

Prevalence of meticillin-resistant *Staphylococcus aureus* colonisation amongst residents in Maltese nursing homes

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doi: 10.3396/IJIC.v14i1.003.18

Abstract

Since the 1960's, meticillin-resistant *Staphylococcus aureus* (MRSA) has become a major pathogen with ever-increasing incidence rates of hospital-acquired and community-acquired infections. Malta has currently one of the highest rates of hospital-acquired and community-acquired infections in Europe. In addition, reports have estimated community carriage at more than 8%. MRSA carriage in homes for the elderly is very important because these residents are often hospitalized and therefore serve as a source of transmission.

The aims of this study were to establish the prevalence of MRSA nasal carriage amongst residents in nursing homes in Malta, to determine their antibiotic susceptibility and to determine the significance of specific risk factors found in the literature.

Nasal swabs were taken from 397 randomly chosen residents in 10 governmental nursing homes. A short questionnaire including possible risk factors reported to be associated with MRSA nasal carriage was also filled.

MRSA carriage amongst nursing home residents was 19.4% (95% CI 17.6 – 21.2%) ranging from 0% to 25% amongst the nursing homes studied. Logistic regression analyses indicated that previous hospital admission was the only risk factor that was found to be significantly (OR: 1.956, p: 0.011; 95CI 1.163 - 3.290) associated with MRSA nasal colonization amongst nursing home residents.

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A high carriage rate of MRSA was identified in Maltese nursing care residents which can contribute to maintaining MRSA incidence in hospitals. Possible interventions include screening of these patients when they are admitted to an acute care facility and possible decolonization attempts in the nursing homes.

Keywords: meticillin-resistant *Staphylococcus aureus*, prevalence, nursing homes, Malta

Introduction

As new antimicrobials have been developed, bacteria have become resistant to these drugs through more complex mechanisms.¹

Staphylococcus aureus is a major nosocomial pathogen. In addition, it has been shown to colonise the nose, specifically the anterior nasal cavity, and the hand.² Furthermore 20% of the population continuously carry a constant type of *S. aureus* strain, whilst 60% of the population carries different types of strains in recurrent periods, and around 20% of the population are non-carriers.²

Elderly individuals residing in nursing homes are at risk of a wide variety of infections. The most common infections that occur within the nursing home communities are mostly skin, respiratory, urinary, gastrointestinal and soft tissue infections.³ In addition, if multi-resistant pathogens are introduced into nursing homes, there is a high possibility to become endemic within the same institution.⁴

Within Maltese hospitals, 48.1% of *S. aureus* blood isolates are meticillin resistant; this is one of the highest proportions of invasive MRSA strains in Europe. Furthermore, a recent point-prevalence study of MRSA carriage in the community identified an MRSA prevalence rate of 8.21% (95% CI: 5.49 – 10.93%).⁵ However, no other studies have been conducted to determine the prevalence of MRSA carriage amongst nursing home residents. This study aimed at determining the prevalence of MRSA nasal carriage amongst nursing home residents and to determine the significance of specific risk factors found in the literature.

Material and Methods

This cross-sectional study was carried out between July 2012 and February 2013. Prior to the start of this study ethical approval was sought and obtained from the Faculty of Health Science Research Ethics Committee and from the University Research Ethics Committee.

The individuals, chosen at random, were residents of Maltese governmental nursing homes. To gain a representative sample size from a population of 1860 individuals that were currently residing in governmental nursing homes, a sample size of 450 individuals was chosen. A complete list of all the individuals that were currently residing in 10 governmental nursing homes was obtained and each individual was given a number code. By using a random number generator, 450 individuals were chosen to be included in the study. Any resident who had undergone MRSA decolonisation within three months prior to the study had been excluded. Also, residents with established dementia were excluded as consent would have not been fully acquired.

After the consent was obtained, sterile cotton swabs were utilized to obtain nasal specimens. Both anterior nares were swabbed by utilizing the same cotton swab. The swab was then placed into bijoux bottles containing sterile enrichment broth, tryptone soya broth with 2.5% sodium chloride, and immediately transported to the laboratory to be aerobically incubated overnight at 35 – 37°C. After the overnight enrichment, the broth was subcultured onto MRSASelect™ Chromogenic Agar (Bio-rad Laboratories – MRSASelect™) and incubated at 35 – 37°C. Any presumptive MRSA pink colonies that grew on MRSASelect™ were subcultured onto nutrient plates and incubated aerobically for 24 hours at 35 – 37°C for further investigation. The presence of MRSA was confirmed by carrying out the gram stain,

catalase test, slide coagulase test (Pro-Lab Diagnostics, Toronto Canada) and the PBP2A latex agglutination test (Mast Diagnostic, Bootle, Merseyside, UK). Lastly, antimicrobial sensitivity testing was carried out by utilizing VITEK 2™ AST-P580 Susceptibility Cards (bioMérieux, Marcy l'Etoile, France).

