



## Clinical Science

## The impact of surgical hand antisepsis technique on surgical site infection

Brad S. Oriel <sup>a, b</sup>, Qi Chen <sup>c</sup>, Kamal M.F. Itani <sup>a, d, e, \*</sup><sup>a</sup> Department of Surgery, VA Boston Healthcare System, 1400 VFW Parkway, West Roxbury, MA 02132, USA<sup>b</sup> Department of Surgery, Tufts University School of Medicine, 136 Harrison Avenue, Boston, MA 02110, USA<sup>c</sup> Center for Healthcare Organization and Implementation Research (CHOIR), VA Boston Healthcare System, 150 South Huntington Avenue, Building 9, Boston, MA 02130, USA<sup>d</sup> Department of Surgery, Boston University School of Medicine, 72 East Concord Street, Boston, MA 02118, USA<sup>e</sup> Department of Surgery, Harvard Medical School, 25 Shattuck Street, Boston, MA 02115, USA

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## ABSTRACT

**Background:** Limited evidence exists regarding the effect on superficial and deep incisional surgical site infections (SDSSIs) of alcohol-based hand rubs (ABR) versus traditional aqueous surgical scrubs (TSS). User preferences and practice are unknown.**Methods:** A retrospective cohort study examining SDSSIs using VA Surgical Quality Improvement Program cases before ABR implementation (2007–2009, TSS group) and after (2013–2014, ABR group). A descriptive survey.**Results:** SDSSI rates were 1.8% and 1.5% for TSS (n=4051) and ABR (n=2293), respectively (p=0.31). The adjusted odds of SDSSI using ABR was not significant (OR 0.82; 95% CI, 0.51–1.32). Greatest SDSSI risk was from preoperative radiotherapy (OR, 2.78; 95% CI, 1.14–6.78), general surgery (OR, 2.39; 95% CI, 1.30–4.39) and preoperative smoking (OR, 1.58; 95% CI, 1.02–2.44). Of 95 surveys included, 52% favored ABR. Although 95% self-reported correct product application, improper duration was revealed in both groups (TSS 18% and ABR 10%).**Conclusions:** Implementation of an ABR for use in surgical hand antisepsis did not alter SDSSI rates. Improving product knowledge and compliance may improve SSI rates.

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## 1. Introduction

Surgical Site Infection (SSI)-related morbidity, mortality and cost have been targeted by healthcare systems since the Deficit Reduction Act of 2005.<sup>1,2</sup> These infections account for over 20% of all healthcare-associated infections which affect 4% of hospitalized patients annually.<sup>3,4</sup> Factors which contribute to SSIs involve the patient, the operating room environment, equipment sterilization, surgical and aseptic technique and hand hygiene.<sup>5,6</sup>

To focus on hand hygiene, surgical hand antisepsis targets both transient and resident skin flora.<sup>7,8</sup> By reducing the microbial inoculum, it is assumed that SSI rates will be reduced. Although evidence exists that the degree of microbial inoculum correlates

with clinical outcomes, the precise relationship between the two remains elusive.<sup>9–11</sup> Most of the available literature uses surrogate endpoints rather than clinical outcomes to evaluate product effectiveness.<sup>6,7,11–15</sup> Studies evaluating SSI rates have, thus far, shown equivalence between alcohol-based hand rubs (ABR) and traditional aqueous surgical scrubs (TSS).<sup>16–19</sup> While the most recently published Centers for Disease Control and Prevention (CDC) guidelines for prevention of SSIs in 1999 do not recommend any agent over another, the World Health Organization renders preference to ABRs.<sup>6,7</sup>

From 2012 to 2014, the period following the addition of an ABR option for surgical hand antisepsis at our institution, we observed an increase in SSIs. This prompted us to remove the ABR from the operating room and to scientifically evaluate this relationship. We hypothesized that compared to TSS products alone, adding an ABR increases SSIs. In addition, we also sought to understand best practice techniques and preferences among personnel who practice surgical hand antisepsis.

\* Corresponding author. Department of Surgery, VA Boston Healthcare System, 1400 VFW Pkwy, West Roxbury, MA 02132, USA.

E-mail addresses: [brad.oriel@va.gov](mailto:brad.oriel@va.gov) (B.S. Oriel), [qi.chen2@va.gov](mailto:qi.chen2@va.gov) (Q. Chen), [kamal.itani@va.gov](mailto:kamal.itani@va.gov) (K.M.F. Itani).

## 2. Material and methods

### 2.1. Study design

This is a local Veterans Affairs (VA) retrospective cohort study using prospectively collected data. The study was approved and granted waiver of consent by the VA Boston Healthcare System (VABHS) institutional review board and local VA Research and Development Committee.

### 2.2. Study population

All patients identified in the VA Surgical Quality Improvement Program (VASQIP) database who underwent surgery at VABHS between January 1, 2007 and December 31, 2009 and between January 1, 2013 and December 31, 2014. All ophthalmic surgery and oral and maxillofacial surgery cases along with any case designated as contaminated or dirty were excluded. The earlier time period served as the baseline period and was naturally limited to only TSS (e.g., chlorhexidine gluconate 4% and povidone-iodine 13%). The later time period corresponded to the study group during which an ABR (ethyl alcohol 70%) was incorporated as an alternative to TSS. The exclusion of the interval spanning January 1, 2010 to December 31, 2012 is explained by the intermittent availability of an ABR beginning in 2010 at VABHS with full institution occurring in February 1, 2012. This eliminated the unpredictable availability of an ABR between January 1, 2010 and February 1, 2012 and allowed through the end of December 2012 for users to acclimate to the new product.

