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Research Article

Epidemiology of MRSA and current strategies in Europe and Japan

Epidemiologie von MRSA und aktuelle Präventionsstrategien in Europa und Japan

Abstract

The prevalence of health-care associated infections caused by multi-drug resistant organisms has significantly increased over the past decade. Among these organisms, Methicillin-resistant *Staphylococcus aureus* (MRSA) plays a prominent and increasing role. Because of consequences for patients and the economic burden in course of prolonged treatment following MRSA infections and additional indirect costs for e.g. isolation or antiseptic treatment, this trend will further damage European health-care systems.

In 2006, a workshop was initiated at the 8th International Congress of the German Society of Hospital Hygiene held in Berlin. The aim of this workshop was to give an overview of the current situation of MRSA in selected European countries and to elaborate on potential strategies to prevent MRSA-infections and dissemination. A questionnaire encompassing 20 questions addressed topics such as epidemiology, current measures and future prospects was distributed to representatives from various European countries and Japan. A variety of widely different answers was obtained. It was shown that in all countries prevalence of MRSA is on a rising tide. This trend is observable in all European countries, albeit less strong in The Netherlands, Slovenia, France, Austria and Scandinavian countries. It was conclude that prevention strategies in a united and expanding European Community will become of utmost importance and that rapid screening strategies, e.g. PCR, might be of assistance in such an approach. A potential strategy to improve infection control measures could be the requirement of health-insurance providers to sign contracts only with hospitals able to proof having an infection control management in place.

Keywords: MRSA, cMRSA, prevention, screening, isolation precaution, antiseptic decontamination, national guidelines, national surveillance, outbreak management

Zusammenfassung

Die Prävalenz von durch multiresistente Erreger (MRE) verursachten nosokomialen Infektionen ist innerhalb der letzten Dekade signifikant angestiegen. Unter den MRE nimmt der Methicillin resistente *Staphylococcus aureus* (MRSA) einen wichtigen Platz mit wachsender Bedeutung ein. Wegen der Konsequenzen für die Patienten und der ökonomischen Belastung durch verlängerte Behandlung nach einer MRSA Infektion sowie der zusätzlichen indirekten Kosten z.B. für Isolierung oder antiseptische Behandlung belastet dieser Trend weiterhin das europäische Gesundheitssystem.

2006 wurde im Rahmen des 8. internationalen Kongresses der Deutschen Gesellschaft für Krankenhaushygiene in Berlin ein Workshop mit der Zielsetzung durchgeführt, einen Überblick über die aktuelle Lage von MRSA in ausgewählten europäischen Ländern zu geben und die Präventionsstrategien zu vergleichen, um daraus Schlussfolgerungen

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zur Prävention von MRSA-Infektionen und zur Eindämmung der MRSA Ausbreitung abzuleiten. Ein Fragebogen mit 20 Items zu Fragestellungen der Epidemiologie, aktueller Präventionsmaßnahmen und zukünftiger Strategien wurde den Experten verschiedener europäischer Länder und Japans zur Beantwortung übergeben.
Im Ergebnis wurde eine große Bandbreite verschiedener Antworten erhalten. Es stellte sich heraus, dass die MRSA Prävalenz in allen Ländern ein wachsendes Problem darstellt, wenn auch weniger stark in den Niederlanden, Slowenien, Frankreich, Österreich und den skandinavischen Ländern. Als eine wesentliche Schlussfolgerung ergab sich, dass Präventionsstrategien und ein in kurzer Zeit Ergebnisse lieferndes Screening z.B. mittels PCR in einem vereinten und expandierenden Europa von herausragender Bedeutung sind. Eine mögliche Strategie zur Verbesserung der Infektionskontrolle könnte darin bestehen, dass die Gesundheitsversicherungen nur Verträge mit den Krankenhäusern abschließen, die ein funktionierendes Infektionsmanagement implementiert haben.

