Screening and Targeted *Staphylococcus aureus* Decolonization of Acute and Intensive Care Patients and Invasive Infections in an Academic Medical Center

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INTRODUCTION

- *Staphylococcus aureus* colonization of skin and mucosa contributes to its pathogenesis [1, 2].
- *S. aureus* decolonization reduces bloodstream infections in ICU patients [3].
- Decolonization in acute care settings has not shown a similar benefit [4].
- We describe a targeted decolonization protocol implemented at a large academic hospital across acute and intensive care settings.
- We hypothesized that decolonization would result in decreased incidence of invasive *S. aureus* infections, as well as 30-day readmission and 30-day mortality rates.

METHODS

- Medicine, Oncology, Transplant, and Intensive Care units implemented test-and-treat approaches to *S. aureus* colonization between 2018 and 2021.
- All patients underwent active surveillance for *Staph aureus* colonization at the time of admission and during changes in level of care.
- Colonized patients identified through active surveillance received 5 days of chlorhexidine 2% applied to the body and mupirocin applied to the nares.
- Patients that received at least 3 days of decolonization treatment were compared against those that received no or minimal decolonization.
- Primary outcome was any *S. aureus* invasive infection occurring 3 or more days after admission date (including blood, respiratory tract, urine, deep tissue, or wound culture).
- Secondary outcomes were 30-day mortality and 30-day readmission.

Table 1. Characteristics of admitted patients by colonization and decolonization status

	Total	Not colonized	Colonized, not decolonized	Received decolonization	P-value
Total	*26,303*	*20,290*	*4090*	*1918*	
Age [median, IQR]	69 [57, 80]	69.00 [57, 80]	68 [55, 80]	66 [54, 77]	<0.001
Sex					
Female	11,749 (44.7)	9270 (45.7)	1699 (41.5)	779 (40.6)	<0.001
Male	14,554 (55.3)	11,020 (54.3)	2391 (58.5)	1139 (59.4)	
COVID status					
Pre-COVID	11,761 (44.7)	8935 (44.0)	2055 (50.2)	771 (40.2)	<0.001
Negative	12,222 (46.5)	9552 (47.1)	1710 (41.8)	957 (49.9)	
Positive	2320 (8.8)	1803 (8.9)	325 (7.9)	190 (9.9)	
Comorbidities					
Cardiovascular	20,343 (77.3)	15,567 (76.7)	3209 (78.5)	1562 (81.4)	<0.001
Pulmonary diseases	9638 (36.6)	7414 (36.5)	1467 (35.9)	757 (39.5)	0.021
Diabetes	9787 (37.2)	7452 (36.7)	1569 (38.4)	765 (39.9)	0.006
Cancer	4447 (16.9)	3574 (17.6)	541 (13.2)	332 (17.3)	<0.001
Rheumatologic	1564 (5.9)	1199 (5.9)	238 (5.8)	127 (6.6)	0.421
Obesity	8730 (33.2)	6730 (33.2)	1321 (32.3)	677 (35.3)	0.070
Length of stay (days)	8 [6, 14]	8 [6, 13]	7 [6, 11]	13 [9, 21]	<0.001
Prior healthcare exposure					
Admission last 90 days	7610 (28.9)	6011 (29.6)	1140 (27.9)	459 (23.9)	<0.001
Transfer from facility	1730 (6.6)	1330 (6.6)	248 (6.1)	152 (7.9)	0.024
Level of care					
Acute care	22,888 (87.0)	17,696 (87.2)	3698 (90.4)	1491 (77.7)	<0.001
Intensive care	3415 (13.0)	2594 (12.8)	392 (9.6)	427 (22.3)	
Outcomes					
Mortality at 30 days	2463 (9.4)	1852 (9.1)	389 (9.5)	221 (11.5)	0.003
Readmission at 30 days	6670 (25.4)	5129 (25.3)	950 (23.2)	591 (30.8)	<0.001

RESULTS

- A total of 6,008 out of 26,303 patients were colonized with MSSA or MRSA. Clinical characteristics and demographics are shown in **Table 1**.
- Data on primary outcomes and rates of invasive *S. aureus* infections (onset at least 2 days after admission) are shown in **Table 2**.
- Invasive *S. aureus* infections (onset at least 2 days after admission) were seen in 654 (2.5%) of screened patients.
- Decolonization rates among colonized patients increased over time, while invasive infections by decolonization were similar (**Figs. 1, 2**).

Table 2. Evaluation of primary and secondary outcomes

	Total screened	Not colonized	Colonized, not decolonized	Received decolonization	P-value
Total	26298	20290	4090	1918	
Primary outcome					
Number of infections					
0	25644 (97.5)	20030 (98.7)	3861 (94.4)	1753 (91.4)	<0.001
1	357 (1.4)	146 (0.7)	148 (3.6)	63 (3.3)	
2	109 (0.4)	45 (0.2)	45 (1.1)	19 (1.0)	
3 or more	188 (0.7)	69 (0.3)	36 (0.9)	83 (4.3)	
Site of infection					
Bacteremia	87 (0.3)	27 (0.1)	28 (0.7)	32 (1.7)	<0.001
Pulmonary	312 (1.2)	117 (0.6)	107 (2.6)	88 (4.6)	<0.001
Urine	18 (0.1)	5 (0.0)	8 (0.2)	5 (0.3)	<0.001
Wound/surgical	84 (0.3)	35 (0.2)	31 (0.8)	18 (0.9)	<0.001
Other	206 (0.8)	92 (0.5)	65 (1.6)	49 (2.6)	<0.001
Days to infection					
3-5	351 (53.7)	124 (47.7)	147 (64.2)	80 (48.5)	0.003
6-7	87 (13.3)	41 (15.8)	24 (10.5)	22 (13.3)	
8 or more	216 (33.0)	95 (36.5)	58 (25.3)	63 (38.2)	
Secondary outcomes					
30-day mortality	2462 (9.4)	1852 (9.1)	389 (9.5)	221 (11.5)	0.003
30-day readmission	6614 (25.2)	5120 (25.2)	920 (22.5)	574 (29.9)	<0.001

