



Brief Report

Perioperative participation of orthopedic patients and surgical staff in a nasal decolonization intervention to reduce *Staphylococcus* spp surgical site infections



Anildaliz Mullen RN, BSN ^{a,*}, Helen J. Wieland RN ^a, Eric S. Wieser MD, ABOS ^a, Ernst W. Spannake PhD ^b, Rebecca S. Marinos PhD, CNO ^a

^a Baylor Orthopedic and Spine Hospital at Arlington, Arlington, TX

^b Johns Hopkins University School of Public Health, Baltimore, MD

Key Words:

Spine surgery
 Perioperative nasal decolonization
 Alcohol-based nasal antiseptic
 Anterior nares
 Staff nasal decolonization

With the goal of reducing rates of surgical site infections in our spine patients, we initiated a trial to investigate the impact of adding perisurgical nasal decolonization involving patients and surgical and nursing staff. We combined immediate presurgical application of a nonantibiotic alcohol-based nasal antiseptic with existing chlorhexidine bath or wipes in a comprehensive pre- and postoperative decolonization protocol. Mean infection rates were significantly decreased by 81% from 1.76 to 0.33 per 100 surgeries during the 15-month trial, when compared with the prior 9-month baseline.

© 2021 The Author(s). Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc. This is an open access article under the CC BY-NC-ND license. (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Transient and sustained carriage of potentially pathogenic bacteria in the nasal vestibule, including both methicillin-susceptible *Staphylococcus aureus* and methicillin-resistant *S aureus* and coagulase-negative staphylococci, are recognized to contribute significantly to the risk of postsurgical infections.^{1,2} The reduction of nasal carriage using 5-day twice-daily topical antibiotic treatment (ie, mupirocin) as part of a protective bundle prior to surgery has been demonstrated in many studies to play a role in reducing surgical site infection (SSI) rates^{1,3} and has become standard practice in many facilities. However, screen and treat protocols are resource intensive, and universal antibiotic treatment, which has been shown to be more effective than screen and treat,⁴ is a challenge to antibiotic stewardship. The use of nonantibiotic antiseptic agents, including alcohol-based preparations, to achieve nasal decolonization of *S aureus* has been discussed recently with the suggestion that they might provide an effective and practical alternative to antibiotic treatment in patients.⁵

The antiseptic approach was selected by our hospital to address SSI rates that were above those desired, despite a regular regimen of preoperative chlorhexidine gluconate (CHG) bathing and wipes. With the goal of expanding the use of nasal decolonization to address

transmission risk that might be posed by nasal carriage in members of our perioperative staff,⁶ an alcohol-based antiseptic that had been demonstrated to be effective and acceptable for use by nursing and surgical staff was selected.⁷ This brief report describes the results from a trial carried out in our spine surgical group to determine if implementation of antiseptic nasal decolonization in patients and staff would be associated with a reduction in *Staphylococcus* spp SSI rates.

METHODS

Our facility is an orthopedic treatment and surgical center with 23 beds, primarily consisting of 1-bed rooms. All patients scheduled for spine surgery were included in the study. Records from 1,073 spine surgical patients undergoing inpatient or outpatient procedures (400 and 673 in the baseline and intervention periods, respectively) were compiled for this report. In the 9-month period prior to the change in our infection control (IC) policies and guidelines, the use of patient-administered nasal mupirocin during the preadmission period was irregularly used; in contrast, during this time, CHG bathing and surgical site decolonization with wipes preoperatively were carried out according to policy, and adherence was recorded.

The modified IC policies and guidelines in place during the trial retained prior CHG procedures. All use of mupirocin in the spine group was uniformly discontinued and replaced by the application of nasal antiseptic to the patient by trained preoperative staff

* Address correspondence to Anildaliz Mullen, RN, Baylor Orthopedic and Spine Hospital, 707 Highlander Blvd, Arlington, TX 76015.

