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CLINICAL AND EPIDEMIOLOGICAL STUDY

Methicillin-resistant *Staphylococcus aureus* (MRSA) in Europe: which infection control measures are taken?

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Abstract
Background The prevalence of hospital-acquired Methicillin-resistant *Staphylococcus aureus* (MRSA) infections shows a huge variety across Europe. Some countries reported a reduction in MRSA frequency, while in others countries increasing MRSA rates have been observed. To reduce the spread of MRSA in the healthcare setting, a sufficient MRSA management is essential. In order to reflect the MRSA management across Europe, MRSA prevention policies were surveyed in ten countries.

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Materials and methods The survey was performed by questionnaires in European intensive care units (ICUs) and surgical departments (SDs) in 2004. Questionnaires asked for availability of bedside alcohol hand-disinfection, isolation precautions, decolonization and screening methods. The study was embedded in the Hospital in Europe Link for Infection Control through Surveillance (HELICS) Project, a European collaboration of national surveillance networks. HELICS was initiated in order to harmonize the national surveillance activities in the individual countries. Therefore, HELICS participants developed surveillance modules for nosocomial infections in ICUs and for surgical site infections (SSI). The coordination of this surveillance has now been transferred to the European Centre for Disease Prevention and Control (ECDC).

Results A total of 526 ICUs and 223 SDs from ten countries sent data on organisational characteristics and policies, demonstrating wide variations in care. Substantial variation existed in availability of bedside alcohol hand-disinfection, which was much higher in participating ICUs rather than in SDs (86 vs. 59%). Surveillance cultures of contact patients were obtained in approximately three-fourths of all SDs (72%) and ICUs (75%). Countries with decreasing MRSA proportions showed especially strict implementation of various prevention measures.

Conclusion The data obtained regarding MRSA prevention measures should stimulate infection control professionals to pursue further initiatives. Particularly, the vigorous MRSA management in countries with decreasing MRSA proportions should encourage hospitals to implement preventive measures in order to reduce the spread of MRSA.

Keywords MRSA · Infection control measures · Europe

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a significant infection-causing bacteria, since it causes potentially life threatening infections and also shows resistance to treatment with usual antibiotics. Hospital-acquired MRSA infections are associated with increased morbidity and mortality [1–3].

The prevalence of MRSA shows a huge variety across Europe with values from less than 1% in northern Europe to >40% in southern and western Europe. For several European countries, increasing MRSA rates over the last years have been described, whereas other countries observed a decreasing trend [4, 5]. To reduce MRSA rates or maintain a low endemicity in the healthcare setting, a sufficient MRSA management is essential [6, 7].

MRSA-specific infection control policies were surveyed in European intensive care units (ICUs) and surgical departments (SDs) to describe possible differences in MRSA management.

Materials and methods

The study was embedded in the Hospital in Europe Link for Infection Control through Surveillance (HELICS) Project, a European collaboration of national surveillance networks [8–10]. HELICS was initiated in order to harmonize the national surveillance activities in the individual countries. Therefore, HELICS participants developed surveillance modules for nosocomial infections in ICUs and for surgical site infections (SSI). The co-ordination of this surveillance has now been transferred to the European Centre for Disease Prevention and Control (ECDC).

For the survey, infection control policies in (a) ICUs regarding central venous catheters (CVC) and (b) SDs performing hip procedures were investigated by questionnaires. Questionnaires also contained questions about MRSA-specific infection control measures such as the availability of bedside alcohol hand-disinfection, isolation precautions, decolonization, and screening methods. Questionnaires were created and presented at a HELICS meeting in November 2003.

In 2004, all national surveillance networks were invited to participate in the study. Each participating network translated the questionnaire into its national language and sent it to the participating ICUs/SDs. Local infection control personnel was asked to fill in patient care parameters which were actually performed. All data received from the questionnaires were checked for plausibility and entered into a database. The data were analyzed descriptively. Results were given as feedback to the individual networks in order to validate data and to allow them to draw their own conclusions.

Results

Ten national networks (Belgium, Finland, France, Germany, Hungary, Lithuania, Poland, Slovenia, Sweden and Spain) sent descriptive data from 526 ICUs and 223 SDs (Tables 1, 2). Participating hospitals had a median of 437 beds and were mainly public hospitals (73%). The median number of single rooms was three per ICU and per SD. Participating SDs performed 120 HIP procedures in the median.

