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Surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) in patients with congenital heart disease in a tertiary care teaching hospital

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Abstract
Aim and Objectives: Methicillin-safe Staphylococcus aureus (MRSA) colonization has been perceived as a noteworthy issue among hospitalized patients. Accessible information about predominance of MRSA among youngsters with inherent coronary illness (CHD) are insignificant. The point of the examination was to decide the pervasiveness of MRSA colonization and to recognize chance components for MRSA colonization among youngsters <19 years old with CHD admitted to a pediatric emergency unit.
Methods: Confirmation and week by week MRSA nasal observation testing was performed, and patients were stratified into six hazard bunches dependent on the Risk Adjustment for Congenital Heart Surgery-1 Method. The MRSA-colonized kids were contrasted with the MRSA non-colonized kids.
Results: Amid the 3-year contemplate period, there were 372 confirmations of kids with CHD to the PICU. Of the 372, 72 (19.4%) had no observation societies performed or had no earlier history of MRSA and were barred from further examination. Of the staying 300 confirmations, 29 (9.7%) (263 individual kids) were observed to be colonized. The mean age of the 263 kids when initially admitted to the PICU was 3.29 years (run 0.03– 18.30, middle 0.66). Age circulation was not essentially unique between the colonized and non-colonized gatherings (P = .236). Sex (P =. 667), race (P = .837), and CHD unpredictability (P = .395) were not altogether connected with colonization. The chances of being colonized if recently hospitalized were 4.42 occasions more prominent than if not recently hospitalized (95% certainty interim 1.89, 10.34).
Conclusion: Routine MRSA observation ought to be performed in patients with CHD to recognize colonized patients.

Keywords: congenital heart disease; MRSA colonization; surveillance cultures

Introduction
Methicillin-safe Staphylococcus aureus (MRSA) keeps on being an inexorably vital reason for grimness and mortality among patients in the United States and worldwide [1]. However, most of distributed information start from studies led in grown-ups, and just a couple of studies have concentrated on MRSA the study of disease transmission in children [1-3]. Moreover, there are meager information depicting the commonness of MRSA colonization among kids with inherent coronary illness (CHD).
Most kids with CHD now endure well into adulthood, [4] and these kids for the most part have various communications with the human services framework, particularly those with progressively complex CHD. These connections incorporate hospitalizations for cardiovascular catheterization and medical procedure, regularly expecting admission to the pediatric emergency unit). Hospitalization inside the past a year is an announced autonomous hazard factor for MRSA colonization among adults [5]. Gerber *et al* revealed in a 6-year investigation of the frequency of S aureus contaminations among hospitalized kids that 30% of patients conceded with S aureus disease had no less than one complex incessant condition and 9% had a cardiovascular condition, in spite of the fact that the subtleties of these heart conditions were not reported [1].
Multidrug-safe living beings, including MRSA, have been generally connected with the social insurance contact and the utilization of wide range anti-microbials. In any case, an ongoing report indicated expanded commonness (6%) of network related (CA-) MRSA

colonization among patients admitted to the PICU [3].
The target of our examination was to portray the commonness of and hazard factors for MRSA colonization among kids with CHD admitted to the PICU.

