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Supporting Antibiotic Stewardship Through Effective Nasal Decolonization

Introduction

In the United States, there are up to 500,000 cases of surgical site infections (SSIs) per year[1], corresponding to around 2% of all surgical procedures[2]. *S. aureus* is the most common cause of SSIs, and is responsible for 30.4% of infections. Of these, a substantial proportion (43.7%) are caused by methicillin-resistant *S. aureus* (MRSA).[3]

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Overall, *S. aureus* SSIs result in considerable morbidity and mortality,[4] incurring an estimated 2.7 million additional days in hospital and causing around 12,000 inpatient deaths per year in the US.[5] *S. aureus* infection is also associated with sizable healthcare costs; a single MRSA SSI incurs a US hospital cost of around $118,500.[6]

In 2003, the total economic burden of *S. aureus* infection was estimated to be $14.5 billion for all inpatient stays and $12.3 billion for surgical patient stays.[5] The situation is similar in other countries with extensive surveillance data: individual patients incur hospital stays that are extended by 10 days, on average, in the United Kingdom.[7] The risk of surgical site infection is in part a function of the type of surgery, and throughout Europe infection rates are similar for various types of surgeries.[7]

Reducing SSI risk

The human body is a reservoir for *S. aureus*. Approximately 30% of healthy adults are carriers.[4,9,10] *S. aureus* carriers are two to nine times as likely as non-carriers to develop SSIs, suggesting that the majority of infections are caused by a patient's endogenous bacteria, including *S. aureus*.[11,12] Therefore, effective control of *S. aureus* colonization prior to surgery is an important step in reducing the SSI risk associated with *S. aureus* carriage.

The anterior nare is recognized as an anatomical niche for *S. aureus*[13] —an environment with its own unique physiology and bacterial ecosystem.[14] Currently, the standard choice for nasal *S. aureus* decolonization prior to surgery is intra-nasal mupirocin (an antibiotic), applied twice-daily for 5 days prior to surgery.[15] A number of studies have shown intra-nasally applied mupirocin to reduce the proportion of procedures resulting in SSIs,[16,17] with one study reporting a reduction of 94% in patients undergoing gastrointestinal surgery.[18] However, other randomized controlled trials have failed to show a significant reduction in infection rates.[19-21]

Nasal *S. aureus* decolonization with mupirocin is associated with drawbacks. The regimen is typically applied twice-daily over a five day period, so patient compliance can be an issue. One study found overall compliance with a mupirocin regimen to be 83%, with only 39% of those patients being fully compliant.[22] Furthermore, because the financial responsibility to purchase mupirocin in the US generally falls on the patient, a number of patients may be unable to afford treatment; one study reported that 13% of patients found it hard or very hard to buy mupirocin ointment due to cost.[23]

Another concern regarding treatment with mupirocin is increasing antibiotic resistance. Not only are resistant strains of *S. aureus* harder to treat, mupirocin usage also provides selective pressure, increasing the level of colonization with resistant *S. aureus*.[24] A study in a Swiss hospital reported that a policy of decolonizing MRSA carriers with mupirocin coincided with the proportion of MRSA isolates showing mupirocin resistance increasing from 0% in 1999 to 95% in 2005.[25] Similarly, increasing short-term use of mupirocin for perioperative *S. aureus* decolonization was associated with a rise in high-level mupirocin resistance in a Dutch hospital.[26]

These limitations have led to the exploration of alternatives for reducing the risk of *S. aureus* SSIs. 3M™ Skin and Nasal Antiseptic (Povidone-Iodine Solution 5% w/w [0.5% available iodine] USP) Patient Preoperative Skin Preparation, has been available since 2010 as a topical antiseptic approach to help reduce the risk of *S. aureus* SSIs, providing an alternative to nasal decolonization with mupirocin. This solution has been specifically formulated to reduce bioburden in the unique environment of the nares, and the efficacy of this particular preparation has been widely studied.[27-31] The regimen involves a one-time application of 5% povidone-iodine solution to the anterior nares prior to a surgical procedure, and reduces nasal *S. aureus* colonization for at least 12 hours.[14]

A summary of clinical evidence

The following pages present some examples of the clinical evidence and findings on 3M™ Skin & Nasal Antiseptic that demonstrate its efficacy, cost effectiveness and overall performance.