Schlüsselwörter: MRSA, cMRSA, Prävention, Screening, Isolierung, antiseptische Dekontamination, nationale Richtlinien, nationale Surveillance, Ausbruchmanagement

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Introduction

The prevalence of health-care associated infections caused by multi-drug resistant organisms, including Methicillin-resistant *Staphylococcus aureus* (MRSA), has significantly increased over the past decade [1], [2], [3]. The trend is visible in all European countries, albeit less strong in The Netherlands, Slovenia, France, Austria, and Scandinavia [1]. Prevention strategies in the European Community will become of importance, including harmonization of typing methods [4]. Because of consequences for patients as well as increasing costs due to prolonged stay following MRSA infections, this situation will damage the European health-care systems [5].
In view of this development, a workshop was initiated at the 8th Congress of the German Society of Hospital Hygiene (DGKH) held in Berlin in 2006. The aim of this workshop was to give an overview of the current situation of MRSA in European countries and Japan and to provide potential strategies in future prevention of MRSA dissemination. The workshop was a reaction to a document of the European commission under the auspices of the "health and consumer protection directorate-general" outlined in an open consultation in December 2005 entitled "Public consultation on strategies for improving patients' safety by prevention and control of health-care associated infections". This document states that "Health-care associated infections affect an estimated one in ten patients and lead to considerable increase of illness, mortality and costs. These infections are not constrained by national boundaries and can rapidly spread between countries as evidenced by international spread of MRSA". The reason why MRSA explicitly was mentioned gives an additional impulse to generate an overview of the various strategies on its control and prevention.
During the workshop, participants representing clinical microbiologists and leading experts of their respective countries presented and discussed issues pertaining to MRSA such as screening, laboratory diagnostic with particular emphasis on more rapid diagnostic approaches like application of chrome-agar plates and the PCR assay technique [6], isolation precautions, decolonisation, burden for the individual patient and society, and the emerge of community-associated MRSA.
Finally, a questionnaire encompassing 20 questions addressing topics such as epidemiology, current strategy measures and future prospects was distributed to the participants. The aim of this paper is to summarize the current overall strategies and measures in preventing and controlling the spread of MRSA on the individual country level, to highlight similarities and to discuss country specific variations in order to generate a basis for a future harmonisation in a European perspective.

Materials and methods

The 8th International Congress of the DGKH was held in Berlin from in April 2nd to April 5th 2006. During the congress, a separate workshop on European MRSA prevention and control strategies was held. After the MRSA workshop, participants (see authors' list) representing 12 European countries and Japan completed a structured questionnaire consisting of 20 questions on MRSA in their respective countries. Representatives from the following countries in alphabetic order responded to the questionnaire: Austria (A), Germany (D), Hungary (HU), Italy (IT), Japan (JP), France (FR), Spain (ES), The Netherlands (NL), and the Scandinavian countries Denmark/Finland/Sweden/Norge/Island (DK/FI/SE/NO/IS) as a joint group.
For further background information, literature references and other sources have been used for the respective countries. The reference literature for the individual

countries is listed as follows: A: [7], [8], [9], [10], [11], D: [12], [13], [14], [15], [16], [17], [18], [19], DK/FI/SE/NO/IS: [20], [21], [22], [23], [24], [25] [26], ES: [27], [28], [29], [30], [31], [32], [33], [34], [35], FR: [36], [37], [38], [39], [40], HU: [41], [42], [43], IT: [44], [45], [46], [47], [48], [49], JP: [50], [51], [52], [53], [54], [55], [56], [57], [58], NL: [6], [59], [60], [61], [62], [63], [64], [65].

Results

Below, the questions together with the participants' answers are summarised.

Q1 Are there National Guidelines for prevention of MRSA dissemination and/or infection? If not, are these regional guidelines for prevention of MRSA dissemination and/or infection?

Representatives of 9 European countries stated that Guidelines for MRSA prevention are available at a national level. In Germany, recommendations for prevention and control of MRSA in hospitals and other medical institutions are prepared by the Commission of Hospital Hygiene and Infection Prevention at the Robert Koch-Institute (RKI). For DK/FI/SE/NO/IS, national guidelines are available in all countries with regional applications in most acute care hospitals. In France, the Comité Technique National des Infections Nosocomiales (Guide prevention des BMR) prepared national Guidelines, and Hungary and the Netherlands also have national guidelines for prevention of MRSA. For Japan, Austria, Spain and Italy so far, no national guidelines exist. While Spain follows adaptation of the Centers for Disease Control and Prevention recommendations, Italy has recommendations produced by "SIMPIOS", a multidisciplinary scientific society for prevention of healthcare related infections. In Austria there is no single official national recommendation for prevention and control of MRSA in hospitals and health-care settings, but there are specific recommendations within the 9 Austrian federal states, mostly in line with the German recommendations provided by the Commission of Hospital Hygiene and Infection Prevention at the RKI.

