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Title: Double Swab 5% vs Single Swab 10% Iodophor for Reducing Methicillin-Resistant *Staphylococcus aureus* with Routine Chlorhexidine Bathing

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Abstract:

A prospective cohort study compared a two-swab-per-nostril 5% iodophor regimen with a one-swab-per-nostril 10% iodophor regimen on methicillin resistant *Staphylococcus aureus* carriage in nursing home residents. Compared with baseline, both single-swab and double-swab regimens resulted in an identical 40% reduction in nasal carriage and 60% reduction in any carriage (skin/nasal).

Introduction:

Methicillin resistant *Staphylococcus aureus* (MRSA) colonization is common in hospitals and nursing homes and carriage is associated with subsequent infection.¹⁻² The nose is the primary MRSA reservoir, with 80% of infections caused by nasal strains.³⁻⁴ Mupirocin ointment is the most commonly used preventative agent to clear MRSA from the nose due to evidence that it decreases MRSA infections by 45% among treated carriers.⁵ However, mupirocin resistance has been identified in several regions and is increasing. Worldwide prevalence of mupirocin resistance ranges between 4.6%-17.8%.⁶ In the U.S., high-level resistance is 4-5%, and as high as 10-15% in some areas.⁷ Antiseptics are a promising alternative because, unlike antibiotics, they have not been associated with clinically meaningful resistance. Povidone-iodine (iodophor) is an antiseptic which suppresses *Staphylococcus aureus* with a single dose and has been shown to prevent surgical site infections.⁸ Nasal iodophor swabs are available in 5% and 10% formulations. In the present study, we report the results of a quasi-experimental study evaluating the impact of a single-swab per nostril 10% iodophor regimen with manufacturer-recommended double-swab per nostril 5% iodophor regimen (<https://multimedia.3m.com/mws/media/716786O/skin-and-nasal-application-instructions.pdf>) in reducing MRSA carriage among nursing home residents.

Methods:

Parent Nursing Home Decolonization Study

We conducted a 9-month study between June 2015-February 2016 at three Southern California nursing homes to assess the impact of universal decolonization on multidrug-resistant organisms carriage, including MRSA.⁹ The baseline period⁹ was June-August 2015; phase-in

period, September-November 2015; and intervention period, December-February 2016. Body decolonization involved daily chlorhexidine (CHG) antiseptic bathing (2% no-rinse cloths for bed baths, or 4% liquid rinse-off for showering) and nasal decolonization with 5% nasal iodophor swabs (3M) for five days for new admissions and Monday-Friday every other week for the entire nursing home. The 5% nasal iodophor administration consisted of two swabs per nostril applied for 30 seconds per nostril twice daily (eight swabs per day). To assess for MRSA prevalence, we conducted six rounds of point-prevalence bilateral nares and axilla/groin swab testing from 50 randomly-selected residents during the baseline and intervention periods.

We report here the experience in one (of the three) participating nursing homes that adopted two different regimens of nasal antiseptic decolonization after the parent study was completed.

Post-Study Quality Improvement Program Assessment

Following the 9-month decolonization study, one nursing home adopted the decolonization regimen as a QI initiative. However, nursing staff expressed pragmatic concerns with the nasal iodophor administration, indicating that two swabs per nostril was redundant and a 30 second application per nostril was impractical. Nursing staff reported iodophor was generally applied for several seconds (rather than 30 seconds) per nostril due to time constraints. In response to this feedback, the nursing home implemented nasal decolonization using a 10% generic iodophor swab, applying one swab per nostril twice daily for at least three revolutions rather than two 5% iodophor swabs per nostril. The twice daily administration schedule was retained.

To understand the effectiveness of the modified nasal application protocol, we conducted a 5-week prospective cohort study (August-September 2016) of nasal decolonization with 10% nasal iodophor administered twice daily, on admission and Monday-Friday every other week plus body decolonization with daily CHG bathing/showering. We conducted two point-prevalence samplings four weeks apart involving bilateral nares and axilla/groin swabs collected from 50 randomly-selected residents.

Demographic and medical characteristics of randomly-sampled residents were compared between the baseline, double-swab 5% iodophor intervention, and single-swab 10% iodophor intervention periods. Changes in MRSA nasal, and overall carriage (nasal or skin) were compared between each intervention period and the baseline period, as well as between the two intervention periods to each another using Fisher's Exact tests and logistic regression models that controlled for history of MRSA, diabetes, wounds, incontinence, dementia, bedbound status, presence of central lines, and presence of urinary catheters. Models comparing the two intervention periods to each other additionally accounted for treatment with CHG or iodophor in the past 24 hours. Studies were approved by the UC Irvine Institutional Review Board.

Results:

Point prevalence swabs were collected from 300 randomly-selected residents during the baseline period and again during the intervention period; during the post-study quality improvement assessment period, 100 randomly-selected residents were swabbed. Resident characteristics are presented in Table 1.

