CE
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Implementing Evidence-Based Practice to Reduce Infections Following Arthroplasty

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Surgical site infections can have a devastating effect on a patient's morbidity impacting their quality of life and productivity in society. Financial burdens are placed on healthcare organizations because of surgical site infections as well. Evidence has shown that it is a worthwhile endeavor to implement a practice to screen and treat patients who are nasal carriers of *Staphylococcus aureus* and *methicillin-resistant Staphylococcus aureus*. Implementing evidence-based practices to combat surgical site infections can help ensure quality healthcare, while producing best possible patient outcomes; however, getting evidence to the bedside can be a challenge. The Johns Hopkins nursing evidence-based practice model is designed to help nurses translate evidence into practice. This article describes the steps one community hospital took to implement an evidence-based practice using the Johns Hopkins model to decrease the likelihood of methicillin-resistant *Staphylococcus aureus* surgical site infections in patients undergoing total knee arthroplasty and total hip arthroplasty.

Today there are many financial burdens on hospitals, and one of them includes readmissions. Medicare, the biggest payer for total knee arthroplasty (TKA) and total hip arthroplasty (THA), will be reducing payments for readmission through the value-based purchasing program in 2015 (Centers for Medicare & Medicaid Services, 2013). This reduction in payment will help heighten the awareness of the devastating effects of methicillin-resistant *Staphylococcus aureus* (MRSA) in TKA and THA postoperative infections. By 2030, 572,000 THA and 3.48 million TKA will be done annually (Kurtz, Ong, Lau, Mowat, & Halpern, 2007). With these projected numbers, 38,000–270,000 joint infections can be expected. The purpose of this article was to demonstrate how one community hospital implemented an evidence-based practice (EBP) protocol using the Johns Hopkins nursing evidence-based practice (JHNEBP) model to decrease the likelihood of MRSA surgical site infections (SSIs) in TKA and THA.

A surgical site infection, as defined by the Centers for Disease Control and Prevention (2015), is an infection that occurs at the surgical incision site. These infections can be superficial and involve only the skin or they can be more serious and involve tissues, organs, or in an arthroplasty implant.

Across the globe, *Staphylococcus aureus* has been one of the leading causes of infections for several decades. In a hospital setting, *S. aureus* is the most common source of infection in inpatients and the second most prevalent source in outpatients (Naber, 2009). *S. aureus* is carried in 20%–30% of patients who have a TKA or THA (Courville et al., 2012). Compared with noncarriers, *S. aureus* carriers have a sevenfold increase risk of SSI (Ramos et al., 2011). A large study by Perl et al. (2002) reported that 84.6% of *S. aureus* infections were caused by *S. aureus* strains identical to those found in the patient's nares.

Even though *S. aureus* has been known to cause the majority of nosocomial infections in the United States, more concerning is the increasing prevalence of MRSA (Centers for Disease Control and Prevention, 2008). The prevalence of MRSA nasal colonization is estimated at 2.17 to 4% in high-risk patients who undergo joint arthroplasty compared with 1.5%–2% in healthy asymptomatic individuals (Schwarzkopf, Takemoto, Immerman, Slover, & Bosco, 2010). Methicillin-resistant *Staphylococcus aureus* has caused serious problems in hospitals and healthcare communities alike since the late 1970s (Pofahl et al., 2009). Methicillin-resistant *Staphylococcus aureus* has the ability to form a biofilm on the implant creating an ideal environment for bacterial survival, multiplication, and antibiotic resistance (Goyal, Aggarwal, & Parvizi, 2012).

Several studies have stated that nasal colonization with MRSA is one of the most significant risk factors for developing an SSI. Safdar and Bradley (2008) explain that nasal colonization with MRSA can increase a patient's risk of SSI fourfold. Surgical site infection is seen in as high as 44% of patients who have been colonized with MRSA compared with only 2% of patients who are not colonized (Pofahl et al., 2009). These results have been reproduced time and again, showing clear evidence

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that MRSA colonization in the nares leads to higher risks for developing SSI, especially in orthopaedic patients. Courville and colleagues' study (2012) verified that instituting an EBP program to decolonize against *S. aureus* in patients who are undergoing a TKA or THA was cost-effective when compared with no decolonization. Therefore, appropriate screening and treatment to decolonize patients with methicillin-susceptible *Staphylococcus aureus* (MSSA) or MRSA in the nares can potentially eliminate the risk of SSI, prevent complications, and avoid unwanted costs.