Patients stayed in the ICUs in median from 2 days in Sweden to 7 days in France and Poland. The nurses-to-patient ratio was very similar in the various ICUs with the

Table 1 Structural characteristics of the participating intensive care units ($n = 526$)

National network (number of intensive care units)	Belgium ($n = 72$)	Finland ($n = 14$)	France ($n = 82$)	Germany ($n = 201$)	Hungary ($n = 72$)	Lithuania ($n = 8$)	Poland ($n = 27$)	Slovenia ($n = 12$)	Spain ($n = 35$)	Sweden ($n = 3$)	All ($n = 526$)
Median number of hospital beds	325	339	464	522	636	1003	300	310	453	464	464
Percentage of hospital type "public"	51%	100%	87%	66%	99%	100%	93%	100%	86%	100%	77%
Percentage of university hospitals/teaching hospitals	14%	93%	32%	70%	57%	63%	7%	67%	89%	67%	53%
Type of ICU (%)											
Medical	24%	14%	36%	19%	11%	25%	67%	33%	22%	50%	26%
Surgery	32%	14%	14%	22%	17%	25%	7%	50%	10%	50%	23%
Trauma	4%	14%	1%	7%	7%	0%	11%	0%	10%	0%	6%
Neurosurgery	0%	7%	2%	5%	3%	13%	0%	0%	7%	0%	4%
Cardiac surgery	3%	7%	1%	3%	0%	12%	7%	0%	7%	0%	3%
Coronary care	6%	7%	0%	8%	1%	0%	0%	0%	13%	0%	5%
Paediatric	0%	14%	0%	3%	3%	12%	0%	0%	3%	0%	2%
General	31%	23%	46%	33%	58	13	8	17%	28%	0%	31%
Median number of beds (ICU)	9	9	10	10	8	12	6	11	12	10	10
Median number of single rooms	6	1	8	2	2	1	1	2	7	3	3
Median length of stay (days)	4	4	7	4	6	3	7	6	6	2	5
Median percentage of ventilated patients	28	75	59	38	34	50	79	30	40	42	28
Percentage of 24 h availability of physician in the ICU	75%	43%	96%	76%	99%	63%	100%	75%	100%	67%	84%
Median number of nurses per bed (day)	0.5	0.9	0.3	0.5	0.5	0.5	0.5	0.6	0.5	/	0.5
Median number of nurses per bed (night)	0.3	0.6	0.3	0.3	0.3	0.4	0.5	0.3	0.4	/	0.3
Percentage of personnel in the hospital dedicated to infection control	100%	100%	93%	98%	97%	50%	100%	100%	80%	67%	95%

/ = no answer

Table 2 Structural characteristics of the participating surgical departments ($n = 223$)

National network (Number of surgical departments)	Belgium ($n = 57$)	Finland ($n = 7$)	Germany ($n = 63$)	Hungary ($n = 49$)	Lithuania ($n = 4$)	Poland ($n = 20$)	Slovenia ($n = 10$)	Spain ($n = 10$)	Sweden ($n = 3$)	All ($n = 223$)
Median number of hospital beds	279	305	365	987	418	346	348	212	464	371
Median number of ICU beds per hospital	9	7	12	12	12	48	11	7	10	12
Percentage of university/teaching hospitals	16%	72%	53%	69%	25%	15%	60%	70%	100%	45%
Percentage of hospital status "public"	41%	86%	45%	98%	100%	95%	100%	100%	100%	68%
Median number of single rooms in the SD	8	5	4	0	1	1	1	0	8	3
Median volume of HIP procedures per year	137	209	120	130	198	71	70	140	300	120
Percentage of personnel in the hospital dedicated to infection control	100%	100%	100%	98%	100%	90%	100%	90%	100%	98%

exception of Finland, where the situation seems to be much better.

The prevention measures concerning MRSA varied between the participating countries (Tables 3, 4). Availability of bedside alcohol hand-disinfection was high in Belgium, France, and Slovenia and it was much higher in participating ICUs than in SDs (86 vs. 59%).

The isolation of MRSA patients in single rooms was described for the majority of the participating SDs (87%) and ICUs (84%). Decolonisation of MRSA patients was more often accomplished in the participating SDs especially in countries like Belgium, Slovenia, and Germany. Surveillance cultures of contact patients who were exposed to newly identified MRSA patients were obtained in approximately three-fourths of all SDs (72%) and ICUs (75%). Patients coming from other wards or other hospitals were screened for MRSA on admission to an ICU more often than on admission to a surgical ward (51 vs. 24%).

Discussion

In this study, patient care parameters concerning MRSA prevention were obtained from ten European countries in order to reflect MRSA management at a broad level.

A study at an international level has several disadvantages: interpreting data of an international study is not so easy since the participating hospitals are not representative for a country nor for Europe as a whole. The acquired data for the current study may also rather overestimate the situation, because all participating ICUs and SDs attended a national surveillance network and therefore may have an advance in infection control due to an increased focus on surveillance and other infection control measures.

Since this study is based on questionnaire rather than on observation, it might be possible that prevention measures were overestimated by the person who filled in the questionnaire relative to practices actually accomplished.

