hospitals have instituted general screening on admission at least in the intensive care units and even on other wards. For early identification of MRSA patients, rapid diagnosis techniques have proved their worth, e.g., polymerase chain reaction (PCR), a technique employed in over a third (36%) of hospitals surveyed.

What microbiological procedure is used to diagnose MRSA at admission screening depends not only on the method itself, but also on whether the laboratory is on-site in the hospital or the samples have to be sent to an external laboratory. Only 35% of the hospitals surveyed have a microbiological laboratory of their own, and in 2007 only 36% carried out a rapid technique such as PCR. It is usually more difficult for an external laboratory to produce a result within 2 to 5 hours, because of the transport involved.

Identifying MRSA patients by screening on admission is only a part of further preventive measures.

Another part is prophylactic isolation of risk patients until the microbiological results are received—similar to the “search and destroy” method used in the Netherlands (www.wip.nl/UK/contentbrowser/onderwerpsort.asp). This procedure and graduated variants of it are already in use by more than 60% of the hospitals surveyed.

To identify MRSA patients rapidly, in addition to the admission screening it is important to have an “alert system” that identifies previous MRSA patients when they are readmitted. Such an alert system is not yet routinely implemented in the hospitals surveyed: Almost one-third of them (28%) have potential for improvement.

One other important measure to reduce the selection pressure is the careful use of antibiotics, i.e., what has been called “antibiotic stewardship.” For this, adequate training in prescription of antibiotics is important, and a good way to test how antibiotics are being prescribed is to monitor the level of their consumption in the hospital. In less than 44% of the hospitals surveyed was the consumption of antibiotics regularly recorded and reported back to the individual wards, so there is a great deal of scope for improvement here. Monitoring and reporting back the level of antibiotic consumption is also a part-objective of the German Antibiotic Resistance Strategy (Deutsche Antibiotika Resistenz Strategie, DART), initiated by the Federal Ministry of Health (Bundesministerium für Gesundheit), as a means to achieving the main goal, reduction of antibiotic resistance and of the spread of resistance in Germany (www.bmg.bund.de).

Discussion

How well recommendations for the prevention of MRSA have been put into practice has been investigated by only a few authors so far (8, 9). Both these studies used questionnaires to obtain data on implementation. They found that programs aiming at

TABLE 3a

Identification of MRSA patients

The following patients are regularly screened:	Number	Percentage
None	0	0
Known MRSA patients (e.g., re-admitted)	132	98.50%
Contact patients (patients who have been in contact with MRSA carriers, e.g., shared a room with them)	127	94.80%
Risk patients (e.g., from rehabilitation clinics or care homes, hospitals, on dialysis, indwelling catheter, chronic wound/skin ulcer/gangrene/deep soft-tissue infection, burn injury, patients who have received antibiotics in the past 6 months, patients with devices, e.g. indwelling catheter, etc.)	115	85.80%
All patients in one intensive care unit	17	12.70%
All patients in all intensive care units	15	11.20%
All patients in selected intensive care units	26	19.40%
All patients on selected non-intensive care units	6	4.50%
When do you screen to identify new MRSA patients (i.e., excluding monitoring nares cultures or control cultures for known MRSA patients)? (Multiple answers possible)		
Not at all	21	15.70%
At admission	110	82.10%
At regular intervals, or other (e.g., weekly)	19	14.20%
At discharge	2	1.50%
Other mode (e.g., outpatient department, primary care physician)	18	13.40%
What is screened at inpatient admission? (n = 134)		
Nose only	3	2.20%
Pharynx only	0	0
Wound if any	3	2.20%
Nasopharynx	2	1.50%
Nose and wound if any	28	20.90%
Nasopharynx and wound if any	48	35.80%
Nasopharynx and wound if any, plus additional cultures (e.g., forehead/scalp border, perineum, rectum)	40	29.90%
No information	10	7.50%
Does the screening use the PCR method (results within 2–5 hours)? (n = 134)		
Yes	48	35.80%
Do you have an alert system (flagging) to identify previously positive (known) patients at re-admission? (n = 134)		
Yes	97	72.40%

