Looking Forward—Infection Prevention in 2016

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It is not a surprise to those who strive for safe patient care that both large and small changes can lead to sustainable results in preventing health care–associated infections (HAIs). When looking forward to supporting efforts to prevent surgical site infections (SSIs) in future years, health care providers must make informed decisions about what to do next. The following large, small, promising, and established interventions for preventing HAIs are best served by ongoing collaboration among perioperative professionals and infection preventionists.

NASAL ANTISEPSIS BEFORE SURGERY

According to the Centers for Disease Control and Prevention (CDC), *Staphylococcus aureus* colonizes the nose of approximately one-third of the general population.[1] Most are colonized with methicillin-sensitive *Staphylococcus aureus* (MSSA), yet a significant minority are colonized with methicillin-resistant *S aureus* (MRSA).

Regardless of strain or resistance, colonization with *S aureus* can contribute to the risk of acquiring an SSI for certain surgeries, notably those involving implants. A 2013 meta-analysis[2] confirmed the risk between nasal carriage and SSIs in orthopedic surgeries involving hardware, and similar findings have been reported after cardiac surgery and other surgeries in general. Given this risk, it is not surprising that perioperative professionals and infection preventionists continue to seek strategies to reduce the risks related to *S aureus* colonization. The results of recent studies suggest that improved outcomes can be achieved for patients undergoing cardiac, orthopedic, and neurosurgery procedures who are colonized with MRSA and MSSA when skin and nasal decolonization are completed before surgery.[3-6]

MRSA/MSSA Decolonization Protocols

Many facilities have instituted preoperative MRSA/MSSA decolonization protocols for procedures or patient types identified as being at higher risk for postoperative *S aureus* infections. Based on the facility's risk assessment, this may include patients known to be, or at risk for being, colonized with MRSA, those undergoing procedures involving implants (orthopedic or cardiac), or those who are otherwise at higher risk for postoperative infection. Preoperative MRSA/MSSA decolonization protocols are unique to each facility and are determined by each facility based on the manufacturer's instructions for use but usually begin with a screening test to identify nasal colonization. After a patient has been identified as being positive for MRSA or MSSA colonization, the clinician should instruct the patient on how to complete a decolonization process during the week before surgery. This may include a schedule of skin cleansing with a chlorhexidine gluconate (CHG) antiseptic during a five-day antimicrobial nasal treatment using intranasal mupirocin ointment.[6] The entire process starting from collection of the nasal specimen to the conclusion of decolonization takes a minimum of six to seven days. The nasal screening specimen may be obtained at the time of presurgical testing in the surgeon's or primary care physician's office or at an outpatient laboratory. The screening results typically are available within 24 hours for the polymerase chain reaction (PCR) test and within up to 72 hours for a culture-based test.

A positive result triggers the decolonization process. This includes

- providing the patient with a prescription for nasal mupirocin, which the patient needs to purchase;
- ensuring that the patient has a CHG-based antiseptic skin cleanser, which can be provided by the clinician or the health care facility or purchased by the patient; and
- giving the patient verbal and written instructions that describe how to

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- apply the mupirocin in the nose per product instructions for the prescribed duration and
- complete the preoperative CHG skin antiseptic application at home as required before surgery per facility protocol.

Each step involves additional time, expense, and patient compliance in an unsupervised setting— the patient's home or residence.

Mupirocin Resistance

The nasal antimicrobial product that is typically used in MRSA decolonization protocols in the United States is mupirocin. As with any antimicrobial, development of resistance is a concern. Studies have demonstrated that mupirocin resistance can develop in up to 10% of the staphylococcal isolates in these patient populations over any given period of use.[7-9] The resistance may be either low or high level, yet either could negatively affect efficacy and put the patient at risk for recolonization with the resistant strain.[10]

Barriers to Compliance

The effectiveness of MRSA or MSSA decolonization is adversely affected by nonadherence to the bundle of steps in the protocol or process. In fact, various studies have found that compliance with the fairly complex decolonization bundles is low.[11,12]

Elective surgeries cannot always be scheduled far enough ahead to allow for completing the entire decolonization protocol. Patients may have difficulty obtaining the prescribed nasal antimicrobial product and the CHG-based antiseptic skin cleanser product in time to complete the process if the elective surgery is scheduled sooner rather than later. Cost also may be a contributing factor in a lack of follow-through because the purchase of the skin antiseptic and mupirocin nasal ointment may amount to $60 to $150 in out-of-pocket expenses. A screening MRSA/MSSA PCR test or culture may not be reimbursable and therefore could be an additional expense for the patient. Any and all of these factors may decrease compliance with the decolonization bundle in elective surgeries.