E-mail address: amullen@uspi.com (A. Mullen).

Conflicts of interest: None to report.

prior to entering the operating room. Nasal decolonization was recorded in the patient chart. Voluntary self-decolonization by preoperative staff was actively encouraged and systematically recorded during the first 3 months of the trial. Adherence on a daily basis was calculated as the ratio of the number of affirming signatures to the number of scheduled nursing staff. During the surgical timeout between procedures, adherence of the surgical staff to the voluntary decolonization procedure was directly encouraged by the surgeon. After surgery, patients were expected to follow the regular 3 times daily cycle of staff-applied antiseptic application in the post-surgical units until discharge, at which time the patient and family-coach were instructed to continue applications for an additional 5-7 days with the remaining antiseptic. The antiseptic used for decolonization was the alcohol-based Nozin Nasal Sanitizer, which was provided at no cost for the first 3 months of the trial by the manufacturer, Global Life Technologies (Chevy Chase, MD). This over-the-counter nasal antiseptic has been used for >10 years and is available to the public. Cultures from all spine surgical patients readmitted for SSI, identified in accord with Centers for Disease Control and Prevention's National Healthcare Safety Network criteria for SSI classifications, were tested for methicillin-susceptible *S aureus* and methicillin-resistant *S aureus*. Because coagulase-negative staphylococcus is known to be carried in the anterior nares⁸ and has been demonstrated to contribute to spine SSIs,² the few infections in which coagulase-negative staphylococcus was the only isolate were included in the *S aureus* infection rate. Rates were calculated on a quarterly basis throughout the baseline and nasal intervention periods. Comparisons between baseline and intervention mean patient data and infection rates were made using a 2-tailed Student *t* test or, in instances of a failed normality test, the Wilcoxon-Mann-Whitney rank-sum test. A *P* value ≤ 0.05 was considered significant.

RESULTS

The characteristics of the baseline and intervention patient cohorts (Table 1) were comparable in the average numbers of quarterly surgeries, age, sex, and inpatient days.

In the baseline period (October 2014-June 2015), during which only CHG cleansing was standardly used, quarterly *S aureus* infection rates were 1.36, 2.38, and 1.55 per 100 surgeries. After the addition of the alcohol-based nasal antiseptic (July 2015-September 2016), quarterly infection rates were 0.83, 0.0, 0.81, 0.0, and 0.0 per 100 surgeries, respectively (Fig 1). This mean change from 1.76 to 0.33 infections per 100 surgeries in the 2 periods represented an 81.3% reduction from baseline, which was statistically significant ($P = .036$). Hospital records indicate that neither of the other 2 orthopedic surgical groups sharing use of these facilities experienced a decline in infection rates over the 2 periods corresponding to the trial.

Adherence rates for the treatment protocols are presented in Table 2. Self-applied and staff-applied CHG rates remained consistent

Table 1
Comparison of characteristics of surgical patients in baseline and infection control intervention cohorts

Patient cohort	No. of patients, mean per quarter	Year of age, median (range)	Sex, % male	Postoperative in patient days, mean (range)	Outpatients, % of total
Baseline					
October 1, 2014-June 30, 2015	133	61 (17-91)	49	2.2 (1-10)	33.4
Intervention					
July 1, 2015-September 30, 2016	135	62 (17-92)	48	2.1 (1-9)	21.4*

*Significantly different from baseline, 2-tailed Student's *t* test, $P = .031$.