responsible use of antibiotic therapy are in need of improvement, as is confirmed by the results of the present study. These two studies did not carry out on-site validation of the management of MRSA patients, however, which is an essential limitation in the analysis of questionnaires. That is why the authors of the present study tested the answers against an on-site point prevalence test. The latter showed that 85% of MRSA patients were isolated either individually or as a cohort, which agreed very well with the 82.1% showed by the questionnaire data. On the other hand, for 9.5% of the patients no measures at all were instituted, which in the questionnaire had been stated by only 1.5% of the hospitals. If one assumes the worst case, the 16.4% of patients mentioned by the hospitals under the item “Isolated when possible” may be taken to be among the non-isolated patients. In this case, 18% of hospitals admit to not isolating, which is twice the figure found in reality at the on-site validation visits. A more notable finding is that 13.4% of those surveyed said that an MRSA patient is not admitted unless isolation is possible. This raises the question of whether the patient is receiving poorer care or is being protected from receiving poorer care (10). At all events, good and open communication on this issue is needed between the various departments (outpatient, inpatient, rehabilitation), and with the help of the regional MRSA networks that now exist should be taking place.

Only 4.3% of known MRSA patients were identified by an alert system. This raises the question of whether this alert system is being inadequately used or indeed is not present at all. As already mentioned, this low number clearly shows a need for improvement.

A large discrepancy with the questionnaire data is visible in the mode of identification of MRSA. In the survey, the hospitals said that in only 15.7% of cases was no screening at all carried out. In reality, 31.1% of MRSA patients were discovered only by clinical tests. The question here is whether an established admission screening is not being adequately implemented, or whether screening compliance is not enough. This finding could also be an indicator of nosocomial cases. Answering this question will require further studies analyzing associations between nosocomial cases and individual preventive measures.

With all the deviations mentioned above, it must not be forgotten that the limitation of a point prevalence test is that it only looks at a short span of time. A test on another day could make the result look rather different. For this reason, it would be worth carrying out more point prevalence tests at various times; taking these all together would give something more closely approximating to a realistic impression.

The response to this questionnaire, with a 100% compliance in answering, was impressively high and shows the interest that exists in this subject. But herein lies another limitation of this study: Only MRSA-KISS participants were selected for the survey. These hospitals are already committed participants; the mere fact of their participating in the MRSA-KISS module shows

TABLE 3b

Other preventive measures

Isolation measures until screening results are received for a patient of unknown MRSA status (n = 134)		
Implemented on a precautionary basis until results received	28	20.90%
Implemented on a precautionary basis until results received only for risk patients (e.g., dialysis patients, chronic wounds, etc.) or in special areas (e.g., intensive care unit)	27	20.20%
Implemented at least in the form of gowned and gloved patient care until results received	24	17.90%
Only implemented after results received	55	41.00%
Are MRSA patients isolated (consistent isolation on an individual or cohort basis)? (n = 134)		
Yes, consistently	110	82.10%
When possible	22	16.40%
No	2	1.50%
If it is not possible to isolate the MRSA patient, (n = 134)		
the patient is not admitted	18	13.40%
personnel are gowned and gloved when caring for the patient	116	86.60%
no measures are implemented	0	0
Decolonization using mupirocin nasal ointment (or other, e.g., bacitracin) (n = 134)		
is carried out for every MRSA patient	97	72.40%
is carried out only for defined MRSA patients (e.g., before elective surgery, during long hospital stays, before transfer)	34	25.40%
is not carried out	3	2.20%
Decolonization using an antiseptic whole-body wash (n = 134)		
is carried out for every MRSA patient	97	72.40%
is carried out only for defined MRSA patients (e.g., before elective surgery, during long hospital stays, before transfer)	31	23.10%
is not carried out	6	4.50%
During decolonization measures, is recolonization prevented by changing bedlinen, clothing, and wash utensils? (n = 134)		
Yes	128	95.50%
Measures regularly carried out during isolation of an MRSA patient:		
Wearing a mask only when working directly with/on the patient	51	38.10%
Always wearing a mask in the patient's room	71	53.00%
Wearing a protective gown only when working directly with/on the patient	60	44.80%
Always wearing a protective gown in the patient's room	77	57.50%
Daily disinfection of surfaces in the room	129	96.30%
Measures carried out in personnel in contact with MRSA patients		
Cultures are regularly taken when a nosocomial case of MRSA occurs	4	3.00%
Cultures are only taken when there is an outbreak (>2 MRSA patients at the same time and in the same place or locally related)	90	67.20%
None	40	29.90%
MRSA carriers among the personnel		
do not work with patients	91	67.90%
wear masks when working with patients	32	23.90%
work with patients so long as they (the personnel) do not have an MRSA infection	8	6.00%
always work with patients without limitation or restrictions	3	2.20%
Do you regularly carry out analysis with feedback of antibiotic consumption on the wards? (n = 134)		
Yes	59	44.00%