Although instructions for the application of skin antisepsis are moderately easy to follow, certain situations (eg, impaired mobility, obesity, hygiene issues) may further complicate the process. Self-application of the nasal mupirocin may be performed incorrectly, and timing or missed doses can hinder the outcomes. In some compliance studies,[11,12] as many as one-third of the patients had difficulty recalling whether they completed the treatment and/or understanding the process. Furthermore, some of the patients indicated lack of compliance because they felt that applying the mupirocin intranasally was an unpleasant experience.[13]

Preoperative Nasal Antisepsis

Current decolonization strategies are challenging for health care providers and facility managers to implement and maintain.

Patients find the at-home processes to be confusing or cumbersome, difficult to comply with, financially challenging, and potentially uncomfortable.

Alternative strategies for nasal antisepsis may simplify the process for patients and standardize application by trained health care providers instead of requiring patients to perform the antisepsis process unassisted, thus improving compliance overall and resulting in improved outcomes for patients.

Pursuant to a patient population and surgery-related infection control risk assessment, the following steps may remain appropriate to the preoperative strategy:

- Providing preoperative showering or bathing instructions for patients undergoing elective surgery.
- Testing high-risk patients or patient undergoing specific surgical procedures for methicillin-resistant *Staphylococcus aureus* and methicillin-sensitive *Staphylococcus aureus* to optimize preoperative antibiotic choice.

Alternative MRSA/MSSA Decolonization Strategy

Successful implementation of a decolonization process to ensure that patients undergoing specific surgeries (eg, those involving implants) will undergo testing, be compliant in obtaining and using the bundled treatments, and correctly administer the treatments in the prescribed time frame before surgery is complex. As a result, alternative strategies for achieving MRSA/MSSA decolonization in the at-risk population are desirable.[14]

Fortunately, some strategies and products may help simplify this process. Recently, compliance and outcome studies have been published related to these alternative processes.[15-17] Performing nasal antisepsis with a povidone-iodine product immediately before surgery has numerous benefits.

- Suppression or eradication of nasal bacteria before the surgical incision is an important risk-reduction strategy for SSI

prevention. A recent head-to-head trial that investigated bacterial suppression and infection outcomes related to use of nasal povidone-iodine in one preoperative group and mupirocin in a similar preoperative group demonstrated similar efficacy of nasal povidone-iodine as compared with mupirocin treatment.[15]

- The ability to control the nasal antisepsis process by having perioperative personnel perform it within 60 to 90 minutes before surgery reduces application and compliance variabilities that result when nasal decolonization is performed by the patient at home.
- The opportunity for a health care provider to review information regarding this risk-reduction strategy at the time of nasal application is a bonus and often overcomes the patient's concern related to any discomfort that may accompany the nasal application.
- Although a MRSA/MSSA screening test may be part of a decolonization bundle related to use of the nasal povidone-iodine antiseptic product, it is not required. Suppression of nasal MRSA/MSSA occurs in the surgical time frame but is not meant to achieve longer-term decolonization. Note that MRSA screening may still be indicated for preoperative patients to validate the choice of preoperative antibiotic prophylaxis and if a patient's physician has determined that decolonization versus preoperative antisepsis is appropriate for that patient.
- Nasal povidone-iodine may be better tolerated than mupirocin. According to a study by Maslow et al,[13] 3.4% of the patients surveyed reported an unpleasant smell after povidone-iodine application, compared with 38.8% of those using nasal mupirocin. Options for preoperative antiseptic showering or bathing, although separate from the protocol for using nasal povidone-iodine for nasal antisepsis, may still be required or recommended, depending on the surgeon's preferences or facility protocols.