Materials and Methods

We led a review diagram survey of all youngsters admitted to the PICU at IMS and SUM Hospital (SUM HOSPITAL) in Jacksonville, Florida between April 1, 2008, and March 31, 2011, with a past filled with CHD. The SUM HOSPITAL is a 184-bed tertiary consideration kids' medical clinic that serves north Florida and southeast Georgia. The 20-bed PICU every year concedes a normal of 1,000 restorative and careful patients (which incorporate cardiovascular, orthopedic, and neurosurgical patients). All patients are confessed to single patient rooms.
Restorative records were checked on for age, sexual orientation, CHD analysis, explanation behind admission to the PICU, length of remain (LOS) in the PICU, the quantity of past hospitalizations, anti-microbial use, and fundamental corticosteroid use amid the investigation time frame. If there should be an occurrence of various affirmations,
just the age at first affirmation was utilized for examination. The patients who were conceded postcardiac medical procedure were stratified into six hazard classifications dependent on the Risk Adjustment for Congenital Heart Surgery 1 (RACHS-1) [6, 7]. To depict the qualities of the patients' earlier hospitalizations, two creators inspected the electronic medicinal records and assembled data on the utilization of anti-microbials, regardless of whether the patient was admitted to the PICU, and was any surgery performed amid the hospitalization.
Beginning from April 1, 2008, all youngsters admitted to the PICU who had no known history of MRSA colonization or contamination had nasal MRSA reconnaissance testing performed upon affirmation. These nasal swabs were gathered by the PICU medical attendants. Patients who were not MRSA colonized on confirmation had week by week MRSA observation testing performed until they either tried positive or were released from the PICU. Patients with a past history of MRSA colonization or disease were thought to be MRSA colonized8; they were not tried for MRSA colonization and were promptly set in detachment for the length of their hospitalization. Any patient who had either a confirmation or week by week observation test positive for MRSA was quickly set on contact disengagement. There was no endeavor to perform decolonization of MRSA for any patient who was recognized as colonized.
At first, MRSA ID was performed utilizing a chromogenic media culture strategy (BBL CHROM Agar MRSA, Becton-Dickinson and Co, New Jersey) as per producer instructions.9 After April 2010, we utilized a constant polymerase chain response (PCR) procedure utilizing Xpert MRSA that is kept running on the Gene Xpert system (Cepheid, Sunnyvale, California) as per makers' instructions.10 The MRSA-colonized youngsters were contrasted with the MRSA non-colonized kids.

Measurable Methods

All examinations were run utilizing SAS Version 9.3 for Windows (SAS Institute Inc, Cary, North Carolina). All out factors were portrayed utilizing tallies and rates and examined utilizing chi-square tests or Fisher precise tests, when the evaluated checks were under five. Ceaseless factors were depicted utilizing means, extents, and medians and broke down utilizing the nonparametric Wilcoxon Rank-Sum tests. Bonferroni change for numerous examinations was connected when fundamental. Chances proportions, alongside 95% certainty interims (CI), were separated from calculated relapses. For the investigation of the earlier hospitalizations, to consider the missing data, log-rank tests were utilized to appraise the dissemination of earlier affirmations with anti-toxin use, ICU confirmation, and medical procedure, individually. The patients with missing data were viewed as the edited perceptions.
Cox relative perils show examination was utilized to decide the impact of anti-toxin and steroid use on the MRSA colonization status.

Results

During the 3-year study period, there were a total of 2618 admissions (for 2281 children) to the PICU, of which 372 (14.2%) admissions were for 320 children with a history of CHD. There is no cardiac ICU; therefore all postsurgical patients are admitted to the general PICU.
Among the children with CHD, 72 (19.4%) admissions (in 69 individual patients) with no prior history of MRSA colonization were missed and not tested for MRSA colonization on admission. These 72 admissions were excluded from further analysis. The remaining 300 admissions were for 263 individual patients who were included in the analysis (Table 1). Of the 300 admissions, 29 (9.7%) were considered colonized (22 individual patients): 11 (3.7%) were newly identified by surveillance testing, 16 (5.3%) had prior history of MRSA colonization or infection, and 2 (0.7%) were identified by non-surveillance clinical testing (both these patients had surveillance testing done on admission that was negative). There were no MRSA infections in patients with CHD admitted to the PICU during the study period. The prevalence of MRSA among all the patients admitted to the PICU during the study period was 15.8%.

Table 1: Characteristics of Patients With CHD Admitted to the PICU.