TABLE 4

Agreement between survey answers and on-site validation in the 35 hospitals

Question	Agreement of the answers	
	Number	Percentage
Are known MRSA patients isolated?	34	97%
Are contact patients isolated?	35	100%
Are risk patients isolated?	34	97%
Isolation until results received	29	83%
Isolation when MRSA proven	32	91%
Alert system exists	31	89%
Training is carried out regularly	32	91%
Regular use of mupirocin nasal ointment for decolonization	34	97%
Daily antiseptic whole-body wash for decolonization	33	94%
Daily change of linen during decolonization treatment	35	100%
Mask put on when entering the patient's room	33	94%
Protective gown put on when entering the patient's room	32	91%
Surfaces disinfected when patient discharged/daily	34	97%

TABLE 5

Results of the point prevalence study; 148 patients with MRSA were present in 30 hospitals on the day of the study (out of 35 validation hospitals)

Parameter	Number (n = 148)	Percentage
Patient found in individual isolation	118	79.70%
Patient found in cohort isolation	7	4.70%
Gowned gloved care observed	9	6.10%
No measure in place	14	9.50%
MRSA identified by		
admission screening*	79	48.20%
other screening	16	9.80%
communication from the previously treating hospital	11	6.70%
clinical examination	51	31.10%
alert system	7	4.30%
Decolonization		
None	32	21.60%
Decolonization procedures carried out	116	78.40%

* subsumes screening of known MRSA patients, risk-factor-based screening, and general screening

that they already pay particular attention to the subject of MRSA and thus to the management of MRSA patients. How far this survey applies to all German hospitals can only be elucidated by further studies. Another limitation is the failure to monitor hand hygiene compliance.

Conclusion

This study provides the first data that give an insight into the implementation of the recommended preventive measures in Germany. To sum up, it may be said that the hospitals surveyed are putting into practice many of the RKI recommendations and in some cases have also put in place further preventive measures. According to this study, individual or cohort isolation of MRSA patients is still less than 100%. What factors play a part in this, and what effects are associated with it, can only be shown by further studies.

Since the incidence of MRSA is still high, additional preventive measures need to be practiced on a regular basis. High compliance with hand disinfection is of considerable importance. Hand disinfection must also be strictly adhered to when it is not known whether a patient is colonized with MRSA. This is why many campaigns in various countries have been aimed at improving this particular compliance. Germany too has one of these campaigns. The “Clean Hands” campaign (“Aktion Saubere Hände”) was launched at the beginning of 2008 under the aegis of the Federal Ministry of Health, with a run time of 3 years. It makes an important contribution to the multimodal approach to infection prevention and the fight against antibiotic resistances (11–13).

The media discussion mentioned at the start of this article has shown one thing: For the purpose of patient safety, an adequate appreciation of the relevant routes of infection and proper hygiene measures must be part of everyday medical life. The only way to achieve this is by well-thought-out student education in infection prevention, and through lifelong learning on the part of all health care personnel about the best preventive methods. A sufficient number of experts in the subject are needed to teach this material.

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Conflict of interest statement

The authors declare that no conflict of interest exists according to the guidelines of the International Committee of Medical Journal Editors.

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