MRSA detection in South Italy: an epidemiological survey to evaluate the burden of this important public health issue

A. Facciolà[1], M. Ceccarelli[1], I.A. Paolucci[2], F. d'Aleo[1], B. Cacopardo[3], F. Condorelli[4], E. Venanzi Rullo[1,5], M.R. Lo Presti Costantino[2], G. F. Pellicanò[6]

[1]Department of Clinical and Experimental Medicine, Unit of Infectious Diseases, University of Messina, Messina, Italy
[2]Department of Specialized Medicine and Clinical Oncology, Unit of Infectious Diseases, University Hospital "G. Martino", Messina, Italy
[3]Department of Clinical and Experimental Medicine, Unit of Infectious Diseases, University of Catania, Catania, Italy
[4]Department of Pharmacological Sciences, Università del Piemonte Orientale "A. Avogadro", Novara, Italy
[5]Department of Pathology and Laboratory Medicine, School of Medicine, University of Pennsylvania, Philadelphia, PA, USA
[6]Department of Human Pathology of the Adult and the Developmental Age "G. Barresi", Unit of Infectious Diseases, University of Messina, Messina, Italy

ABSTRACT:

— ***Objective:*** Methicillin-resistant *Staphylococcus aureus* (MRSA) has emerged about 50 years ago and, since then, it has spread worldwide. Nowadays, it is one of the principal causes of bacterial infections in health-care and community settings, causing several outbreaks in many parts of the world. MRSA is variably distributed in the world, with the lowest prevalence in Scandinavian countries and the highest in some parts of America and Asia.

— ***Materials and Methods:*** We carried out an epidemiological study, collecting all the reports of S. aureus isolates and relative antimicrobial-resistances at the Microbiology Laboratory of the University Hospital "G. Martino" in Messina (Italy) during a three years period (2015-2017).

— ***Results:*** The percentages of the S. aureus detection compared to all the microbial isolates in the entire hospital were 7.5%, 7.5% and 8.9% in 2015, 2016 and 2017 respectively, while the detection of MRSA had a decreased trend of 7%, with a percentage rate of detection equal to 35% in 2017. MRSA was detected the most in surgery wards, with a rather steady rate in the three years. Moreover, we observed a constantly increasing rate in medicine wards and an important decreasing one in the emergency wards.

— ***Conclusions:*** Our data show that, despite a decreasing trend of positive samples, MRSA infection is still an important public health issue and a cause of healthcare-associated infections in our university hospital. It is necessary to keep working to realize effective preventive measures to reduce the burden of these infections.

— ***Keywords:*** MRSA, Epidemiology, Healthcare-Associated Infections, Surgery, Prevention.

INTRODUCTION

Staphylococcus aureus is normally present in the human nasal mucosa and skin and colonizes general population in 20-40% of cases[1-3]. It has been known for a long time that three temporal conditions of *S. aureus* colonization exist. About 15% of the general population is permanently colonized (persistent carriers) while 70% of them are intermittently colonized[4]. Colonization represents an important risk factor because, when the cutaneous and mucosal barriers are damaged (wounds or surgical intervention or chronic skin conditions), the mi-

