The most common pathogens in surgical site infections after total hip and knee arthroplasty are methicillin-sensitive Staphylococcus aureus (MSSA), methicillin-resistant S. aureus (MRSA), and coagulase-negative staphylococci.

Patients colonized with MSSA or MRSA have an increased risk for a staphylococcal infection at the site of a total hip or knee arthroplasty.

Most colonized individuals who develop a staphylococcal infection at the site of a total hip or total knee arthroplasty have molecularly identical S. aureus isolates in their nares and wounds.

Screening and nasal decolonization of S. aureus can potentially reduce the rates of staphylococcal surgical site infection after total hip and total knee arthroplasty.
and clinical burden of infection after total hip and knee arthroplasty. Preoperative risk modification, perioperative antibiotic administration, intraoperative reduction of airborne colony-forming units (laminar flow, body exhaust suits, and reduced operating-room traffic), and surface sterilization (adhesive drapes and alcohol-based skin preparation) should all be considered part of the strategy to control the rates of surgical site infection.

Additionally, numerous studies have linked patient colonization with MSSA and MRSA to an increased risk of staphylococcal surgical site infection after procedures such as total hip or knee arthroplasty. Given that surgical site infections caused by staphylococcal species represent >60% of all infections after total hip or knee arthroplasty, screening and decolonization of *S. aureus* carriers prior to surgery has emerged as an important factor in diminishing staphylococcal infections at the site of total hip or knee arthroplasty.

**Basic Science of *S. aureus***

*S. aureus*, a gram-positive bacterium capable of both aerobic and anaerobic metabolism, is encapsulated by a cell wall composed of polysaccharides, peptidoglycans, teichoic acid, and protein A. The cross-linked peptidoglycan structure in the cell wall of gram-positive organisms is the therapeutic target of the cephalosporin and penicillin family of antibiotics. These bactericidal antibiotics disrupt the cross-linking process by using their structural β-lactam ring to covalently bond to the bacterial penicillin-binding proteins responsible for assembling the cell wall, thus leading to bacterial cell lysis. These antibiotics, however, have limited effectiveness against *S. aureus* because of the bacterial production of β-lactamasas, which hydrolyze the core β-lactam structural ring in β-lactam-containing antibiotics, deactivating their bactericidal properties. Methicillin was developed to counteract the β-lactamasas found in *S. aureus* via a modification to the β-lactam ring, rendering it less susceptible to β-lactamasas. However, the selection pressure on *S. aureus* produced by the routine use of methicillin and its derivatives allowed strains of *S. aureus* to evolve and develop methicillin resistance via the production of an alternative penicillin-binding protein, PBP2a. This alternative penicillin-binding protein is encoded on a gene element known as mecA, which is transmitted to *S. aureus* on a plasmid via the process of bacterial conjugation.

**Association of *S. aureus* Colonization and Staphylococcal Surgical Site Infection After Total Hip or Knee Arthroplasty**

Segawa et al., in a retrospective review of eighty-one periprosthetic joint infections in seventy-six patients after total knee arthroplasty, published in 1999, found that the most common infecting organisms were Staphylococcus species. Recent literature, backed by the Centers for Disease Control and Prevention (CDC), has suggested that this remained the case between 2006 and 2009, with 28% of all deep surgical site infections after total hip or knee arthroplasty having been caused by MSSA; 19%, by MRSA; and 16%, by coagulase-negative staphylococci. The sources of *S. aureus* in surgical site infections are considered to be endogenous to the patient (nasal colonization), exogenous (acquired from hospital equipment, personnel, or a fellow patient), or hematogenous in origin. The association of *S. aureus* colonization and the risk of a staphylococcal infection at the site of a total hip or knee arthroplasty was initially highlighted by Kalmeijer et al., who demonstrated that nasal colonization with *S. aureus* was an independent risk factor for the development of a surgical site infection after total hip or knee arthroplasty, with carriers having a nine times higher risk of developing a staphylococcal surgical site infection. Several studies have strengthened this relationship by showing that the isolates of *S. aureus* found in surgical site infections in patients who were *S. aureus* carriers matched the isolates of *S. aureus* found in their nares up to 85% of the time. More recently, Skårm et al. also elegantly demonstrated this relationship by using molecular typing techniques to show that six of seven patients who were nasal carriers of *S. aureus* and developed an *S. aureus* infection at the site of a total knee or hip arthroplasty or spine procedure had molecularly identical *S. aureus* isolates in their nares and wounds.