Q2 Are there National guidelines for laboratory diagnosis and susceptibility testing of MRSA? If not, are these different local or regional guidelines for laboratory diagnosis and susceptibility testing of MRSA?

Only France (Recommandations méthodologiques pour la surveillance de la résistance aux antibiotiques dans les labos de microbiologie), Italy and Japan and the Scandinavian countries stated that they have specific national recommendations for susceptibility testing of MRSA. In Italy, the testing recommendation has been produced by the antibiotic committee of AMCLI, the Clinical Microbiology Society, as well as by ISS (National Institute of Health) for the laboratories participating to Progetto "AR-ISS" (Antibiotic Resistance Network of the Health Institute) on the internet (http://www.simi.iss.it/). However, the recommended methods and breakpoints generally follow the Clinical Laboratory Standards Institute (CLSI) recommendations. In Japan, breakpoints for *Staphylococcus aureus* are defined as MIC of oxacillin in Mueller-Hinton Broth with is 4 µg/ml or more. Most laboratories in Austria, Germany, Spain and Hungary follow CLSI recommendations.

Q3 Presentation of development of MRSA prevalence in the last 10 years.

For Italy and Japan, no sufficient data on MRSA prevalence are available, although some selected point-prevalence studies have been conducted [48], [49], [50], [51], [58]. While DK/FI/SE/NO/IS, The Netherlands, Spain, Hungary and Germany (Data from Paul-Ehrlich-Society and European Antibiotic Research Study Surveillance (EARSS), available at http://www.rivm.nl/earss/) report gradual to drastic increases over the past years, the last French national prevalence survey (June 2006) evidenced a moderate decrease of MRSA prevalence confirmed by the microbiological lab incidence data. Data from Austria (EARSS) indicates a gradual increase over the last decade. Recently, however, a moderate trend towards decrease in MRSA and increase of other multidrug resistant pathogens, especially ESBL, is observable.

Q4 Is there information about national or regional MRSA outbreaks?

With exception for France, where only major outbreaks are reported, most countries have information on outbreaks, though to various levels. In Austria, outbreaks of only clinical relevant infections are monitored. The data are collected and monitored by the Austrian National Surveillance System ANISS. Similarly in Italy, a regional surveillance system has been developed by region Emilia Romagna. In Germany and Hungary, notification of MRSA infection outbreaks to the local public-health service is mandatory. In The Netherlands outbreaks are monitored through the National Institute of Health and the Environment and also in newspapers and medical journals. For DK/FI/SE/NO/IS, major outbreaks are communicated via the National Institute for infection diseases control in the respective country but also through informal canals within the country, but generally not between the countries.

Q5 How often do re-admissions of already known colonised MRSA patients in the same hospital occur?

In none of the countries re-admission of known MRSA positive patients is monitored. Therefore no detailed information is available. In Germany, also no data are available; however, some information was compiled by Chaberny et al. [12]. For The Netherlands, based on prevalence electronic marking and follow-up of patients after discharge, it can be stated that such re-admissions occur regularly; however, detailed data also is not available.

Q6 Is there an indication for a hospital admission screening in general or is this restricted to certain risk groups, and if so, which risk groups?
The respondents answer this question heterogenic. Only in Spain, there is no general recommendation for MRSA screening. In Austria, following patients at risk are screened on admission: previous known MRSA-infected/colonised patients, patients with frequent re-admissions, with chronic wounds, with catheters (urinary tract, vascular catheters), and patients with a history of previous long-term antibiotic therapy. Additionally, depending on the local epidemiologic situation, selected hospital screen patients from long-term health-care facilities. In the event of suspected outbreak, patients and staff are screened as well. In Germany, following risk groups are screened: patients with proven MRSA colonisation/infection, from high prevalence regions or institutions, with contact to MRSA-colonized/infected patients, or with at least two of the following risk factors: nursing homes, devices, dialysis, wounds, burn injury, and working in pig farms. Other risk groups depend on the epidemiological situation. Similarly, in DK/FI/SE/NO/IS, following patients are screened on admission: previous MRSA-infected/colonised patients on admission. In most countries there is no time limit especially in a patient with risk factors. Patients hospitalised over night or undergone invasive procedures/worked abroad within 6 months (1 year) especially outside Nordic countries, hospitalised in a Nordic hospital within a region with ongoing MRSA outbreaks, and patients from Long-term care facilities (LTCF). France: screening is recommended for all patients in intensive care, from LTCF and patients transferred from other health-care facilities. In Hungary, patients are screened if the admission history indicates MRSA, previous antibiotic therapy and if patients were transferred from another health-care facility or units suspected to have MRSA. Italy: It is recommended that all patients admitted to ICU's should be screened. Patients admitted for solid organ or bone marrow transplantation, heart surgery or renal dialysis are usually also screened. In Japan, active screening is restricted to cardiac surgery and haematological patient, but not recommended officially. In The Netherlands, all patients from a foreign hospital are generally screened for MRSA. Some hospitals screen patients admitted to the intensive care. Previously known MRSA carriers are screened.