Characteristic	Unique Patients, n = 263 (%)	MRSA Colonized, n = 22 (%)	No MRSA, n = 241 (%)
Mean age, years (range)	3.29 (0.03–18.66)	2.56 (0.02–17.1)	3.41 (0.003–18.66)
<28 days old	30 (11.4)	3 (13.6)	27 (11.2)
28–364 days	116 (44.1)	9 (40.9)	107 (44.4)
1–5 years	55 (20.9)	7 (31.8)	48 (19.9)
5–10 years	28 (10.6)	1 (4.5)	27 (11.2)
≥10 years	34 (12.9)	2 (9.0)	32 (13.3)
Gender (%)			
Male	143 (54)	11 (50)	132 (55)
Female	120 (46)	11 (50)	109 (45)
Race (%)			
Caucasian	162 (62)	14 (64)	148 (61)
Non-caucasian	101 (38)	8 (36)	93 (39)

The two clinical non-surveillance positive cultures for MRSA (one each from the conjunctival sac and an incision wound site) were not treated by the clinicians and were considered to be colonization rather than infection for analysis.
Of the 300 admissions for patients with a history of CHD, 209 (69.7%) were postcardiac surgery and 91 (30.3%) were

admissions for patients with a history of CHD who were being admitted to the PICU for nonsurgical management. Of the 209 patients who had surgery, 20 (9.6%) were found to have MRSA colonization, while 9 (9.9%) of the 91 who had no surgery were MRSA colonized (P = .931). Table 2 shows the prevalence of MRSA among the 209 postsurgical patients stratified by the six RACHS-1 risk categories.

The mean age of the 263 children with CHD at their first admission to the PICU (30 had multiple admissions during the study period) was 3.29 years (range = 0.03 to 18.66 years, median = 0.66 years). Table 1 shows the demographic characteristics of our patient population. Age distribution was not significantly different between the MRSA-colonized and noncolonized groups (P = .407, Wilcoxon Rank-Sum Test). Gender (P = .667, Chi-square), race (P = .837, chi-square), and CHD RACHS-1 category (P = .383, Fisher exact test) were also not significantly associated with colonization status.

Of the 122 admissions who had previous hospitalizations, 21 (17.2%) were found to have MRSA colonization, while eight (4.5%) of the 178 who had no previous hospitalizations were MRSA colonized. The odds of being colonized if previously hospitalized were 4.42 times greater than if not previously hospitalized (95% CI: 1.89, 10.34). The 122 admissions with prior hospitalizations represent 106 unique patients (18 colonized and 88 non-colonized). Medical records were only available going back ten years for these patients.

Of the 88 unique patients in the non-colonized group, 17 (19.3%) had completely missing (9 patients) or partially missing (8 patients) information about antibiotic use, surgery, or admission to the ICU, during their prior admissions. None of the 18 patients in the colonized group had missing information.

Of the 71 patients from the non-colonized group with complete information about antibiotic use, 54 (76.1%) had at least one type of antibiotic administrated compared to 14 (77.8%) in the colonized group (P = 1.000, Fisher exact test). In all, 51 (71.8%) in the non-colonized group and 11 (61.1%) in the colonized group had at least one ICU admission (P = .377, chi-square). Forty (56.3%) patients in the non-colonized group and 12 (66.7%) in the colonized group had at least one surgery (P = .427, chi-square).

The estimated median for the proportion of prior hospitalizations with antibiotic use was 76.4% (95% CI: 50.0%, 100.0%) for the colonized group versus 100% (95% CI: 60.0%, 100.0%) for the noncolonized group (P = 0.552).

The estimated median for the proportion of prior hospitalizations with ICU admission was 100.0% (95% CI 0%, 100.0%) for the colonized group versus 100% (95% CI: 66.7%, 100.0%) for the noncolonized group (P = .508). The estimated median for the proportion of prior hospitalizations with surgery was 50.0% (95% CI 0%, 100.0%) for the colonized group versus 50% (95% CI: 33.3%, 100.0%) for the noncolonized group (P = .722).

Of the 29 MRSA-colonized admissions, 13 (44.2%) were patients newly identified for the first time as MRSA colonized during the PICU admission. These 13 admissions were analyzed for the effect of antibiotic and steroid use on becoming MRSA colonized. In all, nine (69.2%) of the 13 newly colonized admissions and 241 (89%) of the 271 noncolonized admissions received antibiotics (P = .056, Fisher exact test), approaching statistical significance. However, in children who received antibiotics and steroids, using a Cox proportional hazards model analysis and controlling for steroids, the use of antibiotics had a protective effect, reducing the risk of being MRSA colonized by 81% (hazard ratio = 0.189, 95% CI: 0.045, 0.784).