IBM Statistical Package for the Social Sciences (SPSS) version 20 (IBM, Armonk NY) was used to determine the prevalence of MRSA from the data obtained. In addition, SPSS was utilized to carry out the Chi-square test for binomial parameters and to perform a multivariate logistic regression analysis to determine the association between MRSA colonisation and risk factors. Through the logistic regression model the odds ratio and the 95% confidence were also determined. It was designated that a *p*-value of < 0.05 meant that there was significant difference and hence the null hypothesis was rejected.

Results

Seventy-seven out of 397 individuals were found to have MRSA nasal carriage. The overall prevalence of MRSA colonization amongst residents in Maltese governmental nursing homes was therefore found to be 19.4% (95% Confidence Interval: 15.6% - 23.6%). It was found that MRSA nasal colonization was slightly more common within individuals aged < 80 years of age but only by a small margin and more prominent in females (20.4%) than in males (18.2%). However, both were not statistically significant (Table I).

Eighty-eight of the residents that participated in the study (22.2%) had undergone antibiotic treatment that was not directed for the treatment of MRSA, in the previous three months prior to the study. The combination of amoxicillin and clavulanic acid (co-amoxiclav) was the most common antibiotic that was prescribed to the residents (20.5%). From the results obtained via the logistic regression, only one risk factor was found to be significantly associated with the carriage of MRSA (Table II). MRSA colonization was significantly higher amongst residents who were admitted into a hospital setting 12 months prior to being screened (OR: 1.956; 95% CI 1.163-3.290).

It was demonstrated that a very high proportion (76% and 54% respectively) of MRSA strains were resistant to the quinolone antibiotics, namely levofloxacin (3rd generation) and moxifloxacin (4th generation). It was also found that 62% of the MRSA strains were resistant to fusidic acid. Of the eighteen antibiotics that were included in the panel of antibiotics tested, it was found that all strains were fully susceptible to nine antibiotics: tobramycin, linezolid, teicoplanin, vancomycin, tigecycline, fosfomycin, nitrofurantoin, rifampicin and trimethoprim/sulfamethaxole.

Discussion

To our knowledge, this was the first study that provided information regarding MRSA carriage amongst nursing home residents in Malta. The data obtained in this point prevalence study showed that the prevalence of MRSA carriage amongst nursing homes residents was

Table I. The association between MRSA carriage and Age and Gender amongst the governmental nursing home Residents included in the study

	Total Number of Residents	MRSA Colonised Residents (%)	95% Confidence Interval
Age Group			
<80 Years	268	53 (19.8)	15.2 – 25.1
≥80 Years	129	24 (18.6)	12.3 – 26.4
Gender			
Male	99	18 (18.2)	11.1 – 27.2
Female	298	59 (20.4)	15.4 – 24.8

Table II. Multivariate analysis by Logistic Regression to test the effects of several variables on MRSA colonisation amongst governmental nursing home Residents

Variable	Proportion (%) of residents colonised by MRSA	χ^2 ^a	<i>p</i>	OR	95% CI
Previous (12 months) Hospital Admission (reference:No)	46/284 (16.2)			1	
Yes	31/113 (27.4)	6.212	0.011	1.956	1.163 – 3.290
Catheters in situ (reference: Absent)	65/351 (18.5)			1	
Present	12/46 (26.1)	1.819	0.177	1.662	0.812 – 3.400
Previous (3 months) antibiotic treatment (reference: No)	57/309 (18.5)			1	
Yes	22/90 (24.4)	0.780	0.377	1.300	0.731 – 2.312
Wounds or Ulcers (reference: Absent)	67/351 (19.1)			1	
Present	10/46 (21.7)	0.006	0.939	1.020	0.619 – 1.680
Gender (reference: Male)	18/99 (18.2)			1	
Female	59/298 (20.4)	0.126	0.723	1.111	0.619 – 1.994
Age (reference: <80 years)	24/129 (18.6)			1	
≥ 80 years	53/268 (19.8)	0.077	0.782	1.078	0.619 – 1.994
Cardiovascular disease (reference: Yes)	35/185 (18.9)			1	
No	42/212 (19.8)	0.050	0.822	1.059	0.643 – 1.745
Diabetes (reference: No)	55/285 (19.3)			1	
Yes	22/112 (19.6)	0.006	0.938	1.022	0.589 – 1.774
Mobility (reference: Bed/Wheelchair bound)	35/182 (19.2)			1	
Mobile	42/215 (19.5)	0.006	0.939	1.020	0.619 – 1.680
History of MRSA infection/carriage (reference: No)	76/389 (19.5)			1	
Yes	1/8 (12.5)	0.276	0.622	0.588	0.071 – 4.854