Efficacy

In a randomized controlled study in arthroplasty or spine fusion surgery, Phillips et al. (2014), showed that the 3M™ Skin and Nasal Antiseptic solution regimen was associated with fewer *S. aureus* SSIs. Mupirocin was applied twice daily for five days before surgery and 3M™ Skin and Nasal Antiseptic was given as a one-time application within 2 hours of surgical incision. Both arms of the study included 2% chlorhexidine gluconate (CHG) wipes. The primary endpoint was surgical site infection within 3 months of surgery. The study found a reduced rate of deep SSI with 3M™ Skin and Nasal used in the per protocol group. The authors concluded nasal povidone iodine may be considered an alternative prophylactic agent to mupirocin in a comprehensive approach to reduce SSIs. In addition, the authors discussed, when compared to mupirocin, 3M™ Skin and Nasal Antiseptic provides more value, defined by quality of outcomes divided by cost. The following charts summarize the infection rates from the study.[27]

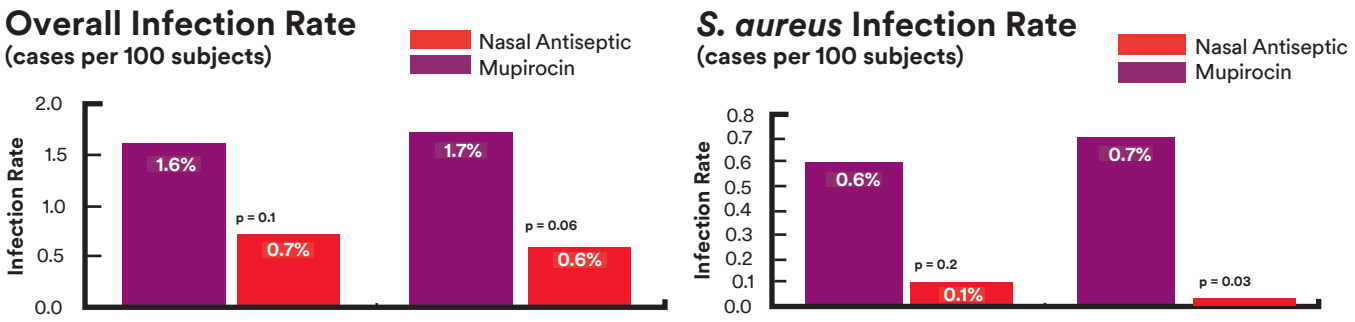
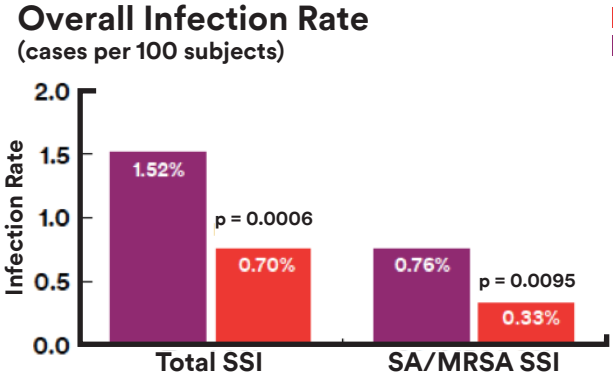


Chart reference: Phillips M, Rosenberg A, Shopsin B, et al. Preventing surgical site infections: A randomized, open-label trial of nasal mupirocinointment and nasal povidone-iodine solution. Infect Control Hosp Epidemiol. 2014;35(7):826-832.

Bebko et al. (2015), published a study examining the effects of a universal MRSA decontamination protocol on SSIs in patients undergoing orthopaedic surgery with hardware implantation. Here, 3M™ Skin and Nasal Antiseptic, when applied as part of a decontamination protocol (also including application of 2% CHG wipes, and 0.12% CHG oral rinse the night before and morning of surgery), was associated with a 71.1% reduction in SSIs compared to control. The study also reported an improved decontamination protocol adherence over mupirocin with a 100% compliance rate.[28]

In a before/after trial in hip and knee replacements, the post-intervention period infection rate was significantly lower when compared to the control. The intervention included nasal decolonization with 3M™ Skin and Nasal Antiseptic on the day of surgery and bathing with CHG soap 3 days prior to surgery. The control group did not include nasal decolonization but was encouraged to bathe with antibacterial soap 2 days prior to surgery. The chart below summarizes the SSI results from the study.[33]



Total 8,961 participants: 2,507 in the control group and 6,454 in the intervention group.

The total SSI rate was significantly lower in the intervention group (0.70/100 procedures than in the control group (1.52/100 procedures); (p=0.0006).

The total SA/MRSA SSI rate was significantly lower in the intervention group (0.33/100 procedures) than in the control group (0.76/100 procedures); (p=0.0095).