Q7 Set-up of the MRSA screening: a) What anatomic locations are sampled? b) How often is this sampling, if more than once, is there a time interval? c) What is the method of specimen collection?
While all participants stated that the method of sampling is using a swab, the time interval for screening ranged from once to twice weekly. In all countries, the nostrils are investigated for MRSA. In most countries, additionally wounds and catheter incision site are also sampled, if present, or urine in cases with long-term urinary catheters.

Q8 Recommended laboratory diagnostic methods: a) agar media, b) enrichment broth, c) selective agar media, such as oxacillin-resistant S. aureus screening agar (ORSA) and other "chromagar's", d) bacterial species determination and sensitivity testing by disc screening by oxacillin and/or other discs MIC by E-test, e) Is vancomycin sensitivity determined?, f) rapid tests e.g. MRSA latex screen, genetic determination, PCR, g) indications for typing participation in European databases.
In Austria, Spain, and The Netherlands, the standard laboratory diagnostic method for detecting MRSA is using a selective medium together with enrichment broth. However, other methods are used additionally as required. In Germany, different agar-media and increasingly PCR techniques together with cultural confirmation are used. DK/FI/SE/NO/IS use agar-medium, approximately 50% used additionally enrichment broth, and 50% selective agar (ORSA, or with cefoxitin). As in Germany, there is an increasing tendency to use PCR methods for screening with cultural confirmation. In Hungary, mostly blood-agar and cooked meat bouillons are used; some also use selective media like ORSA, which most laboratories do in Italy. In Japan, mostly Mannitol-egg salt agar is used in various combinations with chrome-agars and ORSA. In all countries, vancomycin sensitivity is determined. With the exception of Japan, all countries participate at EARSS.

Q9 Isolation precautions: a) generally, no isolation or only barrier precautions, b) preventive isolation by admission in the hospital (always or only with risk patients such as patients in intensive care units and/or selected wards), c) isolation after detection of MRSA, d) indications to end the isolation precautions.
With exception of Italy, in all countries MRSA-positive patients are isolated in a single room, if possible. Additionally, in DK/FI/SE/NO/IS, France, Hungary, The Netherlands, and selected hospitals in Germany, high risk patients are isolated until their MRSA status is known in course of admission screening.
MRSA isolation is discontinued, if 2 negative swabs within 2 days (Austria), or 3 negative swabs within 3 days (Germany), or 3 negative swabs within 7 days (The Netherlands) are obtained. For all other countries with exception of Italy, isolation is stopped based on not further specified algorithms indicating that a patient is MRSA-negative.

Q10 Overall decontamination prescription: a) nose: – decolonisation treatment of choice, duration of treatment, post-decolonisation control, b) throat: – decolonisation treatment of choice, duration of treatment, post-decolonisation control, c) wounds: – decolonisation treatment of choice, duration of treatment, post-decolonisation control, d) body, hair: – decolonisation treatment of choice, duration of treatment, post-decolonisation control, e) tracheostoma: – decolonisation treatment of choice, duration of treatment, post-decolonisation control, f) gastrointestinal tract: – decolonisation treatment of choice, duration of treatment, post-decolonisation control, g) are follow-up procedures of the decontamination prescription embedded to investigate whether

relapse is occurring?; – If all answers are (nearly) the same, a combination answer will be procured.
For MRSA nasal-carriage eradication, most countries including Austria use mupirocin ointment 3x daily for 3–5 days (in Germany some also use octenidine [66]) together with antiseptic mouth wash 3x daily with chlorhexidine, octenidine or polihexanide and total body wash once daily with chlorhexidine, octenidine, polihexanide or povidone-iodine. In Japan, additionally a povidon-codine gargle is used.
In France, Italy, and DK/FI/SE/NO/IS success of eradication is not confirmed generally, patients' follow-up occurs according to doctor's order. In Germany, control of eradication is routinely done in health-care workers (after 10 days, 1 month, 3 months) and in patients on 3 days starting on the third day after end of decontamination. In all other countries, eradication success is monitored after 24 (Spain) to 48 hours after last application of antimicrobial compounds.