Prevention of SSIs requires an understanding of risk factors and implementation of EBP interventions. Evidence-based practice is essential to delivering quality healthcare and ensuring best possible patient outcomes (Melnyk & Fineout-Overholt, 2011). Following EBP can help facilities keep up with the demand of ever-changing healthcare practices. In addition, EBP can help lower healthcare costs by delivering the most effective treatments for various health conditions. Furthermore, as EBP continues to evolve, third party payers will begin to only provide reimbursement to those healthcare providers who are providing care that is evidence based.

Lasting Effects of Infection

The increasing incidence of MRSA surgical site infections is a worrisome strain for patients, physicians, and hospitals both financially and emotionally. Patients who had an arthroplasty infection have endured serious complications due to MRSA. Surgical site infections place an enormous burden on patients by increasing their hospital stay, adding additional surgeries, and placing them at risk for complications. Kurtz et al. (2008) reported that the average length of stay for an infected THA was 2.21 times longer than that for an uninfected arthroplasty. Likewise, for TKA, the length of stay was 1.87 times longer. De Lissovoy et al. (2009) reported that an orthopaedic SSI could add $19,793 to a patient's hospital costs. Patients endure the added stress of the uncertainty of the outcome and success of the treatment.

Surgical site infections can also decrease health-related quality of life (Rao et al., 2011). In a study reported by Whitehouse, Friedman, Kirkland, Richardson, and Sexton (2002), patients who experienced an SSI had a decrease in physical functioning, general health, and social functioning. These patients had complaints of more bodily pain than those who did not have an SSI. They went on to report that their findings were suggestive of the development of SSI following orthopaedic surgery would double a patient's risk for readmission to the hospital during the next 12 months and more than triple the total direct cost of hospitalization.

Along with the burden of additional surgeries to remove infected hardware and replace with new and months of antibiotic therapy and rehabilitation, patients lose functional capacity and work productivity (Courville et al., 2012). Lasting effects of SSI that may not be measurable include loss of income, loss of productivity in society, and personal impact (Whitehouse et al., 2002). A joint infection from a joint arthroplasty is one of the leading causes of morbidity with a mortality rate ranging between 2.7% and 18% (Matar et al., 2010).

Lengthy stays, additional surgeries, and ongoing complications increase costs to patients and hospitals (Goyal et al., 2012). Patients who have joint infections endure on average an additional 3.7 surgeries, which in turn generates an incredible cost in staff, time, and money. Some reports have estimated an average cost for MRSA surgical site infection to be $60,000 all the way up to a 300% more than an arthroplasty without complications (Kurtz et al., 2008). In 2015, under the value-based purchasing program, the Centers for Medicare & Medicaid Services will reduce payments for total knee and hip replacement readmissions placing an even greater finical strain on hospitals (Lee & Moorhead, 2014). In addition, most capitated payer systems consider SSIs a preventable complication and will not provide hospitals with additional monies to cover treatment costs (Kim et al., 2010). By simply establishing an EBP infection prevention program and reducing SSI from 2% to 1%, hospitals that conduct 5,000 inpatient orthopaedic surgical procedures each year could save $350,000 per year in direct hospital costs.

A Model to Guide Implementation of EBP

To implement an EBP infection prevention program, the JHNEBP model was used (Ciliska et al., 2011). The JHNEBP model was chosen because it provides a linear process approach to synthesis and translates evidence into practice. The model also includes tools to help guide the implementation of EBP. The JHNEBP model is composed of three basic nursing concepts: practice, education, and research. The model relies on evidence-based research as well as patient or healthcare provider experiences. It considers internal and external factors before a practice can be changed (Newhouse, Dearholt, Poe, Pugh, & White, 2007).