19.4% (95% CI 17.6 – 21.2%) ranging from 0% to 25% amongst 10 nursing home.

A similar result (22%; 95% CI 18% - 27%) was obtained from a point prevalence study in England.^{6,7}

A previous study carried out in the UK obtained a prevalence of 17%, thus indicating a significant rise of prevalence of MRSA amongst nursing home residents in the UK.⁸ Maltese nursing homes have a prevalence rate which is higher than nursing homes in several

countries including Germany (6.3%),⁹ Italy (7.8 – 38.7%),¹⁰ Ireland (10.1%),¹¹ Belgium (12.2%)¹² and Spain (16.8%),¹³ whereas the prevalence is lower than nursing homes in Northern Ireland (23.3%),¹⁴ Shanghai (22.2%),¹⁵ USA (31.0%)¹⁶ and France (37.6%).¹⁷

No association between age groups or gender and MRSA carriage was found ($p=0.939$ and $p=0.724$ respectively). However contrasting results have been published in different studies whereby MRSA was associated with residents over 80 year of age and residents of between 40 – 49 years of age.¹⁸ This phenomenon was explained by the author that younger residents had a high prevalence of MRSA due to co-morbidities such as immune system deficiency, whilst residents who lived up to 90 years of age developed mechanisms that protected them against colonization and infection.

Logistic regression indicated that previous hospital admission was the only risk factor that was found to be significantly associated with MRSA nasal colonization amongst nursing home residents. This association is consistent with other studies but has not been clearly explained.^{6,8,19} There is also a known association when residents were admitted to a hospital setting for 10 or more days therefore emphasizing the need to reduce the exposure of residents to hospital settings.⁶

A large proportion of MRSA strains cultivated was resistant to fusidic acid. This indicates that such strains are endemic in Malta, due to the known high selective pressure created by the extensive use of this drug in Malta.²⁰ All strains were sensitive to nine antibiotics, which may be explained as such antibiotics are not frequently used in Malta unlike penicillins, macrolides and fluorquinolones.²¹ Similar results were obtained in previous studies in Malta.^{22,23}

This study had certain limitations which need to be kept in mind in the interpretation of its findings. First and foremost, this study was designed as a point prevalence study, therefore the results produced only reflect MRSA carriage at one point in time. Although a multivariable analysis was carried out, this study was weakly designed to identify specific risk factors. The study population may have been biased towards nursing home residents that had a higher level of

independence. This is because wards which were dedicated to residents with dementia were excluded due to difficulty in obtaining full consent. As a matter of convenience and to increase the chances of acceptability to take part in the study, nasal swabs were only taken rather than swabbing from multiple body sites. Therefore, a number of MRSA carriers may have been missed.

Conclusions

This study found that the prevalence of MRSA carriage amongst nursing home residents was 19.4 (95% CI 15.6% - 23.6%). Hence this study suggests that nursing homes are a major reservoir of MRSA carriage. Through risk factor analysis, the main risk factor for MRSA carriage was identified to be admission in a hospital setting. This does not exclude any other possible mechanisms, as risk factor analysis was limited due to the small sample size.

Acknowledgments

The assistance of all nurses and nursing home carers that undertook the swabbing as well as Ms Elizabeth Anne Scicluna and Dr. Liberato Camilleri for statistical analysis is gratefully appreciated.

Funding

This study has been funded by the Faculty of Health Science, University of Malta.

Ethical Approval

This study has been approved by the University of Malta Research Ethics Committee.

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