RESULTS

Fig 1. Decolonization rates by 3-month interval

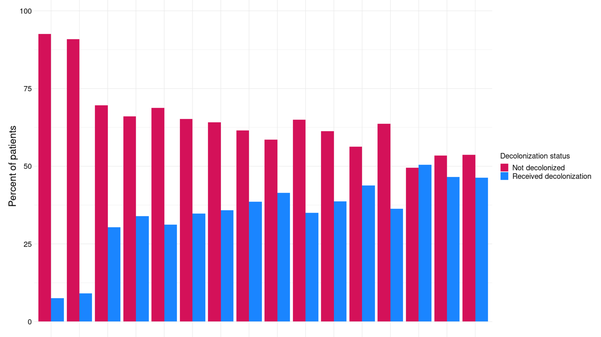

Fig 2. Invasive infections by decolonization status over time

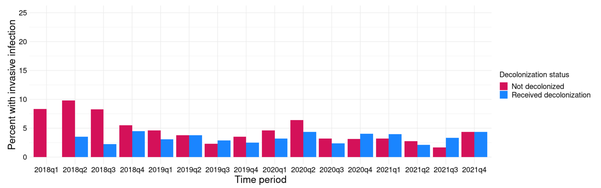

Fig 3. Invasive infections by site and colonization status

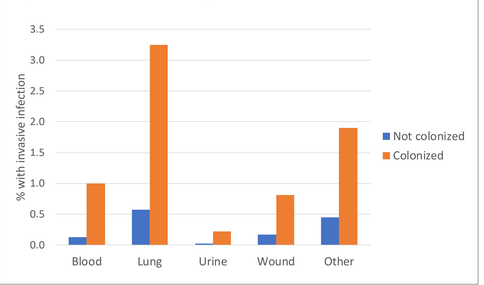

Table 3. Multivariate regression of factors associated with primary and secondary outcomes

		Invasive infection		30-day readmission		30-day mortality	
	Total (%)	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Total	*6008*						
Age (per year)	67 [54, 79]	0.99 (0.99, 1.00)	0.055	1.00 (1.00, 1.00)	0.922	1.02 (1.02, 1.03)	<0.001
Sex: male		1.69 (1.35, 2.14)	<0.001	1.07 (0.95, 1.21)	0.260	1.22 (1.02, 1.46)	0.029
COVID status (ref: pre-COVID)							
Negative	2667 (44.4)	0.84 (0.67, 1.05)	0.121				
Positive	515 (8.6)	0.96 (0.65, 1.38)	0.811				
Comorbidities							
Cardiovascular	4771 (79.4)	1.75 (1.27, 2.47)	0.001	1.26 (1.08, 1.48)	0.004	1.70 (1.30, 2.24)	<0.001
Pulmonary	2224 (37.0)			1.09 (0.96, 1.23)	0.180	1.44 (1.21, 1.72)	<0.001
Diabetes	2334 (38.8)	1.23 (0.90, 1.52)	0.065	1.13 (1.00, 1.27)	0.055		
Cancer	873 (14.5)			1.38 (1.18, 1.62)	<0.001	3.54 (2.89, 4.31)	<0.001
Rheumatologic	365 (6.1)						
Obesity	1998 (33.3)						
Length of stay	8 [6, 14]	1.03 (1.02, 1.03)	<0.001	1.01 (1.01, 1.02)	<0.001	1.01 (1.01, 1.02)	<0.001
Level of care: ICU	821 (13.7)	1.59 (1.32, 1.90)	<0.001	1.12 (1.00, 1.27)	0.050	2.12 (1.82, 2.47)	<0.001
Prior admission last 90 days	1599 (26.6)			1.58 (1.39, 1.80)	<0.001	1.23 (1.02, 1.49)	0.032
Transfer from facility	400 (6.7)					1.23 (0.90, 1.67)	0.175
Decolonized	1918 (31.9)	0.98 (0.77, 1.24)	0.886	1.27 (1.12, 1.45)	<0.001	0.92 (0.76, 1.12)	0.462

RESULTS (cont.)

Multivariate regression

- Each variable of interest was evaluated for association with outcomes after controlling for age, sex, and length of stay.
- Variables significant in these models were evaluated with an adjusted model to determine overall associations.
- After controlling for confounding factors, decolonization was not significantly associated with incident invasive infections (**Table 4**, p = 0.886).
- There was a significant association between decolonization and 30-day readmission but not 30-day mortality (p < 0.001, p = 0.462, respectively).

CONCLUSIONS

- We report on a universal *S. aureus* screening program; of all eligible patients screened, 16.6% were positive for MSSA and 6.3% for MRSA.
- As expected, colonization was significantly correlated with risk of invasive *S. aureus* infection.
- Decolonization was not associated with changes in the primary outcome of invasive infection, nor secondary outcome of mortality.
- It is unclear what drives the association between decolonization and readmission, given the lack of association with invasive infections.
- Further investigation is needed to assess what factors may affect limited efficacy of decolonization.
- Subsequent analyses will evaluate for factors impacting decolonization efficacy, such as time from screen to implementation.
- We will also investigate other endpoints such as antibiotic usage, time in ICU, and ventilator days.

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