### 2.3. Study database

VASQIP has been previously described.<sup>20</sup> In brief, it analyzes risk-adjusted 30-day morbidity and mortality data within the VA. It tracks demographic, preoperative risk and laboratory data, operative data and 30-day postoperative mortality and defined morbidity outcomes in select patients undergoing major surgery. The information is prospectively abstracted by a nurse reviewer trained in clinical medicine and quality assurance. The reviewer uses standard CDC National Healthcare Safety Network definitions of operative procedure category and SSIs to ensure data reliability.

### 2.4. Statistical analysis

The cases (ABR + TSS group) and controls (TSS group) were compared between categories of patient characteristics, intraoperative and outcomes variables using either the *t*- or  $\chi^2$ -test. A composite SSI outcome variable, "SDSSI," was created by combining superficial and deep incisional SSIs.

The unadjusted odds of developing an SDSSI related to patient and operative characteristics known to be predictive of SSI including ABR, sex, age, body mass index (BMI), race, diabetes, chronic obstructive pulmonary disease (COPD), dyspnea, congestive heart failure, alcohol use, preoperative smoking status, acute renal failure, dialysis, preoperative radiotherapy, steroid use, preoperative serum albumin, preoperative serum total bilirubin, preoperative transfusion >4 units packed red blood cells (PRBC), preoperative open wound, preoperative sepsis, surgical specialty, American Society of Anesthesiologists (ASA) classification, emergent surgery, wound classification, intraoperative transfusion, operation duration, work relative value unit (RVU) and total hospital length of stay were calculated.<sup>21</sup> Compliance with SSI Surgical Care Improvement Project measures during both time periods as evaluated on a quarterly basis by the Veteran Health Administration External Peer Review Program varied between 97% and 100% for VABHS.

The adjusted odds of developing an SDSSI related to ABR implementation was subsequently calculated using a multivariate regression model, adjusting for significant covariates from our univariate analysis. Additionally, ABR implementation and ASA classification 3 were forced into the model secondary to clinical relevance.

Quarterly SDSSI rates over time were compared. Also, a within-group analysis was performed for the ABR + TSS period comparing quarters of high versus low SDSSI rates based on patient, intraoperative and postoperative characteristics. Lastly, patients from both TSS and ABR + TSS were selected using significant variables obtained from the within-group analysis and SDSSI rates were compared. All comparisons utilized either the *t*- or  $\chi^2$ -test. All analyses were completed using SAS v9.2 (SAS Institute Inc) with  $\alpha = .05$ .

### 2.5. Survey

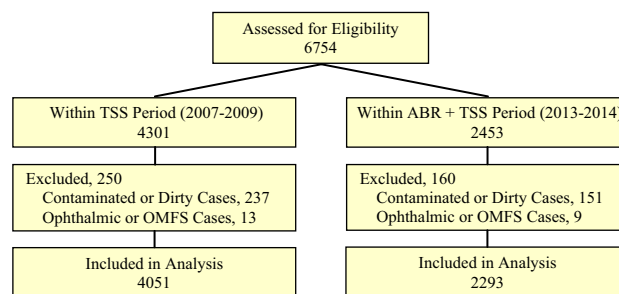
One-hundred thirty-one anonymous paper surveys were distributed to all surgical and operating room personnel who perform surgical hand antisepsis at either of two campuses within VABHS. Participants represented all surgical specialties. The survey assessed product preference, product-specific patterns of use, surgical hand antisepsis education and product knowledge. Descriptive statistics were utilized as well as the  $\chi^2$ -test for user-specific comparisons.

## 3. Results

### 3.1. Retrospective cohort

Of 6,754 VASQIP cases transmitted within the pre-defined time periods, 6,344 (93.9%) met inclusion criteria: 4,051 TSS and 2,293 ABR + TSS (Figure 1). The characteristics of patients before (TSS period) and after the introduction of ABR (ABR + TSS period) are shown in Table 1. SDSSI rates for TSS and ABR + TSS were 1.8% and 1.5%, respectively ( $P = 0.31$ ; Table 2).

Univariate analysis found the following variables to be significantly associated with a higher SDSSI rate: preoperative smoking (odds ratio [OR], 1.89; 95% confidence interval [CI], 1.29-2.76), preoperative radiotherapy (OR, 7.48; 95% CI, 3.50-15.99), preoperative transfusion (OR, 13.06; 95% CI, 2.79-61.15), preoperative open wound (OR, 2.63; 95% CI, 1.39-4.96), general surgery (OR, 1.95; 95% CI, 1.31-2.91), otolaryngology (2.46; 95% CI, 1.30-4.64), vascular (OR, 1.90; 95% CI, 1.21-2.99), ASA classification > 3 (OR, 2.86; 95% CI, 1.83-4.48), emergent surgery (OR, 3.18; 95% CI, 1.52-6.65), clean contaminated wound classification (OR, 2.31; 95% CI, 1.58-3.39), intraoperative PRBC transfusion (OR, 1.08; 95% CI, 1.03-1.13), operative duration (OR, 1.34; 95% CI, 1.27-1.42), work RVU (OR, 1.07; 95%



**Fig. 1. Study Population (n) in Two Time Periods.** Abbreviations: TSS traditional aqueous surgical scrub, ABR alcohol-based hand rub, OMFS oral and maxillofacial surgery.

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