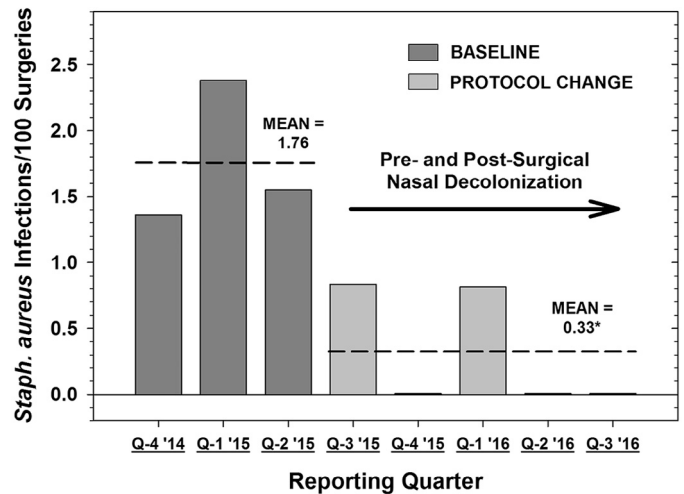


Fig 1. Infection rates prior to and after adoption of comprehensive alcohol-based nasal decolonization. Bars represent rates for successive quarters from October 1, 2014-September 30, 2016. *Staph.*, *Staphylococcus*; Q, quarter. *The 81.3% mean decrease in rate between baseline and intervention periods was statistically significant ($P = .036$).

across the baseline and trial periods, with a small (8%) increase in reported CHG wipes. Patient nasal decolonization rates were fairly well maintained, averaging 95% over the 15-month trial period. Systematic records of voluntary use were only kept for preoperative staff during the first 3 months of the trial. These showed a decrease in participation rates after the first month to 74% in the remainder of the quarter.

DISCUSSION

The adoption of protocols for patient and staff decolonization in the spine surgery group at our facility using an alcohol-based nasal antiseptic was associated with a substantial reduction in *S aureus* SSIs that was maintained over the subsequent 15-month intervention period. In 3 of the 5 treatment quarters, these SSI rates decreased to zero.

In some investigations, separating the relative contributions of patient skin and patient nasal decolonization to infection rate reduction is difficult to assess.^{9,10} In the case of the current study, standardized use of CHG was consistent during the baseline and intervention periods, and the only procedural change was the addition of patient and staff nasal decolonization. Furthermore, the reduction in *S aureus* SSIs observed in the spine surgical group during the intervention was not experienced by other groups at the facility during that time, suggesting that a facility-wide improvement in IC was not responsible. We believe that these 2 factors, in combination with the high level of staff adherence to patient decolonization maintained during the intervention period, suggest that the strength of the association between nasal antiseptic use and reduced infection rates is high.

The bundling of patient skin and nasal decolonization is known to be effective^{10,11} and maximizes risk reduction from the 80% of *S aureus* infections caused by self-inoculation.¹² To address the contribution to transmission that may be made by staff,¹³ voluntary nasal self-decolonization was instituted. Although adherence data for the first 3 months of the trial in preoperative nursing staff suggest the potential for their involvement in strategies to lower human bacterial burden, the data are insufficient to assess their contribution to the present results.

Table 2
Reported adherence to decolonization treatment protocols

Reporting quarter	Treatment adherence (%)					
	Patient			Preoperative staff		
	Preadmission CHG bath*	Preoperative CHG wipe†	Preoperative nasal decolonization‡	Daily nasal decolonization‡		
			July	August	September	
Baseline						
Q4 2014	96	84	—	—	—	—
Q1 2015	92	84	—	—	—	—
Q2 2015	92	88	—	—	—	—
Nasal protocol						
Q3 2015	96	96	99	94	71	77
Q4 2015	89	92	91	NR	NR	NR
Q1 2016	100	96	95	NR	NR	NR
Q2 2016	100	88	100	NR	NR	NR
Q3 2016	88	92	91	NR	NR	NR

CHG, chlorhexidine gluconate; NR, voluntarily self-administered, not reported; Q, quarter.

*Patient self-administered and reported at admission.

†Preoperative staff-administered in accordance with established infection control policies and guidelines and recorded.

‡Voluntarily self-administered, reported.