Q11 Methods for barrier precautions to prevent re-colonisation: a) area to be involved in the preventive isolation measures, b) bed hygiene, c) disinfection of the surroundings of the patients, d) management of private belongings of the patients, e) handling of kitchen utensils and soiled linen, f) handling of instruments to be used for diagnostic or therapeutic procedures after MRSA contamination.
A: a–f is applied. No special handling of kitchen utensils is performed other than routine hospital standard. D: a. private room, b. daily change of linen, c. bedstead, bedside locker, bath, hand contact areas, d. exchange or disinfection of personal items (glasses, razor, tooth brush etc.), e. no special procedures for kitchen utensils, disinfecting washing of linen, f. disinfection after use. DK/FI/SE/NO/IS: Since MRSA patients are cared for isolation with strict precautions this is not an issue. ES: a, b and f are applied. FR: a–f is applied. HU: a and f. Precautions to prevent re-colonisation are applied. Isolation measures are standard contact and droplet precautions. IT: Bed hygiene, disinfection of the surroundings of the patient and dedicated instruments, such as thermometers and stethoscope. JP: Usually cleaning of the patient environment only. NL: MRSA patients are cared for in strict isolation. Masks and caps and a long-sleeved coat with cuffs should be worn while treating a patient in strict isolation.

Q12 Education of personnel involved in different fields of patient management, cure and care e.g. medical doctors, nursing staff, physiotherapeutic and radiology staff, cleaning and disinfection household staff.
In all countries, continues medical education on MRSA is provided. Education contains information regarding epidemiology of MRSA-spread and specific precautions. For DK/FI/SE/NO/IS, it was stated that generally the infection control practitioner is consulted when infected patients are cared for.

Q13 Are there guidelines in the cure, care or social interactions with MRSA positive patients after discharge from the hospital also in relation to decolonisation schedules for the: a) outpatient clinic in or outside the hospital, b) nursing care at home, c) in nursing homes, d) for senior citizens, e) other public health situations anticipated (sports, clusters of PVC + strains).
In most countries, no explicit patient or population information exists. In all countries, selected hospitals and nursing homes provide general information on MRSA. In Germany, the RKI prepared information on *Staphylococcus aureus* and Guidelines for Infection Prevention in geriatric care and nursing homes. For DK/FI/SE/NO/IS guidelines for LTCF exist in most countries. In The Netherlands, the Working Group on Infection Prevention has prepared some information for setting outside the hospital.

Q14 Are these decolonisation schedules after discharge from the hospital reimbursed? Is carriage of MRSA registered so that at re-admission at the hospital the patients can be identified as a MRSA carrier?
In none of the countries complete MRSA eradication outside of the hospital is reimbursed. Also, none of the countries has a system in place where the MRSA status of a patient is registered uniformly in order to identify these patients at re-admission. Some selected hospitals have installed an electronic registration system, which gives 'warning' at admission of previously MRSA-positive patient. Many hospitals actively ask for previous MRSA carriage and hospitalisation abroad on admission. In Germany, mupirocin is reimbursed. Only in Italy MRSA eradication is reimbursed outside the hospital.

Q15 Are there national recommendations for appropriate selection and use of antibiotics supporting to prevent selection and dissemination of MRSA?
With exception of Italy, all countries have recommendations on selection and use of antibiotics. In Austria (ABS program), these recommendations are prepared by the antibiotic strategy platform implemented by the Austrian Ministry for Health, Social affaires and youth. In The Netherlands and DK/FI/SE/NO/IS national antibiotic formulary is present. In Germany, Japan and Hungary recommendations are provided by medical societies.

Q16 a) Is there an obligating participation in national surveillance surveys? Is this related to the subject, listed as (question 1), b) Is vancomycin resistance included in this surveillance?
Only in Germany and DK/FI/SE/NO/IS participation in national surveillance is obligatory, including surveillance of vancomycin resistance. In Germany, participation is specifically regulated by §23 of the German Infection Protection Law (Infektionsschutzgesetz). In Spain and Japan, mandatory MRSA surveillance exists. In all other countries, surveillance is not mandatory, but encouraged and voluntary, and is largely followed. If surveillance occurs, vancomycin resistance also is reported.