**Carriage of *S. aureus***

Surveillance studies have suggested that the colonization rate in the general population varies worldwide, with MSSA nasal carriers making up 20% to 36.4% of the population, and MRSA nasal colonization composing 0.6% to 6% of the population. The prevalence of nasal carriage of MSSA and MRSA in various geographic regions is summarized in Table I. The anterior nares are widely believed to be the primary reservoir for MSSA and MRSA in colonized individuals, with three distinct patterns of nasal colonization having been identified in the general population: intermittent carriers (60%), persistent carriers (20%), and individuals who are noncarriers (20%). The binding mechanism of *S. aureus* to the anterior nares is believed to be mediated by clumping factor B, a surface protein found on *S. aureus*, which attaches to loricrin, a surface protein found on the squamous epithelial cells of the anterior nares.

Secondary anatomic reservoirs of *S. aureus* colonies have also been identified and include the oropharynx, axillae, groin, perineum, forehead, and neck. Testing these additional secondary reservoirs may increase carrier state detection; however, the clinical and economic utility of adding these additional anatomic reservoirs as collection sites for *S. aureus* screening is most likely dependent on the prevalence of MRSA in the patient population. In the U.S., the prevalence of MRSA in the general population is high enough that screening via nasal swab alone is considered sufficient by the CDC as colonization at secondary sites has been shown to be rare without concomitant nasal colonization. However, in some European and Scandinavian countries with a low prevalence of MRSA, consideration should be given to culture of multiple anatomic sites to improve detection ability.

**Surveillance Methods**

Specimens are collected from anatomic *S. aureus* reservoirs using commercially available collection swabs. These swabs can be used dry or moistened with sterile saline solution as directed by the manufacturer. The technique of nasal sampling involves rubbing the swab in the anterior nares of each nostril for five
seconds. Further research is required to conclude that one collection method is superior to another\(^4\).

The two commonly used laboratory methods for the identification of \textit{S. aureus} include culture on chromogenic solid media and polymerase chain reaction. From an economic standpoint, culture on chromogenic media is the less expensive test, while polymerase chain reaction is considered the so-called gold standard for MRSA detection\(^44\). The decision to use either method depends on the desired speed to provide a test result and the cost of materials and labor, which varies for each institution. Additionally, preparing specimens in batches to maximize laboratory efficiency may delay the speed of delivering a clinical result. A comparison of several different methods of MRSA detection approved by the U.S. Food and Drug Administration (FDA) is given in Table II.

### Perioperative Antibiotics

The American Academy of Orthopaedic Surgeons (AAOS) and Surgical Care Improvement Project (SCIP) recommend first or second-generation cephalosporins as the prophylactic antibiotics of choice in patients having total hip or knee arthroplasty who are not colonized with MRSA, with vancomycin prophylaxis reserved for those who are colonized\(^45,46\). Recent literature, however, has suggested that current antibiotic prophylaxis in patients having total hip or knee arthroplasty with first-generation cephalosporins is active against only 42% to 46% of the most common pathogens associated with surgical site infections after total hip or knee arthroplasty\(^4\). The addition of vancomycin or an aminoglycoside to the prophylactic perioperative antibiotic regimen results in a predicted activity of 83% to 97% against the most common pathogens in surgical site infections after total hip or knee arthroplasty\(^4\).

Dual antibiotic therapy theoretically offers better coverage of staphylococcal species, while continuing to provide coverage against some non-gram-positive organisms. However, literature supporting the routine use of dual antibiotic prophylaxis in patients having total hip or knee arthroplasty is sparse. Sewick et al. performed a retrospective review of the cases of 1328 patients having total hip or knee arthroplasty who received dual antibiotic prophylaxis with cefazolin and vancomycin and 500 patients having total hip or knee arthroplasty who received cefazolin alone, to determine if dual antibiotic prophylaxis could lower the rate of surgical site infection in unscreened patients undergoing total hip or knee arthroplasty\(^47\). Despite being underpowered, the study noted a decrease in the absolute number

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**TABLE I Geographic Prevalence of MSSA and MRSA Nasal Colonization**