There are other related antiseptic and antimicrobial strategies that warrant scrutiny. Additional research into alternate nasal decolonization options, including photodisinfection and nasal antisepsis with alcohol-based products, is underway.[16,17]

ANTIMICROBIAL STEWARDSHIP

Many professional organizations, government agencies, presidential committees, and industry champions have come together in the past few years to make addressing antimicrobial resistance a national priority. According to the September 2014 Report to the President on Combating Antibiotic Resistance:

> *antibiotic stewardship refers to systematic efforts to optimize the use of antibiotics — not just reduce the total volume used — in order to maximize their benefits to patients, while minimizing both the rise of antibiotic resistance as well as adverse effects to patients from unnecessary antibiotic therapy. Stewardship involves identifying the microbe responsible for disease; selecting the appropriate antibiotic, dosing, route, and duration of antibiotic therapy; and discontinuing antibiotics when they are no longer needed. Antibiotic stewardship programs have been shown clearly to reduce the percentage of antibiotic-resistant organisms in a facility, reduce the occurrence of* C difficile *infections, improve patient outcomes, decrease toxicity, and reduce pharmacy costs.*[18(p42)]

Preventing and treating infectious complications using antimicrobial agents has had a major effect in all clinical areas, including surgery and intensive care medicine.[19] The misuse of antimicrobials, however, threatens to undermine the advantages that antimicrobials have provided in the past century. Antimicrobial stewardship programs are imperative in health care facilities. This program should

- be multidisciplinary, involving all key stakeholders;
- provide a formulary that is limited to nonduplicative antibiotics with demonstrated clinical need; and
- institute evidence-based guidelines for the management of infection-prone complications.

Antimicrobial stewardship precepts are relevant to surgical antibiotic prophylaxis and prevention of SSIs. It is incumbent on surgeons, physicians, and other prescribing health care providers to ensure that their antimicrobial prescribing practices are consistent with the tenets of antimicrobial stewardship and appropriateness to desired patient outcomes.

WOUND EDGE PROTECTORS

Wound edge protectors are reported to reduce the rate of SSIs in a variety of procedures, including open abdominal, urology, and orthopedic surgeries.[20-24] These devices have been used in surgery for more than 40 years to reduce SSIs, although it should be noted that a recent study suggested the need for additional large, high-quality, randomized controlled trials to substantiate the use of wound edge protectors.[25]

The most common pathogens reported to cause postoperative SSIs are normal skin flora.[26] Wound edge protectors are designed to protect the wound edges from skin flora contamination, other contamination (eg, bowel contents), and trauma during surgery, consequently reducing the risk of SSIs. Surgical site infections continue to be one of the most frequent complications after surgery and substantially increase costs, morbidity, and mortality. A wound protector,

therefore, is one tool to consider when designing surgical infection prevention programs.

Single-ring wound protector devices have been available since the 1960s. Dual-ring protectors are a more recent design, available since 2002. The comparative evidence of efficacy for dual- versus single-ring protectors in lowering the risk of SSIs, however, is lacking. The average cost of a superficial surgical wound infection is estimated to be $20,000.[27] This can justify the cost of using a disposable product such as a wound edge protector.

WOUND CLOSURE AND POSTOPERATIVE DRESSINGS

Although there are standard guidelines for many surgical infection prevention products and practices, a standard guideline for surgical wound closure or postoperative wound dressings is not currently available. Numerous wound closure and dressing products are designed to reduce the risk of SSIs, including antimicrobial-impregnated (eg, triclosan-impregnated) sutures.[28]

The quality of evidence for skin glue, another wound closure device suggested to reduce the risk of SSIs, is growing, supported by clinical research.[29] The supporting theoretical rationale for use of skin glue on an incision or over staples is that it creates a closed aseptic wound until the skin begins to heal, providing a natural barrier to bacteria.