Q17 Is there an obligatory notification to health authority/government for outbreaks of MRSA?
With exception of Austria and Spain, in all other countries notification of MRSA outbreaks is mandatory. In Germany and The Netherlands, notification is regulated by law (§6 of the German Infection Protection Law and Law of infectious diseases, respectively). In DK/FI/SE/NO/IS reporting of MRSA outbreaks is not mandatory, however, health authorities will notice since reporting of all MRSA cases is mandatory. In Italy, although notification is required by law, MRSA outbreaks rarely are reported.

Q18 What is the impact of community-acquired (CA) MRSA?
In all countries, only little data is available and mostly because of the low number of reports quality of data is not sufficient to interpretated meaningful trends. However, sporadic notifications indicate potential for increase. In DK/FI/SE/NO/IS where reporting of all MRSA cases including MRSA carriage is mandatory, CA-MRSA is viewed as a coming threat with an increasing number of domestic cases the last 3–5 years. There is also an increase of CA-MRSA acquired abroad during vacations. Also, in Spain, France and The Netherlands the incidence seems to be increasing, particularly Panton-Valentine Leucocidine (PVL) positive strains. Only in Japan it s reported that there seems to be no specific issue with community-acquired MRSA so far (H. Kobayashi, personal communication).

Q19 What are the three main future expected developments in MRSA?
Participants state that if MRSA incidence and prevalence continue to increase, there is the risk that a decrease of medical awareness might occur as no significant breakthrough is achieved. Further dissemination, increase of infections, and increase of CA-MRSA is expected. MRSA might become a public indicator for quality and surveillance results on the individual hospital level, as occurred in France now. In DK/FI/SE/NO/IS it is expected that MRSA in the community might increase and will spread within certain risk groups. Also, MRSA might spread to the community and LTCFs, and back to hospitals, resulting in an increasing numbers of outbreaks in hospitals. Spain will focus on increase control of carriers and alternative treatments. Hungary will put emphasis on review and update of national guidelines of MRSA prevention, integrate prevention into nursing-care, and implement a mandatory reporting of MRSA infections to the Hungarian Nosocomial Surveillance System, together with regulation for appropriate use of antimicrobials. Italy also will stress more on the development of surveillance systems on a national, regional, and local level, place greater attention to hand and environmental hygiene, measures to prevent transmission of MRSA and other multiple-resistant organisms and to antibiotic use. In addition, implementation of measures devoted to prevent spread of resistance outside the hospitals are needed. For Japan it is foreseen that MRSA becomes a “normal” resident of the populations' microbial flora, virulent strains will emerge, and an increase of VRSA and other multi-drug resistant MRSA is expected. Similarly, The Netherlands expects emergence of vancomycin intermediate resistant strains, and hidden community spread, including PVL + strains. The strategy will be more extensive screening to keep the search and destroy policy ongoing, together with rapid, e.g. PCR, diagnosis.

Q20 Are there important MRSA topics worth to be reviewed concisely, which were outside the scope of the above presented findings?
Participants state that in view of the increasing mupirocin resistance there is a need for evidence based alternatives for MRSA eradication. Also, the role of regional networks in MRSA-prevention and control needs to be reviewed. Results of other national surveillance of multi-resistant organisms need to be pooled, such as glycopeptide resistant enterococci and multiresistant Enterobacteriaceae including those with ESBL, in order to identify robust universal strategies for control. Japan would be interested in issues of transportation of virulent and multi-drug resistant MRSA strains. In The Netherlands, new challenges will be follow-up events, community-acquired PVL positive strains in clusters, animal reservoirs (e.g. pigs), unexpected events, and more rapid diagnostic approaches such as the use of PCR or application of rapid growth chromagar media.
Matters such as reimbursing costs for MRSA screening, even before hospital admission and reimbursement of costs generated in course of eradication in the hospital and outpatient settings need to be solved. In countries using a DRG-based finance model, this could be achieved by taking these costs into the DRG-reimbursement scheme. Aside of cost issues, it would be supportive to introduce also a laboratory-based reporting system for MRSA together with a better and more uniform documentation concept of prescribed antibiotics. A potentially high impact concept of improving infection prevention and control measures generally could be the requirement of health insurance providers only to sign contracts with hospitals, which can proof having a structured and well organised infection control and quality management system in place.