<table>
<thead>
<tr>
<th>Study</th>
<th>Geographic Location</th>
<th>Patient Population</th>
<th>No. of Patients</th>
<th>MSSA Nasal Colonization Rate* (No.)</th>
<th>MRSA Nasal Colonization Rate (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berthelot et al.(^31) (2010)</td>
<td>France</td>
<td>Orthopaedic patients on day of hospital admission</td>
<td>3908</td>
<td>20.2% (790)</td>
<td>0.6% (23)</td>
</tr>
<tr>
<td>Yano et al.(^23) (2009)</td>
<td>Japan</td>
<td>Orthopaedic patients on day of hospital admission</td>
<td>2423</td>
<td>NR</td>
<td>2.6% (63)</td>
</tr>
<tr>
<td>Gorwitz et al.(^32) (2008)</td>
<td>Multiple sites in U.S.</td>
<td>National Health and Nutrition Examination Survey participants</td>
<td>9004</td>
<td>28.7% (2442)†</td>
<td>1.5% (208)†</td>
</tr>
<tr>
<td>Price et al.(^30) (2008)</td>
<td>Western U.S.</td>
<td>Orthopaedic outpatients</td>
<td>284</td>
<td>28.5% (81)</td>
<td>1.8% (5)</td>
</tr>
<tr>
<td>Mertz et al.(^33) (2007)</td>
<td>Switzerland</td>
<td>Inpatients, health-care workers, and blood donors</td>
<td>2966</td>
<td>36.5% (1082)</td>
<td>0.6% (18)</td>
</tr>
</tbody>
</table>

*NR = not reported. †These numbers are the weighted percentages as given in Gorwitz et al.

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**TABLE II Laboratory Methods for MRSA Surveillance**

<table>
<thead>
<tr>
<th>Product Brand Name*</th>
<th>Method†</th>
<th>Approved Specimen Site</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Time to Result (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSASelect(^77)</td>
<td>Culture</td>
<td>Nares</td>
<td>89%</td>
<td>93%</td>
<td>24</td>
</tr>
<tr>
<td>Spectra MRSA(^77)</td>
<td>Culture</td>
<td>Nares</td>
<td>83.6%</td>
<td>92.1%</td>
<td>24</td>
</tr>
<tr>
<td>BBL CHROMagar MRSA(^77)</td>
<td>Culture</td>
<td>Nares</td>
<td>87.7%</td>
<td>98.6%</td>
<td>24</td>
</tr>
<tr>
<td>BD GeneOhm MRSA ACP(^78)</td>
<td>PCR</td>
<td>Nares</td>
<td>92%</td>
<td>94.6%</td>
<td>2.83</td>
</tr>
<tr>
<td>XpertMRSA(^79)</td>
<td>PCR</td>
<td>Nares</td>
<td>94.3%</td>
<td>93.2%</td>
<td>1.25</td>
</tr>
<tr>
<td>LightCycler(^80)</td>
<td>PCR</td>
<td>Nares</td>
<td>95.3%</td>
<td>96.4%</td>
<td>1.98</td>
</tr>
</tbody>
</table>

*MRSASelect is manufactured by Bio-Rad; Spectra MRSA, by Thermo Scientific; BBL CHROMagar MRSA, by BD Worldwide; BD GeneOhm MRSA ACP, by BD Worldwide; XpertMRSA, by Cepheid; and LightCycler, by Roche. †PCR = polymerase chain reaction.
of MRSA surgical site infections, but did not find a significant difference in the overall rate of surgical site infections (1.1% for dual therapy versus 1.4% for single therapy). A follow-up study by Courtney et al. was performed on the same patient cohort to assess for the risk of acute kidney injury with dual antibiotic prophylaxis. They found that the use of dual antibiotic prophylaxis resulted in significantly higher rates of acute kidney injury than the use of cefazolin alone (13% versus 8%; p = 0.002) and that acute kidney injuries caused by dual antibiotic prophylaxis were greater in severity than those in patients who received cefazolin alone (3% had Grade-II or III injury versus 0%; p = 0.003). The addition of vancomycin as part of routine prophylactic perioperative antibiotic therapy should be done only after careful consideration and consultation with institutional infection control committees, as routine vancomycin use may also result in the emergence of vancomycin-resistant pathogens. Large, multicenter, prospective randomized studies are needed to better clarify the role of routine dual antibiotic prophylaxis in patients having total hip or knee arthroplasty.