There are three major phases to the JHNEBP model, practice question, evidence, and translation (Melnyk & Fineout-Overholt, 2011). Within these phases, there are 18 descriptive steps (see Table 1). During the first phase, a practice question is identified, an interdisciplinary team is formed, and a leader is identified. Next, in the evidence phase, a search is conducted for internal and external evidence. The evidence is then summarized on the basis of strength and recommendations are made for change. Last, the translation phase is used to determine the appropriateness and feasibility of the change. An action plan is created for implementation and then evaluation of outcomes is conducted. The last step of the JHNEBP model is dissemination of the findings.

Practice Question

A PICOT format, a process to structure clinical questions to facilitate a useful search to find relevant answers, was used for Step 1 (identifying an EBP question) (Melnyk & Fineout-Overholt, 2011). The clinical question was "In THA and TKA patients (P), how does the use of a clinical practice guideline to prevent

Table 1. The John Hopkins Nursing Evidence-Based Practice Model

Steps	Application
Step 1: Identify an EBP question	"In THA and TKA patients (P), how does the use of a clinical practice guideline to prevent infection (I) compared to non-standardized interventions (C) affect surgical site infection rates (O) postoperatively (T)."
Step 2: Define scope of practice question	Population based
Step 3: Assign responsibility for leadership	CNS and infection preventionist
Step 4: Recruit multidisciplinary team	Med/Surg nursing manager and assistant manager, Pharm D, Lab manager, AC and PACU manager, Infectious Disease Physician, Outpatient Pharmacy Manager
Step 5: Schedule team conference	CNS and Infection Preventionist met weekly, conferences were held with the multidisciplinary team as needed
Step 6: Conduct internal and external search for evidence	Internal: clinical expertise, patient preferences
	External: literature search, regulatory and professional standards, guidelines, expert opinion
Step 7: Critique all types of evidence	Clinical practice guidelines, randomized control trials, cross-sectional analysis, observational cohort studies, prospective clinical studies, case-controlled studies, and systematic reviews
Step 8: Summarize evidence	Evidence summarized in body of paper
Step 9: Rate strength of evidence	Level I evidence: two publications applied
	Level II evidence: six publications applied
	Level III evidence: three publications applied
	Level IV evidence: one publication applied
	Level V: four publications applied
Step 10: Develop recommendations for change in processes or systems of care based on the strength of evidence	1. Perform nasal swab testing for MRSA and MSSA 2 weeks prior to surgery using a culture.
	2. Use chlorhexidine gluconate wash for 5 days prior to surgery and morning of surgery.
	3. Decolonize MRSA- and MSSA-positive patients using intranasal antibiotic.
	4. Construct a process to ensure that patients who are positive for MRSA or MSSA are able to receive their nasal decolonization treatment in a timely manner prior to surgery.
Step 11: Determine appropriateness and feasibility of translating recommendation into the specific practice setting	Interdisciplinary group met to discuss appropriateness for the Joint Center and cost of implementation.
Step 12: Create action plan	Tasks were assigned by leadership.
Step 13: Implement change	A go live date was set and the action plan was implemented
Step 14: Evaluate outcomes	Process and flow of care was evaluated. Seven months postimplementation SSI rate is zero.
Step 15: Report results of preliminary evaluation to decision makers	Current results are shared at quarterly Joint Center meetings and evidence-based practice council
Step 16: Secure support from decision makers to implement recommended change internally	Preceded step 12. Obtained from key stake holders.
Step 17: Identify next steps	Continue to monitor patient compliance with protocol and SSIs.
Step 18: Communicate findings	Continue to monitor SSI and report findings at Joint Center meetings. Publish via articles and poster presentations.

Note. AC = ambulatory care; CNS = clinical nurse specialist; EBP = evidence-based practice; MRSA = methicillin-resistant *Staphylococcus aureus*; MSSA = methicillin-susceptible *Staphylococcus aureus*; PACU = post anesthesia care unit; SSI = surgical site infection; THA = total hip arthroplasty; TKA = total knee arthroplasty.