Discussion

MRSA has been extensively reported in some countries (e.g. Scandinavia, The Netherlands) and published in international journals, while findings from other countries (e.g. Japan, Hungary) remain largely available in national surveys and publications in the respective mother language.
The responses to the questions of this survey allow outlining some trends. National guidelines are not generally present. There are some recommendations for controlling MRSA, but they vary in structure and content. The increase of MRSA has been noted nearly everywhere but

the different incidences between countries might be influenced by the strategy of the various health-care settings. The epidemiology of MRSA is generally surveilled. Unnoticed re-admissions of known MRSA carriers can easily occur due to the absence of effective screening policies [64]. When patients are screened, a variety of different anatomic locations are sampled. Enrichment culture to obtain a maximal yield has been advocated. Decolonization procedures are often applied, but these measures are mostly not reimbursed. Isolation measures vary widely. In general, specific education on MRSA issues is provided for relevant personnel. The increase of PVL positive community-acquired MRSA has been noted generally. Future developments and new threats are spotted in this field, including "vancomycin resistance", PVL positive community-acquired strains "surprising findings" (e.g. pigs), further spread of MRSA in communities and hospitals, and the need for rapid detection techniques.

Analysing all different answers and views, it becomes evident that countermeasures against MRSA vary strongly between countries. Strategies range from active "search and destroy" to an attitude of "let it go". If strategy against MRSA are loosened, an increased prevalence of MRSA is to be expected, leading to more extended health-care costs. It is no coincidence that in countries without strict control measures the highest prevalence of MRSA occurs. Yet, this is not a universal rule. In high-prevalence region's, it has been demonstrated that infection prevention measures specifically directed against MRSA (isolation, better hand hygiene, disinfection of the surroundings of patients) are of benefit in reducing the burden of MRSA and associated costs, without the expectation of ever be able to reach the aim of a "search and destroy" policy, or "zero MRSA level". The recent success obtained in France with an incidence reduction of 30% within the last ten years is an example highlighted by EARSS. Today, not only in these countries, but also in countries who apply "search and destroy" policy successfully, such as The Netherlands and the Scandinavian countries, this aim is threatened and possibly sabotaged by the rise of community acquired, PVL positive strains family transmitted MRSA and animal (e.g. pigs) [15], [65] facilitated spread, including partly different MRSA types than the usual predominant MRSA clones. Developments outside of the hospital are a direct threat for unexpected (re)-introduction of MRSA into the hospital. Nevertheless the recent published agreements of the Public Health-care Council of The Netherlands to maintain the strict search and destroy policy stated: "The most important argument for maintaining this strategy is that rescinding the policy will lead to a much higher prevalence of MRSA and the associated increase in disease burden and mortality". British research has shown that rescinding a strict policy results in a marked increase in MRSA infections. Moreover, if the policy were to be rescinded, the costs incurred by MRSA infections would strongly increase and would probably be much higher than in the current situation with the strict MRSA policy.

Costs for decolonisation of patients and health-care workers and general control measures against MRSA are often not reimbursed, yet, they are easily justifiable. Preventive measures against MRSA should be regarded equal with vaccination. This also should include laboratory costs for detection and follow-up screening [64]. To underline the importance of MRSA, it should become a notifiable organism, as it is the case in the United Kingdom [2], [3] and Scandinavia.

General principles like early detection and isolation of MRSA positive patients are recommended by all guidelines [67]. Yet, there is still a role for consensus and the opinion of experts in devising national guidelines. We consider the summary of the workshop on MRSA hold in Berlin as an addition to detailed and useful compilation of Humphreys review [67] on national guidelines, which predominantly focused on English speaking countries, although Germany and The Netherlands were included.

Despite increasing knowledge, more rapid detection techniques, including PCR [6], and interventions with regard to the multi-resistant strains problem and optimal treatment of infection-diseased patients worldwide, the trends in recent years show that the future pertaining to MRSA is not viewed optimistically by various experts in the field.

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Please cite as

Kramer A, Wagenvoort H, Åhrén C, Daniels-Haardt I, Hartemann P, Kobayashi H, Kurcz A, Picazo J, Privitera G, Assadian O. Epidemiology of MRSA and current strategies in Europe and Japan. GMS Krankenhaushyg Interdiszip. 2010;5(1):Doc01. DOI: 10.3205/dgkh000144, URN: urn:nbn:de:0183-dgkh0001445

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Published: *2010-02-10*