Nevertheless, this survey shows interesting results: various key infection control measures are implemented unequally in Europe. Possible reasons for these differences have been already discussed in the literature [10–12]. Each country's epidemiology of antibiotic resistant microorganisms itself may also lead to regional distinctions in the compliance with infection control measures. Variations were also seen between participating ICUs and SDs. SDs performed decolonization procedures more frequently, whereas ICUs put more emphasis on hand-disinfection availability and screening methods. Maybe the implementation of these measures is easier on an ICU, typically a bounded space with an average of ten beds,

Table 3 Characteristics concerning the MRSA management of the participating intensive care units ($n = 526$)

National network (number of intensive care units)	Belgium ($n = 72$) (%)	Finland ($n = 14$) (%)	France ($n = 82$) (%)	Germany ($n = 201$) (%)	Hungary ($n = 72$) (%)	Lithuania ($n = 8$) (%)	Poland ($n = 27$) (%)	Slovenia ($n = 12$) (%)	Spain ($n = 35$) (%)	Sweden ($n = 3$) (%)	All ($n = 526$) (%)
Availability of bedside alcohol hand-disinfection	97	93	98	86	76	63	63	92	69	67	86
Isolation of MRSA patients in single rooms	90	100	85	89	92	50	41	50	74	67	84
Use of barrier precautions[a] before contacting the patient	90	86	80	100	100	63	100	100	97	67	94
Routine use of mupirocin for decolonisation of MRSA patients	78	7	23	92	51	0	22	92	43	0	63
Routine antiseptic washing of MRSA patients (e.g. with chlorhexidine)	81	0	35	79	76	0	63	75	66	0	66
Routine screening of											
Possibly exposed patients of newly identified MRSA patients	78	100	67	81	76	25	33	100	80	100	75
Newly admitted patients from other wards/hospitals	56	36	78	42	40	29	48	100	46	67	51
Newly admitted patients from other countries	43	100	60	35	38	0	48	92	34	100	44
Newly admitted patients from long term care facilities	69	0	80	55	47	13	48	100	49	33	58

[a] Defined as the use of gloves, gown and mask

Table 4 Characteristics concerning the MRSA management of the participating surgical departments ($n = 223$)

National network (number of participating SDs)	Belgium ($n = 57$) (%)	Finland ($n = 7$) (%)	Germany ($n = 63$) (%)	Hungary ($n = 49$) (%)	Lithuania ($n = 4$) (%)	Poland ($n = 20$) (%)	Slovenia ($n = 10$) (%)	Spain ($n = 10$) (%)	Sweden ($n = 3$) (%)	All ($n = 223$) (%)
Availability of bedside alcohol hand-disinfection	72	29	48	76	75	30	70	20	67	59
Isolation of MRSA patients in single rooms	95	100	90	98	50	55	50	80	100	87
Use of barrier precautions[a] before contacting the patient	81	86	100	100	100	90	90	100	100	93
Routine use of mupirocin for decolonisation of MRSA patients	86	29	95	53	0	25	90	80	33	71
Routine antiseptic washing of MRSA patients (e.g. with chlorhexidine)	84	14	84	74	50	65	60	80	33	75
Routine screening of										
Possibly exposed patients of newly identified MRSA patients (%)	79	100	81	75	0	15	90	60	100	72
Newly admitted patients from other wards/hospitals	33	29	8	20	25	30	80	10	33	24
Newly admitted patients from other countries	21	100	15	22	0	/	70	0	100	24
Newly admitted patients from long term care facilities	47	14	32	25	50	25	80	20	33	35

[a] Defined as the use of gloves, gown and mask

/ = no answer

than in an SD, which may include several different units in one hospital.

Which control measures contribute to a low or a decreasing MRSA prevalence?

In a study of practices and MRSA prevalence in Europe, MacKenzie et al. [13] showed significant associations between a lower MRSA prevalence and (a) the use of alcohol-based solutions for hand hygiene and (b) placement of MRSA patients in single rooms. Regarding the single prevention measures in the current study, it stands out that countries with low MRSA endemicities, such as Finland and Sweden [4], showed a high compliance for availability of bedside alcohol hand-disinfection and isolation procedures, which supports the findings by MacKenzie et al. [13]. In France, a country with a decrease in its MRSA rate [5], participating ICUs showed data concerning the availability of bedside alcohol hand-disinfection which were the highest of all participating hospitals. This also seems to eminently be the situation in Slovenia, another country with decreasing MRSA proportions over the last years [4]. The compliance with evidence based recommendations in Slovenia was the highest in Europe: in Slovenian ICUs, seven of all nine control measures sampled were described as being performed with a compliance of 90% or more. ICUs and SDs focused on the screening of contact patients, patients coming from long term care facilities, other hospitals or other countries. In addition, in the participating Slovenian hospitals, all ICUs and 90% of the SDs described the use of barrier precautions before contacting the patient. For the reduction of MRSA rates and maintenance of low endemicity, the implementation of screening in combination with isolation measures was also described by Bootsma et al. [14].

The data surveyed in the present study suggest that the intensive implementation of various prevention measures may improve a country's MRSA prevalence and thereby contribute to a better outcome of patients treated in the corresponding hospitals.

This development should be seen as an encouraging example of national handling of multiresistant pathogens and should stimulate infection control professionals to pursue further initiatives [6, 7, 15] to limit the spread of MRSA.

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