infection (I) compared to nonstandardized interventions (C) affect surgical site infection rates (O) postoperatively (T)" (see Table 2). In Step 2 (define the scope of the practice question), our scope was limited to the THA and TKA population. In Step 3 (assign responsibility for leadership), the leadership responsibilities were assigned to the clinical nurse specialist (CNS) of the Joint Center and to the infection preventionist. They took the responsibility to complete Step 4 (recruit multidisciplinary team) by recruiting the medical/surgical nursing manager and assistant manager, a PharmD, laboratory manager, ambulatory care and postanesthesia care unit manager, infectious disease physician, and outpatient pharmacy manager. These team members were selected on the basis of their involvement with the Joint Center and infection prevention. Last, in Step 5 (schedule a team conference), the CNS set up a time and place for the team to meet. In this meeting, the current Joint

Table 2. Components of PICOT

Patient population/disease	The patient population or disease of interest, for example:
	Geriatric, Caucasian, total hip replacement, arthritis
Intervention or issue of interest	The intervention or range of interventions of interest, for example:
	practice guideline, physical therapy, washing hands, alcohol consumption
Comparison intervention or issue of interest	What clinicians want to compare the intervention or issue against, for example:
	Absences of therapy, placebo, no intervention
Outcome	Outcome of interest, for example:
	infection rates, risk of cancer, influence on delirium, influence on mobility
Time	The time involved to demonstrate an outcome, for example:
	The time it takes for the intervention to achieve the outcome (postoperative period). The time over which populations are observed for the outcome to occur (2 weeks).

Note. From *Evidenced Based Practice in Nursing and Health Care: A Guide to Best Practice*, by B. Melnyk and Fineout-Overholt, 2011, (2nd ed.). Philadelphia, PA: Lippincott Williams & Wilkins. Reprinted with permission.

Center infection rates were discussed and brief overviews of current EBPs were described. The interdisciplinary team agreed that because of the current infection rates, something needed to be done. The CNS and infection preventionist stated that they would search for the best available evidence and reconvene the group once the evidence was summarized.

Evidence

Step 6 (conduct internal and external search for evidence) was completed by the CNS and infection preventionist. Currently, all arthroplasty patients are admitted to a noninfectious surgical floor. The team felt that this practice was internal evidence that could be supported as a best practice. An external search for evidence was completed of English language research published in 2006–2014 on orthopaedic surgical site infection prevention. The databases and resources that were searched included the Cumulative Index to Nursing and Allied Health Literature, PubMed, MEDLINE, the National Guideline Clearinghouse, and Cochrane Collaboration's systematic reviews, as well as the Centers for Disease Control and Prevention, Centers for Medicare & Medicaid Services, National Association of Orthopaedic Nurses, and Institute for Healthcare Improvement (IHI). Key words used in the search included *surgical site infection*, *total joint arthroplasty*, *preoperative screening*, *MRSA and MSSA*, *decolonization*, and *nasal screening*.

In steps 7 through 10, all types of evidences were researched, including clinical practice guidelines, randomized control trials, cross-sectional analysis, observational cohort studies, prospective clinical studies, case-controlled studies, and systematic reviews. The evidence was summarized and then reviewed on the basis of strength, the number of studies, and the overall quality. Evidence strength and quality were assessed using the standardized scoring system found within the JHNEBP appraisal tools (American Nurses Association, 2014). Articles that were used included one systematic review, one practice guideline, six quasi-experimental studies, three qualitative studies, and five non-research-based articles of organizational reviews with internal and external reports and expert opinions. By conducting the literature review, the following seminal findings lead the team to develop an infection prevention program specific to THA and TKA patients.

Literature Review Findings

Courville et al. (2012) concluded the use of a screen and treat process before total joint arthroplasty is a simple, safe, and cost-effective intervention that can reduce the risk of SSI. These authors developed a three-tier approach, using a hypothetical cohort of patients. Group 1 was provided preoperative screening cultures followed by mupirocin treatment for those with positive cultures for *S. aureus*. Group 2 was provided with mupirocin treatment without screening, and Group 3 received no screening or treatment. The results revealed both the screen and treat, Group 1, and the treat all, Group 2, had greater benefits and lower costs than Group 3, who received no decolonization.