Table 2: The MRSA prevalence among postcardiac surgery patients stratified by rachs-1 risk category.

Rachs-1 Category	All Surgical Admissions, n = 209 (%)	MRSA Colonized, n = 20 (%)	No MRSA, n = 189 (%)
1	29 (13.9)	1 (5)	28 (14.8)
2	102 (48.8)	10 (50)	92 (48.7)
3	60 (28.7)	7 (35)	53 (28.0)
4	9 (4.3)	0 (0)	9 (4.8)
5	1 (0.5)	0 (0)	1 (0.5)
6	8 (3.8)	2 (10)	6 (3.2)

Discussions

Staphylococcus aureus carriage is a notable hazard factor for infection [11, 12] One report evaluated the overall danger of careful site diseases related with nasal colonization, contrasted with no colonization, to be in excess of multiple times higher [13]. Safdar and Bradley played out an orderly audit and assessed that the danger of contamination following colonization with MRSA was fourfold higher when contrasted and methicillin-defenseless Saureus [12, 14].

Routine observation for MRSA and other vital anti-microbial safe pathogens is regularly a critical component of powerful disease control programs.12 Holzmann-Pazgal revealed that affirmation and week after week dynamic reconnaissance refined gave off an impression of being a viable instrument to diminish the spread of MRSA in a PICU, free of improving hand cleanliness compliance [15].

One of the objectives of this examination was to decide the predominance of MRSA among patients with CHD who are admitted to the PICU. We trust that distinguishing proof and segregation of these patients were critical to keep the spread of MRSA among all patients admitted to the PICU. The consequences of our examination exhibited that among this gathering of patients with CHD who have expanded contact with the social insurance framework, the pervasiveness of MRSA colonization (9.5%) was higher than the 6% rate announced by Milstone *et al* in an investigation done on a general PICU population [3]. Currently, MRSA represents over 60% of staphylococcal diseases in the ICU, [12] and the most well-known kind of contaminations with MRSA, particularly CA-MRSA, are skin and delicate tissue infections [16]. Interestingly, there were no patients with MRSA contamination in our investigation; nonetheless, the majority of our careful heart patients get prophylactic anti-toxin treatment with vancomycin that covers MRSA.

Our outcomes likewise shown that when contrasting patients who progressed toward becoming MRSA colonized with the individuals who were not, the utilization of anti-infection agents had a defensive impact, decreasing the danger of being influenced by 81%, while controlling for steroid use in patients who got the two anti-toxins and steroids. We don't have a clarification for this finding, and thinking about that just few patients progressed toward becoming MRSA colonized while admitted to the PICU this outcome ought to be translated with alert and further research is important to address this issue. In distributed investigations, patients who were MRSA colonized would in general be younger [3]. In our patients, we found that age, sexual orientation, and RACHS-1 chance classification were not indicators of MRSA colonization. We additionally discovered that earlier

hospitalization was related with a fourfold higher probability of MRSA colonization. Further portrayal of the past hospitalizations exhibited no huge distinction in the utilization of anti-infection agents, being admitted to the PICU, or having a surgery between those patients who were MRSA colonized and the individuals who were most certainly not.

Our review information gathering and the way that just about one-fifth of the patients admitted to the PICU with CHD were avoided from investigation on the grounds that the chance to perform standard MRSA reconnaissance was missed are different confinements of our examination. In any case, there were no noteworthy contrasts in the mean age (P = .06), sex (P = .5), and ethnicity (P = .34) between the patients who were incorporated and those barred from the investigation (information not appeared).

Conclusions

In perspective on the high predominance of MRSA colonization among youngsters with CHD in our examination, we presume that our discoveries bolster the standard reconnaissance for MRSA in such kids upon admission to the PICU, particularly in those patients with a background marked by earlier hospitalizations. This should forestall conceivable coincidental transmission to noncolonized hospitalized patients by distinguishing the colonized patients and putting them in proper separation. Since we didn't endeavor to decolonize patients related to MRSA, further investigations should be led to decide if there is an advantage of decolonization to avert securing and transmission of MRSA among patients with CHD admitted to the PICU.

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