Postoperative wound dressings designed to reduce the risk of SSIs include negative pressure dressings. Procedures studied to investigate the efficacy of this type of dressing include sternotomy, cesarean delivery in obese women, and open reduction internal fixation of high-risk lower extremity fractures. These studies indicated there is SSI risk benefit with the use of negative pressure dressings.[30-32] In addition, a variety of antimicrobial-impregnated postoperative dressings are available, including those impregnated with silver and polyhexamethylene biguanide (PHMB), a derivative of CHG.[33] Additional studies are needed to provide higher-quality evidence to support their use.

GUIDELINES FOR TEMPERATURE AND HUMIDITY

Regulatory bodies have cited many institutions for issues related to temperature and humidity in ORs and sterile processing areas. The effects of temperature and humidity on patient outcomes are less clear. The following facts are known:

- for certain procedures, low patient core temperatures have been associated with an increased likelihood of SSIs,[34,35]
- extremely hot ORs may cause sweating by the surgical team and perspiration may contaminate sterile items or the sterile field,
- extremely low humidity and flammable gases have been associated with an increased risk of fire,[36]
- extremely high humidity for prolonged periods has been linked to increased fungal growth,[37]
- certain key items such as rapid biological indicators do not operate consistently when used in climate conditions outside those delineated in the manufacturer's instructions for use,[38] and
- climactic variation between hot items being moved from a sterilizer and the outside area may lead to "wet loads."[39]

The guidelines for optimal temperature and humidity from the Association for the Advancement of Medical Instrumentation (AAMI),[39] AORN,[40] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE),[41] Facility Guidelines Institute (FGI),[42] and others are not harmonized. The reason for this relates to the different foci: ASHRAE and FGI on building design, and AAMI and AORN on daily clinical operations. In addition, the guidelines consist predominantly of expert opinion or other guideline references rather than high-level scientific studies or evidence. These organizations have begun to work together to harmonize their guidelines and have released joint interim guidance for heating, ventilation, and air conditioning (HVAC) in the OR and sterile processing department.[43] Every health care organization that provides surgical services should evaluate and determine the HVAC operating parameters that meet their patient, personnel, and product storage needs for ORs, the sterile processing department, endoscopy suites, and sterile storage rooms.

Guidelines for Optimal Temperature and Humidity

Association for the Advancement of Medical Instrumentation (AAMI)

http://www.aami.org

Association of Perioperative Registered Nurses (AORN)

https://www.aorn.org

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

https://www.ashrae.org

Facility Guidelines Institute (FGI)

http://www.fgiguidelines.org

Pulling together a multidisciplinary team to review the current HVAC operating practices and performing a risk assessment of the affected area(s) is a good first step. The team should enter the values and parameters they will follow on a day-to-day basis into their organization's HVAC system policy, along with appropriate corrective measures to mitigate risk and restore the HVAC system to the desired parameters when conditions fall outside of those values. The team should identify medical products and devices that require tightly controlled storage conditions and move those products to a location where the humidity and temperature are maintained within the manufacturer-prescribed parameters (eg, a temperature- and humidity-controlled cabinet).

COLLABORATION BETWEEN PERIOPERATIVE PROFESSIONALS AND INFECTION PREVENTIONISTS

Professionals from perioperative services and the infection prevention department need to come to consensus regarding surgical results and outcomes. Methods, scope of surveillance and improvement activities, and regulatory mandates may be somewhat different (eg, specifics of the National Healthcare Safety Network criteria for mandated SSI reporting to the Centers for Medicare & Medicaid Services [CMS]) but overlap and merge at the juncture of patient safety and patient outcomes. One solid way to make sure that all players understand and act in concert in their efforts to achieve these goals is to actively seek out and participate in joint ventures. The infection control committee and teams will always benefit if surgical professionals are active members.

New processes or products, procedures, and identified areas of improvement in surgical settings are well served when, as part of a needs assessment (eg, surveillance, HAI evaluation), all team members understand the current state versus the desired state. Then and only then can the team members identify and implement informed improvement initiatives that include collaboration on infection prevention risk assessment. The synergy that results from professional collaboration is key to a joint view of success in preventing avoidable harm to each and every patient.

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