CORRESPONDING AUTHOR: ALESSIO FACCIOLÀ, MD; E-MAIL: AFACCIOLA@UNIME.IT

cro-organism can penetrate into the deep tissues or the bloodstream and cause infection. Particularly, people with invasive medical devices (such as peripheral and/or central venous catheters) or immunocompromising conditions are more vulnerable to *S. aureus* infection[5]. Moreover, people with *MRSA* colonization, or carriers, are the most important source of person-to-person transmission[6]. Methicillin resistance was firstly reported in the mid-1940s, earlier than the introduction of methicillin. Probably, the cause of this critical issue was the extensive use of penicillin rather than the introduction of methicillin[7]. Since the 1960s, methicillin-resistant *S. aureus* (*MRSA*) has spread worldwide and become one of the most important causes of bacterial infections in both health-care and community settings[6]. After its marketing, methicillin was largely used; however, because of its renal toxicity, it is now not marketed for human use and has been replaced by similar penicillins known as isoxazolyl-penicillins such as oxacillin, flucloxacillin and dicloxacillin[8]. Nevertheless, the term methicillin-resistant *S. aureus* is still largely used. Methicillin resistance was developed by horizontal transfer by uptake of a genetic cassette called "staphylococcal cassette chromosome mec" (SCCmec). SCCmec is a mobile genetic element that encodes the genes mecA or mecC, which confer resistance to methicillin and, therefore, to most β-lactam antibiotics[9]. Moreover, hospital-acquired *MRSA* is often resistant to other antibiotic classes, as they have an ability to acquire resistance to any antibiotic class[10]. After its emergence, *MRSA* caused hospital outbreaks in many parts of the world [health-care-associated *MRSA* (HA-MRSA)][10]. However, a change in *MRSA* epidemiology occurred when it was detected in individuals without previous health-care contact [community-associated *MRSA* (CA-MRSA)], particularly among indigenous people in Australia in the 1980s and other healthy people, including children, in the United States in the 1990s[11,12]. Finally, since the mid-2000s, it has also been associated with livestock exposure [livestock-associated MRSA (LA-MRSA)][13]. The epidemiology of *MRSA* has remarkable geographical variations, with the lowest prevalence being reported in Scandinavian countries and the highest in some parts of America and Asia[14,15]. In 2015, in the United States, the rate of invasive *MRSA* infections (including bacteremia) was 18.8 per 100,000 people with 332 deaths[16]. Moreover, the incidence of HA-MRSA decreased since 2005 by 54%[17]. European surveillance data show an increased *MRSA* prevalence from the North to the South of the continent. As a matter of fact, in Northern Europe countries (Netherlands, Norway, Sweden and Denmark) <5% of *S. aureus* isolated from invasive infections are methicillin-resistant, whereas the detection percentage is higher (25-50%) in Southern Europe countries (Portugal, Spain, Italy and Greece). However, since the early 2000s it has been reported a decreasing *MRSA* prevalence in several European countries[18]. In Italy, the percentage of *MRSA* detection has been around 33-34% for years. Especially alarming were the data of a survey carried out in 2010, which showed that in Italy the proportion of MRSA was around 36-37%[19]. The aim of this study is to evaluate the prevalence of *MRSA* in the University Hospital "G. Martino" of Messina, Sicily, in order to compare our epidemiological situation with the national and international ones, highlighting the wards in which *MRSA* has been detected more frequently and analysing the possible criticisms of a complex realty such as a university hospital.

MATERIALS AND METHODS

We carried out a cross sectional study collecting all the staphylococcal species and antimicrobial-resistances of *S. aureus* isolated in the Messina University Hospital "G. Martino" during the three years period 2015-2017. The data were provided by the Local Microbiology Laboratory. Microbial species and relative anti-microbial resistance were obtained using the Vitek 2 automatic system (Biomerieux, Italia). Data were analysed with descriptive statistics (mean, percentage, standard deviation).

RESULTS

In the considered three years period we observed a slightly increased trend of the *Staphylococcus* spp detection rates equal to 16.7%, 19.6% and 19.9% of all microbial isolates in 2015, 2016 and 2017, respectively. *S. aureus* was the most detected one among all the staphylococcal species. The percentages of its detection compared to all the microbial isolates in the entire hospital are shown in Figure 1. We then evaluated the rate of detection of methicillin-resistance strains. Figure 2 shows the percentages of *MRSA* detection. As it can be observed from the figure, the percentages of *MRSA* detection showed a decreasing trend in the considered period. The percentages of *MRSA* detection divided for the three hospital areas (surgical, medical and ICU areas) are shown in Figure 3. Surgical area showed always the highest percentages of MRSA detection, which remained fairly stable during the three years. Medical and emergency areas showed lower detection rate with an increase for the first and an important decrease for

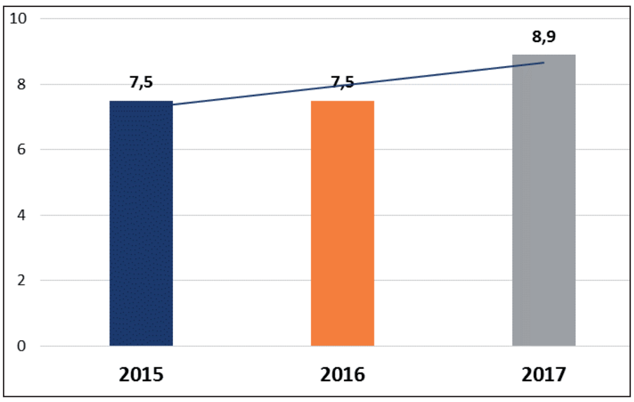

Figure 1. Percentages of *S. aureus* detection rates isolated in all the entire Hospital in the three years period 2015-2017.