Kim et al. (2010) concluded that the implementation of a prescreening program to identify MRSA and MSSA is feasible and can lead to significant reduction in postoperative SSIs. During their study period, 7,019 patients were screened, 1,588 (22.6%) were *S. aureus* carriers, and 309 (4.4%) were MRSA carriers. Overall, 13 cases (0.19%) of SSI were identified, which was significantly lower than the control period where out of 5,293 patients, there was 24 cases (0.45%) of SSI. Methicillin-resistant *Staphylococcus aureus* and MSSA-positive patients were asked to use intranasal ointment and a chlorhexidine wash. Of the 309 MRSA carriers, 85% completed the eradication protocol and were subsequently retested. Seventy-eight percent came back negative, whereas 22% were still found to be positive. During the study period, only one (0.02%) of 5,122 patients developed an SSI following a negative screening result. As an end result of the study, the screening and treatment program was associated with a 59% reduction in the rate of SSI in comparison to the control period.

The IHI (2012) recommends three evidence-based interventions to prevent SSI in patients undergoing TKA and THA procedures. Two of these recommendations include having patients use chlorhexidine gluconate (CHG) soap for at least 3 days prior to surgery, screening patients for *S. aureus*, and decolonizing *S. aureus* carriers with 5 days of intranasal mupirocin. The IHI's guideline outlines studies that show the repeated use of CHG soap has residual effects on reducing bacterial counts on the skin. The guideline provides rationale on the importance of screening for *S. aureus* and decolonizing with mupirocin. Resources listed within the guideline state that patients who carry MRSA or MSSA in their nares are more likely to develop *S. aureus* SSI. Cited within the guideline is the randomized, double blinded, placebo controlled trial study by Bode et al. (2010), who concluded *S. aureus* carriers treated with 5 days of intranasal mupirocin and CHG washes prior to surgery had a 60% lower *S. aureus* SSI rate than the placebo group.

On the basis of the aforementioned literature findings, the CNS and infection preventionist made the following recommendations:

1. Perform nasal swab testing for MRSA and MSSA 2 weeks prior to surgery using a culture.
2. Use CHG wash for 5 days prior to surgery and morning of surgery.
3. Decolonize MRSA- and MSSA-positive patients using an antibiotic applied intranasal.
4. Construct a process to ensure that patients who are positive for MRSA or MSSA are able to receive their nasal decolonization treatment in a timely manner prior to surgery.

Translation

Once all the evidence was gathered and recommendations were developed, the CNS organized a second interdisciplinary meeting. During this meeting, the summary of evidence was presented, step 11 of the JHNEBP model, and the team discussed the appropriateness and practicability of implementing the recommendations. The interdisciplinary group felt that the actions were appropriate considering the supporting evidence; however, there were concerns of the cost of implementing these new practices. Upon further investigation, it was concluded that switching from molecular screening to a bacterial culture, there would be an approximate savings of $20 per patient. The cost to the hospital for the CHG wash would increase approximately $3 per patient. Because of the hospital's internal structure, Step 16 of the JHNEBP model, secure support from decision makers to implement recommended change internally, preceded Step 12. Approval for the new process was obtained from the Joint Center committee, the orthopaedic surgeons, and the value analysis team. Overall, it was determined that the minimal cost per patient to implement the EBP far exceeded the cost of just one surgical site infection.

In Step 12 (create action plan), the interdisciplinary team created an action plan for implementing the changes. The laboratory manager was assigned with the task of incorporating the new culture screenings and providing an automatic print out of those who screened positive for the CNS and infection preventionist. The manager of ambulatory care ordered and stocked the 16-ounce bottles of CHG wash. The CNS worked with the laboratory department, preadmission testing, and doctor's offices to create a process to notify the patient who was positive for MRSA or MSSA. Part of this process included making sure that patients received their prescription for nasal decolonization. Three patient education documents were created by the CNS. These education sheets were to be reviewed with the patient during preadmission testing. A surgery preparation checklist that helps the patient document daily when the CHG wash and nasal decolonization is completed. The patient is asked to bring the surgery preparation checklist on the day of surgery. This checklist will help provide accountability to the patient for completing these necessary measures. A step-by-step guide on how to use the CHG wash and nasal ointment was included. The CNS made sure that the documents were health literate and understandable to the patient.