**Decolonization**

**Mupirocin**

The mainstay of treatment in staphylococcal decolonization is mupirocin, which acts on bacterial protein synthesis via the inhibition of bacterial isoleucyl-tRNA synthetase. Mupirocin is effective against most staphylococcal, streptococcal, *Haemophilus influenzae*, and *Neisseria gonorrhoeae* species and has been used for over two decades as a safe, reliable, and effective decolonization agent. It is the only agent that is FDA-approved for nasal decolonization of *S. aureus*. It is available as a 2% nasal ointment in a paraffin base, which is applied intranasally twice daily for a five-day treatment course prior to the day of surgery. The nasal formulation of mupirocin was created to reduce mucosal irritation caused by the nasal application of standard 2% mupirocin ointment prepared in a polyethylene glycol base.

The effectiveness of mupirocin in the decolonization of *S. aureus* nasal carriers was shown in a meta-analysis that found a success rate of up to 94% at one week, which decreased to 65% at least two weeks of follow-up. Treatment failure risks were associated with colonization at multiple anatomic sites, longer hospital stays, and bacterial resistance to mupirocin. A decolonization protocol consisting of a five-day course of nasal mupirocin and one preoperative chlorhexidine shower demonstrated durable decolonization in 72.2% of patients with MSSA and 61.5% of patients with MRSA at a mean of 155 days after surgery. Mupirocin is not recommended for empiric preoperative therapy in patients without surveillance because of the potential risk of increasing bacterial resistance from selection pressure.

Bacterial resistance to mupirocin can be categorized as low level or high level. Low-level resistance is defined as a minimum inhibitory concentration of 8 to 256 mg/L and is mediated by a point mutation in the gene coding for isoleucyl-tRNA synthetase. High-level resistance is defined as a minimum inhibitory concentration of ≥512 mg/L and is mediated by the acquisition of a plasmid containing the *mupA* gene, which encodes for an alternative isoleucyl-tRNA synthetase. The prevalence of high-level mupirocin resistance in the U.S. was estimated in 2010 to be 3.3%. Prior mupirocin use has been shown to increase the risk of mupirocin resistance in MRSA carriers ninefold.

**Topical Agents**

Topical agents such as chlorhexidine or triclosan body wash are recommended by the CDC for patient-administered preoperative skin preparation as they have been shown to decrease bacterial counts on the skin. They are often used as adjuncts to mupirocin ointment in decolonization protocols to reduce bacterial density at extra-anatomic sites. Two-percent chlorhexidine wipes have recently been introduced to improve ease of administration and have been shown to be as effective as 4% chlorhexidine solution in reducing bacterial skin counts. Several recent studies have also examined whether chlorhexidine wipes used as empiric preoperative monotherapy can reduce surgical site infection rates after total hip or knee arthroplasty without regard to *S. aureus* carrier status. The application protocols in these studies varied, with some having the patient apply the 2% chlorhexidine wipes preoperatively to six anatomic sites—head and neck, both arms, both legs, and the surgical site—while other protocols had it applied only to the surgical site. This may account for the mixed results demonstrated in these studies, which are summarized in Table III.

**Alternatives**

Patient adherence to conventional decolonization protocols was reported by Caffrey et al. to be suboptimal, with only 31.1% (fourteen) of forty-five patients colonized with MRSA who were adherent to a treatment protocol of twice daily nasal mupirocin for five days and daily chlorhexidine baths for three days prior to surgery. Other alternative decolonization methods, such as povidone-iodine and photodisinfection, have been developed to improve patient adherence. These points-of-care decolonization methods are administered in the preoperative holding area prior to the procedure, and they potentially avoid increasing the risk of bacterial mupirocin resistance while improving compliance. A 5% (w/w) povidone-iodine solution is commercially available for the nasal suppression of *S. aureus* in the perioperative period and is applied to each nostril one hour before surgery. It is believed to provide bacterial suppression for up to twelve hours after application. In a recent industry-sponsored, nonblinded, prospective, randomized controlled trial, in which standard decolonization protocols with mupirocin ointment and chlorhexidine wash were compared with a regimen of povidone-iodine solution and chlorhexidine wash in patients undergoing primary or revision total knee or hip arthroplasty or spinal fusion over a one-year period, no significant difference between the treatment arms was found with respect to the rate of surgical site infections at three months postoperatively.