Chart reference:
Rivera K, Smith R, Hardenstine H, Rose L, Snedeker L, Wolfgang J. Implementation of a total joint replacement pre-operative skin and nasal decolonization process for the reduction of *Staphylococcus aureus* (SA) and methicillin resistant *Staphylococcus aureus* (MRSA) infection. Presented at the APIC National Conference, Charlotte, NC, June 2016.

As part of a larger best practice effort, the number of total hip arthroplasty (THA) and total knee arthroplasty (TKA) SSIs was reduced to zero in the seven months following implementation of a best practice bundle, which included:

- 2% CHG cloths the night before and morning of surgery
- 3M™ Skin and Nasal Antiseptic applied in preop holding
- Patient warming 30 minutes preop and during surgery using 3M™ Bair Hugger™ warming gown system
- Antibiotic infusion completed 10 minutes prior to incision
- Team huddle prior to patient entry into OR to review completion of checklist and coordination of start time for opening of instruments[34]

Cost effectiveness

Conducted by Torres et al. (2016), a retrospective study in total knee and hip arthroplasty investigated the incidence of SSIs and cost-effectiveness of universal application of 3M™ Skin and Nasal Antiseptic versus MRSA screening followed by treatment of carriers with mupirocin. The authors concluded the new protocol strategy to be significantly less expensive with no difference in infection rates. The new protocol does not rely on patient compliance and eliminates the risk of mupirocin resistance.[29]

Further cost/value analysis was shown by Osborn et al. (2015), who experienced a 61% reduction in neurosurgery spinal fusion infections, resulting in a cost savings of $228,635 within 12 months.[35] Additional exploration of the use of 3M™ Skin and Nasal Antiseptic in total joint arthroplasty and realignment of previous lean process improvements by Waibel (2013), showed the readmission cost avoidance was $62,302 based on the actual cost of MRSA SSI readmissions in the six months prior to the product trial.[36]

