Risk of Methicillin-Resistant *Staphylococcus Aureus* (MRSA) Infection during a Hospitalization among MRSA Carriers and Non-Carriers in the Absence of Contact Isolation

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ABSTRACT

Background:
Contact isolation of methicillin-resistant *Staphylococcus aureus* (MRSA) carriers is designed to "protect" non-carriers from MRSA infection. The Cleveland Clinic does not place MRSA carriers in contact isolation. The purpose of this study was to examine the value of contact isolation by comparing the risk of MRSA infection in MRSA carriers and non-carriers, in the absence of contact isolation.

Methods:
Adult patients hospitalized at Cleveland Clinic from Jan 1, 2008 to December 31, 2015, who were tested for *S. aureus* colonization by PCR or culture of a nasal swab at least once during the hospitalization were screened for inclusion. Only the first hospitalization per patient was considered. Included patients were divided into MRSA carriers and MRSA non-carriers, based on the result of their first nasal MRSA test result. Among these patients, the risk of subsequent MRSA bloodstream infection (BSI) and non-bacteremic MRSA infection during the same hospitalization were determined, and compared, for non-carriers versus carriers.

Results:
Of 74595 patients identified, 1223 were excluded because they had a *S. aureus* infection within 3 days of admission to the hospital. Of the remaining 73372 patients, 5% were MRSA carriers. One hundred twenty (0.2%) of 69452 non-carriers developed an MRSA infection during the same hospitalization compared to 82 (2.1%) of the 3920 MRSA carriers (RR 0.08, 99% CI 0.06 – 0.12, p-value 3.62×10^{-50}). Relative risks were very similar when analyzed separately for bacteremic and non-bacteremic infection. A Monte Carlo simulation with 1000 trials simulating corrections for false positive and false negative nasal MRSA tests found very similar results. The magnitude of the effect was similar across subgroups of age, sex, hospital length of stay, and year (figure).

Conclusion:
Non-carriers are at much lower risk of developing MRSA infection during a hospitalization than are MRSA carriers. The absolute risk of MRSA infection in non-carriers is one-fifth of 1%, even in the absence of "protection" by contact isolation of MRSA carriers. These findings suggest that the focus of preventing MRSA infections should be on protecting MRSA carriers, not the non-carriers.

INTRODUCTION

- Contact isolation of methicillin-resistant *Staphylococcus aureus* (MRSA) carriers is designed to "protect" non-carriers from MRSA infection.
- The Cleveland Clinic does not place MRSA carriers in contact isolation.
- The purpose of this study was to examine the value of contact isolation by comparing the risk of MRSA infection in MRSA carriers and non-carriers, in the absence of contact isolation.

METHODS

- Adult patients hospitalized at the Cleveland Clinic from 2008 to 2015, who were tested for MRSA colonization during the hospitalization were screened.
- The first hospitalization per patient was included.
- Patients who had a positive blood or other culture for MRSA (other than a positive nasal screen) before being tested for MRSA carriage, or within 3 days of admission to hospital, were excluded.
- Patients were classified as MRSA carriers and MRSA non-carriers, based on their first nasal MRSA test result.
- For these patient, the risk of subsequent MRSA bloodstream infection (BSI) and non-bacteremic MRSA infection during the same hospitalization were determined, and compared for MRSA non-carriers carriers versus carriers. Analyses were done using R.

RESULTS

74595 patients were screened for MRSA carriage during at least one hospitalization during the study period. 1223 were excluded because they had a *S. aureus* infection within 3 days of admission to the hospital. Of the remaining 73372 patients, 3920 (5%) were MRSA carriers.

Baseline Characteristics

Table 1. Baseline characteristics of included patients

Characteristics[1]	Carriers (n = 3920)	Non-carriers (n = 69452)	p-value[2]
Age	64 (16)	63 (15)	<0.001
Male sex	2194 (56)	41002 (59)	<0.001
Year			<0.001
2008	317 (8)	2628 (4)	
2009	775 (20)	8884 (13)	
2010	803 (21)	9675 (14)	
2011	578 (15)	9617 (14)	
2012	233 (6)	9667 (14)	
2013	170 (4)	9988 (14)	
2014	402 (10)	9810 (14)	
2015	642 (16)	9183 (13)	
Hospital length of stay, days	13.43 (12.53)	11.35 (13.01)	<0.001

[1]Expressed as mean (SD) for continuous variables, and n (%) for categorical variables
[2]Student t-test for continuous variables and chi square test for categorical variables

Comparison of Risk of MRSA Infection Among Carriers and Non-carriers

Non-carriers were far less likely to develop MRSA infections during the hospitalization than were carriers

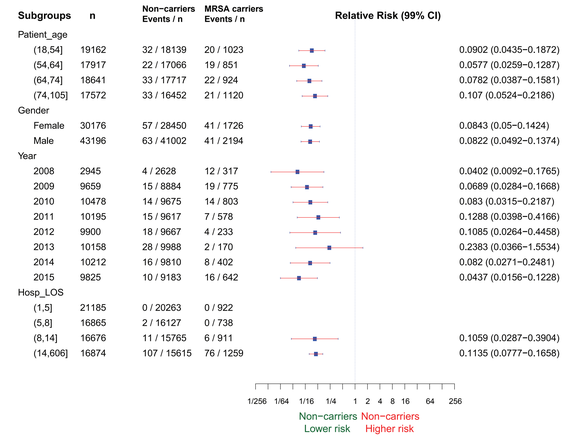
Table 2. Comparison of risk of MRSA infections for non-carriers versus carriers

Infection	Non-carriers[1] (n = 69452)	Carriers[1] (n = 3920)	RR	95% C.I.	p-value
MRSA infections overall	120 (0.17)	82 (2.09)	0.08	0.06 – 0.12	3.62×10^{-50}
MRSA bacteremia	39 (<0.01)	27 (0.69)	0.08	0.04 – 0.16	1.30×10^{-17}
Non-bacteremic MRSA infection	81 (0.12)	55 (0.14)	0.08	0.05 – 0.13	4.97×10^{-34}

[1]Expressed as number of infections (% of total patients in the group)

Subgroup Analysis

The RR for MRSA infections overall, for non-carriers versus carriers, was similar across all subgroups of age, sex, year, and hospital length of stay (figure).



CONCLUSION

In the absence of contact isolation, non-carriers are at much lower risk of developing MRSA infection during a hospitalization than are MRSA carriers.

The absolute risk of MRSA infection in non-carriers is one-fifth of 1%, even in the absence of "protection" by contact isolation of MRSA carriers.

The focus of preventing MRSA infections should be on preventing MRSA infections in MRSA carriers, not in isolating them to "protect" non-carriers.