Photodisinfection relies on the excitation of photoactive substances, such as methylene blue, with nonthermal red laser light at a wavelength of 665 nm causing the local release of free radical oxygen species that damage plasma membranes, resulting in bacteriolysis without damage to host cells. This technology has been implemented in a commercially available product that...
is approved for use in Canada, but not the U.S., and is administered in the immediate preoperative period. A cohort study found a lower rate of surgical site infection in a group of 3068 patients undergoing orthopaedic, cardiac, vascular, thoracic, or neurosurgical procedures who had decolonization with a protocol of photodisinfection and chlorhexidine wash (1.6%; forty-eight hours after treatment, only 52% of these patients had an immediate eradication rate of 87%. However, those who had MSSA colonization in the treatment arm had an immediate eradication rate of 83.9%, while those with MRSA had an immediate eradication rate of 87%. However, by forty-eight hours after treatment, only 52% of these patients remained culture-negative for S. aureus, suggesting a transient effect of photodisinfection on nasal colonization.

**Effectiveness of Decolonization**

Controversy continues with regard to the ability of S. aureus decolonization protocols to reduce the prevalence of surgical site infections in patients undergoing total hip or knee arthroplasty. In evaluating the literature, one should be cognizant of several factors including the study design, prevalence of MSSA and MRSA in the geographic area of the study population, type of study population (community outpatients for elective surgery versus institutionalized patients), and year in which the study was published, as endemic MRSA rates and isolates are changing with time. A recent meta-analysis of nineteen studies seeking to determine the efficacy of surveillance and decolonization in orthopaedic patients found that there was a wide range of study designs from retrospective observational to prospective, double-blind, placebo-controlled, randomized controlled trials. While all of the studies included in the meta-analysis suggested a decrease in the rates of surgical site infection with decolonization, five of them did not reach significance and were underpowered. Infection rates are generally low in orthopaedic surgery, and large sample sizes are needed to achieve adequate power, especially for small reductions in overall surgical site infection rates. A recently published, large multicenter prospective cohort trial by Schweizer et al., involving >40,000 unique operations, examined...
the effect of the introduction of a standardized preoperative
S. aureus screening and decolonization program on deep S. aureus
surgical site infections in cardiac surgery and hip and knee arthroplasties performed at twenty hospitals.66 The hip and knee arthroplasty cohort demonstrated a significant reduction in postoperative rates of deep infection with S. aureus following the introduction of the screening and decolonization program (difference per 10,000 operations, –17 [95% confidence interval CI, –39 to 0]; rate ratio, 0.48 [95% CI, 0.29 to 0.80]). The results of some of the more pertinent studies involving patients having total hip or knee arthroplasty are presented in Table IV.66-71

Cost-Effectiveness of Decolonization
A recent study using data from the National Inpatient Sample database estimated the periprosthetic joint infection rate to be 2% for primary total hip arthroplasty and 2.4% for primary total knee arthroplasty. The costs associated with the treatment of deep surgical site infections necessitating revision total hip or knee arthroplasty have been estimated at $60,000 to $110,000, with a periprosthetic joint infection with MRSA costing almost twice as much to treat and with an associated hospital stay that is twice as long as one involving MSSA. Therefore, the prevention of staphylococcal periprosthetic joint infection has the potential to result in substantial cost savings. In a model that estimated the cost of a revision total hip or knee arthroplasty for the treatment of infection to be $70,000, Slover et al. estimated that a screening and decolonization program needed to result in a 35% reduction in revision rates to be cost-effective. They also noted that the more expensive the cost of revision total hip or knee arthroplasty for infection, the smaller