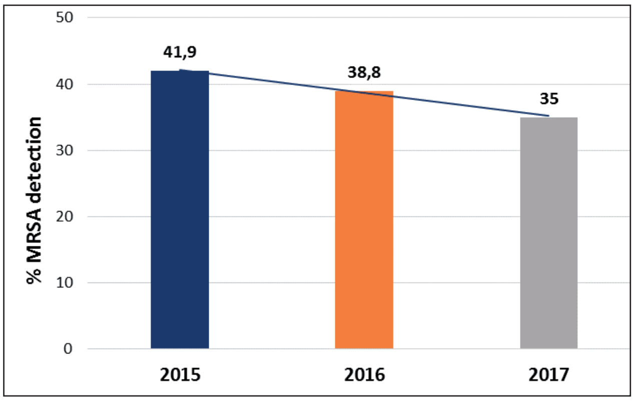

Figure 2. Trend of percentages of MRSA detection in the three years period 2015-2017.

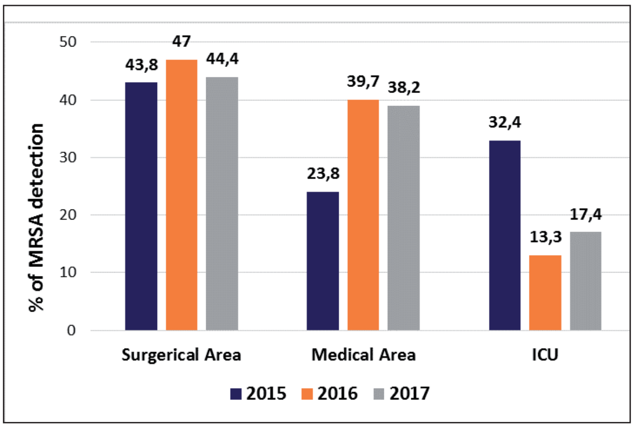

Figure 3. Percentages of MRSA detection in the three hospital areas.

the second. Table 1 resumes the percentages of *MRSA* detection in the principal units of the three considered hospital areas. Finally, Table 2 shows the percentages of *MRSA* detection in the principal biological materials.

DISCUSSION

Antimicrobial resistance has become one of the most important threats of the public health worldwide. These multidrug-resistant (MDR) bacteria cause therapeutic failure, increase the risk of death and cause remarkable health costs. *MRSA* has become one of the most important MDR during the last decades, causing severe infections in health facilities and the community. Particularly, it is estimated that people with a *MRSA* infection have an extra risk of 64% to die than people with a methicillin-sensitive *Staphylococcus aureus* (*MSSA*) infection[20]. Our results are similar to the general epidemiology of the *MRSA* detection in healthcare facilities[18]. In particular, we observed that *S. aureus* was the most detected staphylococcal species in all the considered three years, with a slightly increased trend of detection during

Table 1. Percentages of MRSA detection in the various wards of the three considered areas.

	2015	2016	2017	Total of the three years
Surgical area				
Plastic Surgery	1.1	13.3	9.9	**24.3**
Vascular Surgery	6.5	10.2	7.4	**24.1**
Oncological Surgery	16.3	3.9	3.3	**23.5**
Orthopaedics	4.6	5.5	8.2	**18.3**
General Surgery	4	5.5	5	**14.5**
Neurosurgery	3.3	1.6	7.4	**12.3**
Thoracic Surgery	3.3	3.1	0.8	**7.2**
Urology	0.7	3.1	0.8	**4.6**
Otolaryngology	2	0	0.8	**2.8**
Paediatric surgery	1.3	0.8	0	**2.1**
Obstetrics and Gynecology	0.7	0	0.8	**1.5**
TOT	**43.8**	**47**	**44.4**	
Medical area				
Internal Medicine	9.2	28.6	17	**54.8**
Paediatrics	3.3	2.4	16.2	**21.9**
Nephrology	5.2	1.6	1.7	**8.5**
Infectious Diseases	2	3.1	0.8	**5.9**
Neurology	0.7	1.6	2.5	**4.8**
Pulmunology	0.7	1.6	0	**2.3**
Oncology	2	0	0	**2**
Haematology	0.7	0.8	0	**1.5**
TOT	**23.8**	**39.7**	**38.2**	
Emergency area				
Paediatric ICU	20.6	3.9	5.8	**30.3**
Adult ICU	10.5	7.1	8.3	**25.9**
Cardiological ICU	1.3	2.3	3.3	**6.9**
TOT	**32.4**	**13.3**	**17.4**	