The relative raw reduction in nasal MRSA carriage was 26% in both iodophor treatment periods, from a baseline prevalence of 27% to 20% for both the double-swab 5% iodophor and

single-swab 10% iodophor regimens (Table 2). Similar raw reductions were also observed for either nares or skin carriage between the two regimens, (P=0.4) (Table 2). Adjusted models found identical 40% reductions in MRSA nasal carriage when comparing the baseline period independently to the double-swab 5% iodophor group (P=0.03) and the single-swab 10% iodophor group (P=0.1). (Table 2) Adjusted models also found identical 60% reductions in MRSA carriage from nares and axilla/groin when comparing the baseline period to either the double-swab 5% (P<0.001) or single-swab 10% (P=0.007) nasal iodophor groups. There was no significant difference between the single swab and the double swab regimen for MRSA nasal carriage (OR 1.02 (0.58, 1.8), P=0.9) or any body site MRSA carriage (OR 1.08 (0.62, 1.88, P=0.6) Adherence to the nasal administration protocols was similar between groups (83% and 80% in the 5% and 10% nasal iodophor groups, respectively).

Discussion

We found similar reductions in nasal and any site (nasal or skin) MRSA carriage when using a single-swab per nostril 10% iodophor regimen (4 swabs per day) compared with a double-swab per nostril 5% iodophor regimen (8 swabs per day). In addition, the 10% iodophor regimen involved a generic formulation, which would reduce costs further.

Reasons for the similar performance of these two regimens include the possibility that the higher 10% iodophor concentration may have delivered sufficient iodophor using fewer swabs. This finding could be important since nurses reported being unlikely to apply the nasal products for the recommended 30 seconds per swab due to time constraints. We instituted the operational instruction to apply the swabs for “at least three revolutions” to ensure adequate application to all

surfaces of the nostrils. Furthermore, nurses reported that using two swabs per nostril seemed wasteful given adequate nares saturation from a single swab.

We found significant reductions in overall MRSA carriage when comparing either iodophor regimen period to the baseline period (60% reduction for both periods). However, we found 40% reductions in nasal MRSA carriage from baseline period to both intervention periods had discordant significance values, likely due to the three-fold smaller number of samples taken during the 10% iodophor QI initiative.

We note that results were similar even though the baseline and single-swab 10% iodophor sampling occurred in the summer and the double swab 5% iodophor sampling occurred in the winter. Several studies have shown that MRSA rates and transmissibility are higher in the summer months, suggesting that the relative performance of the 10% iodophor compared with the 5% iodophor may be even better than our data indicate.¹⁰

While further studies with larger sample sizes are warranted, this study supports the use of a single-swab per nostril 10% generic iodophor as similarly effective to a two-swab per nostril 5% iodophor to reduce MDRO carriage. In addition, the nurses' feedback highlights that infection prevention programs must consider feasibility and implementation ease even for simple interventions to ensure that optimal results."

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Table 1: Nursing Home Resident Characteristics by Study Period

	Baseline	5% Iodophor	10% Iodophor
	N (%)	(2 swabs/nostril)	(1 swab/nostril)
		N (%)	N (%)
Number sampled	300	300	100
History of MRSA	33 (11.0%)	30 (10.0%)	14 (14.0%)
Diabetes	143 (47.7%)	151 (50.3%)	48 (48.0)%
Hemodialysis	22 (7.3%)	27 (9.0%)	9 (9.0%)
Wounds	72 (24.0%)	38 (12.7%)	9 (9.0%)
Bedbound	34 (11.3%)	44 (14.7%)	3 (3.0%)
Incontinence	173 (57.7%)	179 (59.7%)	60 (60.0%)
Urinary catheter	34 (11.3%)	32 (10.7%)	13 (13.0%)
Central line	18 (6.0%)	13 (4.3%)	8 (8.0%)
CHG in past 24h	0 (0.0%)	228 (76.0%)	80 (80.0%)
Iodophor in past 24h	0 (0.0%)	116 (82.8%)*	43 (79.6%)*

Table 1 Legend

Abbreviations:

MRSA = Methicillin resistant *Staphylococcus aureus*

CHG = chlorhexidine gluconate

There are no statistically significant differences in characteristics between time periods for all 3 groups. CHG use and iodophor use in the baseline period differed from the two intervention periods ($P < 0.001$ for all comparisons).

* Nasal iodophor was given Monday-Friday every other week, except for new admissions, who received 5 days of twice daily iodophor on admission. Half of the samples for MRSA colonization were taken during weeks during which all residents were scheduled to get iodophor; the other half of the samples were taken on weeks that nasal iodophor was not scheduled to be given to all residents. During the 5% iodophor intervention, 116 of the 140 residents due to receive iodophor in the 24 hours prior to sampling actually received iodophor. During the 10% iodophor intervention, 43 of the 54 residents due to receive iodophor in the 24 hours prior to sampling actually received iodophor.

**adjusted model

Table 2: MRSA Carriage by Study Period

	Baseline, N (%)	5% Iodophor (2 swabs/nostril) N (%)	10% Iodophor (1 swab/nostril) N (%)
Number sampled	300	300	100
MRSA			
Nares	80 (26.7%)	59 (19.7%)	20 (20.0%)
OR [95% CI]	--REF--	0.67 [0.46 – 0.99]	0.69 [0.40 – 1.19]
Skin	83 (27.7%)	21 (7.0%)	10 (10.0%)
OR [95% CI]	--REF--	0.67 [0.46 – 0.99]	0.69 [0.40 – 1.19]
Any	113 (37.7%)	62 (20.7%)	22 (22.0%)
OR [95% CI]	--REF--	0.43 [0.30 – 0.62]	0.47 [0.28 – 0.79]

Table 2 Legend

Abbreviations:

MRSA = Methicillin resistant *Staphylococcus aureus*

--REF-- = Referent group

CI = confidence interval

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