<table>
<thead>
<tr>
<th>Study†</th>
<th>Study Design</th>
<th>No. of Patients</th>
<th>Surgical Procedures</th>
<th>Carriage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schweizer et al. 66 (2015)</td>
<td>Multicenter prospective observational; Level-II evidence</td>
<td>42,525 overall; 31,692 had THA or TKA; 20,633 who had THA or TKA during preintervention period had no S. aureus screening and 11,059 who had THA or TKA during intervention period had screening and decolonization</td>
<td>Elective and emergency cardiac surgery, THA, and TKA</td>
<td>NR</td>
</tr>
<tr>
<td>Kalmeijer et al. 67 (2002)</td>
<td>Double blind, prospective, placebo-controlled RCT; Level-I evidence</td>
<td>315 in treatment group and 299 in placebo group</td>
<td>Elective THA or TKA and spine surgery</td>
<td>30.3% (95) in treatment group and 28% (86) in placebo group colonized with MSSA</td>
</tr>
<tr>
<td>Kim et al. 68 (2010)</td>
<td>Prospective cohort; Level-III evidence</td>
<td>7019 screened and decolonized patients and 5293 unscreened historical controls</td>
<td>Elective orthopaedic surgery (THA or TKA, sports medicine, and spine)</td>
<td>22.6% (1588 of 7019) colonized with MSSA and 4.4% (309) colonized with MRSA</td>
</tr>
<tr>
<td>Hacek et al. 69 (2008)</td>
<td>Retrospective cohort; Level-III evidence</td>
<td>912 screened and decolonized patients and 583 unscreened historical controls</td>
<td>Elective THA and TKA</td>
<td>24.5% (223 of 912) colonized with S. aureus</td>
</tr>
<tr>
<td>Hadley et al. 70 (2010)</td>
<td>Retrospective cohort; Level-III evidence</td>
<td>1644 patients in treatment group and 414 in control group</td>
<td>Elective THA and TKA</td>
<td>21.4% (351) colonized with MSSA and 3.5% (58) colonized with MRSA</td>
</tr>
<tr>
<td>Rao et al. 71 (2011)</td>
<td>Prospective cohort; Level-III evidence</td>
<td>1285 of 1440 patients screened and decolonized, 2284 concurrent unscreened controls, and 741 historical controls</td>
<td>Elective THA and TKA</td>
<td>22% (278 of 1285) colonized with MSSA and 3% (43) colonized with MRSA</td>
</tr>
</tbody>
</table>

*RCT = randomized controlled trial, THA = total hip arthroplasty, TKA = total knee arthroplasty, NR = not reported, MSSA = methicillin-susceptible S. aureus, MRSA = methicillin-resistant S. aureus, BID = bis in die or twice a day, CHG = chlorhexidine-gluconate, SSI = surgical site infection, CI = confidence interval, and RR = rate ratio. †All studies were performed in the U.S., except for Kalmeijer et al.67, which was done in the Netherlands.
the reduction in the revision rate needed to be to achieve a cost-effective screening and decolonization program.

In another cost-effectiveness model, Courville et al. examined the cost-effectiveness of decolonization measured in U.S. dollars per quality-adjusted life year in patients undergoing total hip or knee arthroplasty across a wide range of program costs. They found that unless the cost of revision total hip or knee arthroplasty was <$26,000, decolonization was more cost-effective than not decolonizing at all.