Study limitations

Our spine population was not sufficiently large to establish a concurrent control group, and a before-and-after intervention study design was adopted. Despite efforts to ensure that relevant nonintervention conditions remained as consistent as possible during baseline and trial periods, the inherent characteristics of this design limit the ability to establish the extent of the causal relationship between the treatment and the reduction in SSI rates. Reported compliance data for self-administered applications in both patients and staff are likely to reflect a positive bias. It is recognized that the protocols and results of this present small, single-center intervention may not be generalizable to larger facilities and may be most applicable to acute surgical facilities of similar focus, size, and activity.

CONCLUSIONS

After implementation of an alcohol-based antiseptic nasal decolonization program in patients and members of our hospital spine surgery group, *Staphylococcus* spp SSIs were significantly reduced from baseline over the subsequent 15-month period.

References

- Schweizer ML, Chiang HY, Septimus E, Moody J, Braun B, Hafner J, et al. Association of a bundled intervention with surgical site infections among patients undergoing cardiac, hip, or knee surgery. *JAMA* 2015;313:2162-71.
- Warner SJ, Uppstrom TJ, Miller AO, O'Brien ST, Salvatore CM, Widmann RF, et al. The epidemiology of deep surgical site infections after pediatric spinal fusion surgery. *Spine* 2016;doi:10.1097/BRS.0000000000001735.
- Thakkar V, Ghobrial GM, Mauluccia CM, Singhala S, Prasada SK, Harropa JS, et al. Nasal MRSA colonization: impact on surgical site infection following spine surgery. *Clin Neurol Neurosurg* 2014;125:94-7.
- Huang SS, Septimus E, Kleinman K, Moody J, Hickok J, Avery TR, et al. Targeted versus universal decolonization to prevent ICU infection. *N Engl J Med* 2013;368:2255-65.
- Septimus EJ, Schweizer ML. Decolonization in prevention of health care-associated infections. *Clin Microbiol Rev* 2016;29:201-22.
- Ilie-Turenne M-C, Fernandez H, Mediavilla JR, Rosenthal M, Mathema B, Singh A, et al. Prevalence and characteristics of *Staphylococcus aureus* colonization among healthcare professionals in an urban teaching hospital. *Infect Control Hosp Epidemiol* 2010;31:574-80.
- Steed LL, Costello J, Lohia S, Jones T, Spannhake EW, Nguyen S. Reduction of nasal *Staphylococcus aureus* carriage in health care professionals by treatment with a nonantibiotic, alcohol-based nasal antiseptic. *Am J Infect Control* 2014;46:841-6.
- Kaur DC, Narayan PA. Mupirocin resistance in nasal carriage of *Staphylococcus aureus* among healthcare workers of a tertiary care rural hospital. *Indian J Crit Care Med* 2014;18:716-21.
- Mehta S, Hadley S, Hutzler L, Slover J, Phillips M, Bosco JA. Impact of preoperative MRSA screening and decolonization on hospital-acquired MRSA burden. *Clin Orthop Relat Res* 2013;471:2367-71.
- Schweizer M, Perencevich E, McDanel J, Carson J, Formanek M, Hafner J, et al. Effectiveness of a bundled intervention of decolonization and prophylaxis to decrease Gram positive surgical site infections after cardiac or orthopedic surgery: systematic review and meta-analysis. *BMJ* 2013;346:f2743.
- George S, Leasure AR, Horstmanshof D. Effectiveness of decolonization with chlorhexidine and mupirocin in reducing surgical site infections: a systematic review. *Dimens Crit Care Nurs* 2016;35:204-22.
- Coates T, Bax R, Coates A. Nasal decolonization of *Staphylococcus aureus* with mupirocin: strengths, weaknesses and future prospects. *J Antimicrob Chemother* 2009;64:9-15.
- Cohen B, Hyman S, Rosenberg L, Larson E. Frequency of patient contact with health care personnel and visitors: implications for infection prevention. *Jt Comm J Qual Patient Saf* 2012;38:560-5.