Table 2. Percentages of MRSA detection in the various biological materials.

	2015	2016	2017	Total of the three years
Wound swabs	18.3	25.8	17.1	**61.2**
Blood	14.6	23	19.1	**56.7**
Respiratory materials	12.8	16.1	16.5	**45.4**
Catheters and prosthesis	4.9	3	3.8	**11.7**
Other	52.8	68.8	57.9	

the three years. However, alongside with the increase of this detection rate, we observed an important decrease of 7% of *MRSA* detection, with a percentage of 35% in 2017, perfectly in line with national Italian data[19]. The higher percentages of *MRSA* detection were found in wards belonging to the surgery area, particularly plastic, vascular and oncological surgery. This finding is in line with the higher percentage of *MRSA* detection in the various biological materials. Indeed, the highest percentage was found in wound swabs even if blood detection is still largely present. While the percentages remained fairly stable in this area, we observed important increases in the medical and decreases in the emergency area. This finding is surely the result of a prevention policy, which concerns above all at risk wards as the adult and paediatric ICUs, aiming to contain the incidence of healthcare-associated infections by MDRs.

MRSA control interventions have been widely implemented in health-care facilities worldwide. There are many important preventive measures to contain selection, spread and transmission of *MRSA*. These containing measures aim to reduce the *MRSA* infection spreading by policy of antimicrobial stewardship (including restrictions of their prescription), discovering of the patients who are asymptomatic carriers and preventing *MRSA* transmission between healthcare workers (HCWs) to patients or patients to patients[21]. Several studies focused the attention on the role played by the healthcare environment as reservoir of MDRs[22-28]. In this process, an important role seems to be played by the HCWs' hands by the contact with patients colonized or infected by *MRSA* colonization or handling *MRSA*-contaminated equipment[29,30]. With these modalities, *MRSA* can be transmitted between patients[31]. Hand hygiene using alcohol-based products or soap and water and environmental sanitation are able to reduce *MRSA* spread via this route[32]. Moreover, it is important that HCWs use contact precautions (disposable gowns and gloves) during care to reduce *MRSA* transmission (and in general MDRs pathogens) associated with contamination of hands and clothing. Indeed, there is now a robust evidence suggesting that this practice is associated with reduction of *MRS*A acquisition and transmission[33]. It is also strongly recommended the isolation in single room of patients with *MRSA* colonization when it is possible even if there is a controversy on this issue due to some studies showing that single-room isolation was not effective in reducing *MRSA* transmission[34]. Another important way to control the nosocomial spread of *MRSA* is an active surveillance to identify the large reservoir represented by asymptomatic carriers, on which it is possible to carry out a topical decolonization to reduce transmission or infection risk (*MRSA* screening). This surveillance may be applied to all patients or limited to those at higher risk of *MRSA* carriage. A widely MRSA screening has been one of the most controversial areas in infection control since the 2000s. Indeed, while some studies showed its efficacy in reducing *MRSA*-associated disease[35], others demonstrated that it is rather weak and no cost-effective to control the *MRSA* infection[36-38].

CONCLUSIONS

MRSA infection continues to be an important public health issue in our territory and a cause of healthcare-associated infections, with percentage of *MRSA* detection in line with national Italian data. The reduction of *MRSA* infection in some parts of the European continent shows that it is possible to act preventive measures to reduce the burden of this disease. Surgical activities are surely the most critical points on which address the efforts and the resources.

Conflict of Interest:
The Authors declare that they have no conflict of interests.

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