### TABLE IV (continued)

<table>
<thead>
<tr>
<th>Decolonization Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>For MSSA or MRSA-positive carriers, 2% mupirocin ointment applied to nares BID for 5 days and daily CHG baths for 5 days. For patients negative for <em>S. aureus</em>, CHG baths the night before and day of surgery.</td>
<td>Pooled results: 101 deep <em>S. aureus</em> SSIs (45 MRSA, 44, MSSA, and 12 unknown) in 28,218 operations during preintervention (no screening) period and 29 deep <em>S. aureus</em> SSIs (14 MRSA, 13 MSSA, and 2 unknown) in 14,316 operations during intervention period. THA and TKA subgroup analysis: Significant reduction in deep <em>S. aureus</em> SSIs with implementation of screening and decolonization (difference per 10,000 operations, -1.17 [95% CI, -1.39 to -0.96]; RR, 0.77 [95% CI, 0.65 to 0.90]). Conclusion: Screening and decolonization decreases <em>S. aureus</em> SSI in THA and TKA. Study limited by observational nature and lack of placebo control. Raw results for individual subgroups (cardiac surgery and THA or TKA) not published.</td>
</tr>
<tr>
<td>2% mupirocin applied BID to nares until day of surgery (≥2 doses)</td>
<td>1.6% (5) in treatment group vs. 2.7% (8) in placebo group developed MSSA SSIs and of those 1 (of 5) and 5 (of 8), respectively, were endogenous in origin. Conclusion: Trend toward decreased MSSA SSIs with screening and decolonization; study underpowered.</td>
</tr>
<tr>
<td>5-day preop. course of 2% mupirocin ointment applied to anterior nares BID and a 5-day preop. course of daily chlorhexidine baths</td>
<td>0.06% (4) in treatment group vs. 0.19% (10) in control group developed MRSA SSIs (p = 0.03; 0.13% (9) in treatment group vs. 0.26% (14) in control group developed MSSA SSIs (p = 0.09); total rate of SSIs in treatment group was 0.19% (13) vs. 0.45% (24) in control group (p = 0.0093). Conclusion: Screening and decolonization reduces SSIs; study limited by use of historical controls.</td>
</tr>
<tr>
<td>5-day preop. course of 2% mupirocin ointment applied to anterior nares BID and chlorhexidine bath for patients having TKA only on day of surgery</td>
<td>0.77% (7) in treatment group vs. 1.7% (10) in control group developed <em>S. aureus</em> SSIs (p ≤ 0.1). Conclusion: Trend toward decreased MSSA SSIs with screening and decolonization; study underpowered.</td>
</tr>
<tr>
<td>5-day course of 2% mupirocin ointment applied to anterior nares BID for all patients and single preop. chlorhexidine shower for all patients</td>
<td>1.28% (21) in treatment group vs. 1.45% (6) in control group developed deep SSIs from any organism (3 in treatment group and 1 in control group were MRSA) (p = 0.809). Conclusion: Trend toward decreased deep SSI rate with screening and decolonization; study underpowered.</td>
</tr>
<tr>
<td>5-day course of 2% mupirocin ointment applied to anterior nares BID and 5-day preop. course of daily chlorhexidine baths</td>
<td>1.2% (17) of 1440 in treatment group vs. 2.7% (20) of 741 historical controls developed SSIs (5 of 17 in treatment group and 11 of 20 in control group had <em>S. aureus</em>) (p = 0.009). The study assumed all infections in concurrent control group presumably occurred in <em>S. aureus</em> carriers based on the colonization rate of 25% in the treatment group, for a total of 19 <em>S. aureus</em> SSIs (3.3%) in 571 concurrent controls vs. the 0.3% staphylococcal SSI rate in the treatment group (p = 0.001). Conclusion: Screening and decolonization reduces SSIs; however, author assumptions made regarding study data make conclusion difficult to interpret.</td>
</tr>
</tbody>
</table>

### TABLE V Grade of Recommendation

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Grade*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative <em>S. aureus</em> screening and decolonization with mupirocin and chlorhexidine bathing reduces rates of surgical site infection after total hip and knee arthroplasty.</td>
<td>B (Level I, II, and III studies with some conflicting results)</td>
</tr>
</tbody>
</table>

*Grade is based on the system described by Wright et al.51*

### Overview

The major pathogens associated with superficial and deep surgical site infections after total hip or knee arthroplasty are predominantly *S. aureus* and coagulase-negative Staphylococcus. The community prevalence of MRSA has been increasing over the course of the last decade, and patient colonization with *S. aureus* has been shown to be an independent risk factor for the development of a surgical site infection after total hip or knee arthroplasty. Appropriate selection and administration of perioperative antibiotics and the implementation of screening and decolonization (difference per 10,000 operations, -1.17 [95% CI, -1.39 to -0.96]; RR, 0.77 [95% CI, 0.65 to 0.90]). Conclusion: Screening and decolonization decreases *S. aureus* SSI in THA and TKA. Study limited by observational nature and lack of placebo control. Raw results for individual subgroups (cardiac surgery and THA or TKA) not published.
antibiotics for total hip and knee arthroplasty should be based on preoperative colonization results, patient-related factors, and hospital antibiograms. The current literature suggests that screening and decolonization of *S. aureus* is a low-risk, cost-effective intervention that may reduce the risk of staphylococcal surgical site infection after total hip and knee arthroplasty. Larger-scale, appropriately powered, prospective, randomized placebo-controlled studies are needed to definitively demonstrate a significant reduction in surgical site infections. With proper data input, national registries would offer powerful information on this topic. Empiric decolonization of patients undergoing total hip or knee arthroplasty using mupirocin should be avoided as it may lead to an increase in the prevalence of resistant *S. aureus* strains. The 2013 International Consensus Meeting on Surgical Site and Periprosthetic Infection did not recommend universal surveillance and decolonization for patients having total hip or knee arthroplasty, but did acknowledge that such programs decrease the rates of surgical site infection (85% agreement), with mupirocin as the most accepted agent used for decolonization (80% agreement). Consideration should be given to making screening and decolonization of *S. aureus* a part of the standard preoperative workup of patients undergoing hip or knee arthroplasty (Table V).

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### References