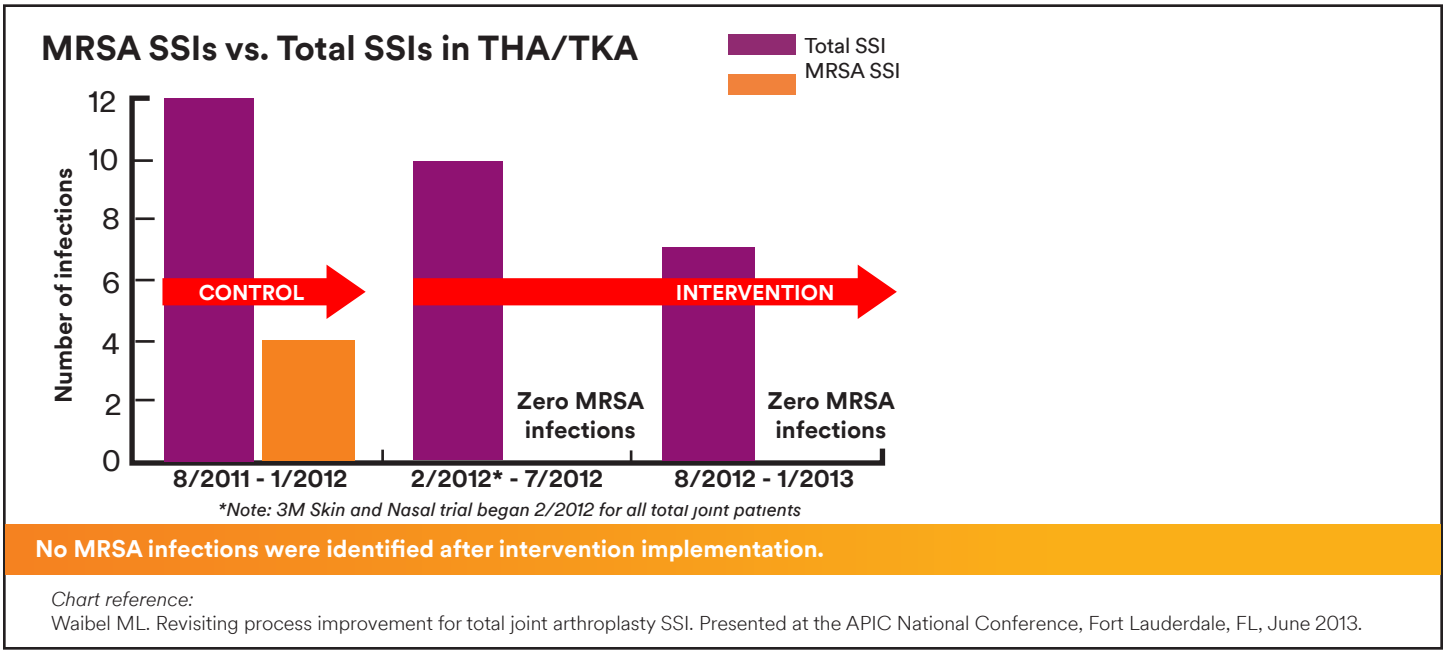


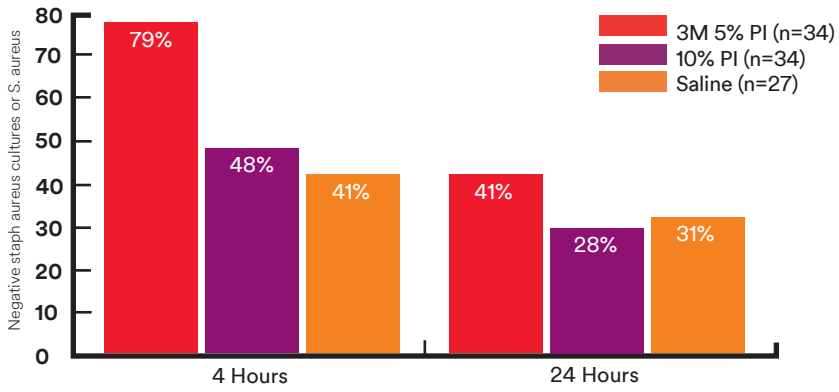
Chart reference:
Waibel ML. Revisiting process improvement for total joint arthroplasty SSI. Presented at the APIC National Conference, Fort Lauderdale, FL, June 2013.

Overall performance of 3M™ Skin & Nasal Antiseptic versus other methods

When compared to other products currently in the market, 3M™ Skin & Nasal Antiseptic proved to be significantlymore effective than both Clorox Healthcare™ Nasal Antiseptic Swabs (Medline Industries) and Betadine®, against MRSAand high-level mupirocin-resistant MRSA in an ex vivo porcine mucosal tissue model. After 6 and 24 hours following treatment, 3M™ Skin and Nasal Antiseptic showed significantly better antiseptic activity than Clorox Healthcare Nasal Antiseptic Swabs or Betadine.[37]

A randomized, placebo-controlled study compared the efficacy of two povidone-iodine based products and saline on nasal decolonisation of *S. aureus* in patients undergoing orthopaedic procedures. The study reported 3M™ Skin and Nasal Antiseptic was significantly more effective at decolonizing *S. aureus* over the 4-hour time interval (p=.003) with no significant difference observed over the 24-hour time interval. The study concluded a single one-time application of the 3M™ Skin & Nasal Antiseptic may be effective at eliminating nasal *S. aureus* in over two-thirds of patients. The negative nasal *S. aureus* culture results are summarized below.[31]

Negative Nasal *S. aureus* Cultures Post Treatment



429 patients were randomized, of which 95 (22.1%) were positive at baseline for S. aureus and 13.6% of these were MRSA. 3M™ Skin and Nasal Antiseptic demonstrated significantly more effective intranasal decolonization of *S. aureus* over the 4-hour timeframe (p=0.003).

At 4 hours...

79%

of 3M™ Skin and Nasal Antiseptic patients had negative *S. aureus* culture,

but only

48%

of 10% Povidone Iodine patients had negative *S. aureus* culture.

The ease of incorporating effective nasal decolonization into the preoperative protocol is an important consideration when selecting which method and product to use. 3M™ Skin & Nasal Antiseptic is a one-time application done the hour prior to surgery resulting in a 99.5% reduction in *S. aureus*.[32] Study results have demonstrated SSI reduction rates using this simple one-time preop application as part of an SSI reduction bundle.[30] Compare this to an alcohol-based product (Nozin® Nasal Sanitizer) with an 82% reduction in *S. aureus*.[38] This product requires multiple applications pre-operatively, post-operatively, and continuing after discharge for a total 5-7 day regimen to help reduce SSI rates.[39]

Conclusion

Reducing *S. aureus* in the nares can help reduce the risk of SSI, when used as part of a comprehensive preoperative protocol. 3M™ Skin and Nasal Antiseptic is a simple solution to address nasal colonization of *S. aureus* and the clinical evidence is continuing to mount for this safe and effective approach.

3M Medical Solutions Division strives to help health care providers reduce the risk of SSIs and other hospital acquired infections through innovative, clinically proven infection prevention solutions. With its system of people, products and processes, 3M remains a trusted resource, committed to helping health care facilities reduce the risk of infections, improve patient outcomes, and control their bottom lines.

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With 3M™ Skin and Nasal Antiseptic, you can make a change that makes a real difference. To request a sample, visit **go.3M.com/TakeControl**.

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