Once all processes were mapped out, to complete Step 13 (implement change), a go live date of June was determined. Patients were scheduled for preadmission testing 10 working days prior to their surgery. During preadmission testing, they received the CHG and decolonization education sheets and were screened for MRSA and MSSA, using the new culture media. Patients who were screened as positive for either MRSA or MSSA were notified by their physician's office and a prescription for nasal decolonization was called in to their pharmacy of choice. One week prior to surgery, the patients attended a presurgical joint education class where they received more information on the importance of using the CHG for five consecutive days prior to surgery and the morning of surgery. The importance of nasal decolonization was reviewed during this time. For patients who did screen positive, the CNS and infection preventionist received a printout of the test results. The CNS made follow-up telephone calls with the patients 5 days prior to surgery to ensure that they were using the intranasal antibiotic and CHG wash appropriately and to address any questions.

Outcomes

After the new process had been in place for 6 months, Step 14 (evaluating outcomes) was completed. Twenty-four MSSA-positive and three MRSA-positive patients were identified by the interdisciplinary team. Upon review, it was noted that all processes were completed successfully. The screening was done correctly and within the appropriate time frame prior to surgery. The follow-up phone call by the CNS verified that the patient was using the CHG wash and intranasal antibiotic. Prior to implementation, the Joint Center had a 4-month SSI rate of 5.3%, compared with a 7-month postimplementation SSI rate of 0. To complete Step 15 (reporting results of preliminary evaluation to decision makers), the findings were disseminated to the Joint Center team, surgeons, and EBP council.

Steps 17 and 18 conclude The Johns Hopkins process. These steps include identifying the next steps of the process and then disseminating the findings. The interdisciplinary team will continue to track the process of screening and identifying patients who are at risk for infections. The team will continue to track SSI, determine why they occurred, and the changes that need to be made to prevent future occurrences. Costs to the hospital as well as the patient will be monitored. The CNS and the infection preventionist agreed to disseminate the findings, attend nursing and infection control events with poster presentations, publish the results, and communicate the findings within the institution.

Nursing Implications

While it is important to implement EBP processes and educate patients about their role in infection prevention, nurses play an important role in mitigating SSI. The CNS felt compelled to reinforce to the nurses the importance of hand hygiene, sterile dressing changes, and appropriate timing of antibiotics (IHI, 2012). The infection preventionist reinforced this teaching by ensuring surgery was following appropriate attire guidelines, controlling surgery room temperatures, and monitoring traffic control considerations in and out of the surgery rooms. The nurse's understanding of the EBPs will only help to hold each other and each department accountable for the new process. Nurses who are knowledgeable about MRSA and MSSA, and who use EBPs to prevent infection, will help prevent SSIs. While infection prevention is an interdisciplinary process, nurses serve as the front gate keeper between patients and all caregivers.

Future Research

Other things to consider when preventing infection may include rescreening for successful eradication of MRSA and MSSA prior to surgery. By screening patients just prior to surgery, it can be concluded that decolonization was effective and the patient was compliant with using the CHG wash and nasal antibiotic, all of which may help in further reducing postoperative infections (Goyal et al., 2012). Nutritional status plays an import part in incision healing and preventing infection (Illingworth et al., 2013). Ideal nutritional status for total joint arthroplasty patients includes a lymphocyte count of more than 1,500 cells/μl, an albumin level of more than 3.5 g/dl, a zinc level of more than 5 μg/dl, and a transferring level of more than 200 mg/dl. Glucose control pre- and postoperatively play an important role in SSI. The study by Mraovic, Suh, Jacovides, and Parvizi (2011) found blood glucose levels preoperative and postoperative day 1 to be significantly related to infection. Nondiabetic patients were three times more likely to develop an infection if their postoperative blood glucose was more than 140 mg/dl, strengthening the fact that infection is more accurately tied to the current status of glycemic control rather than to the diagnosis of diabetes. Other factors that can contribute to a patient's risk for infection, which institutions have very little control over, is a patient's home environment and patient compliance with treatment regimens, dressing changes done in the home and the patient's hand hygiene practices. Patient compliance is an important component in the success of preventing SSIs (Ramos et al., 2011). To combat this issue, health literate patient education is key.

Summary

With the high volume of patients receiving arthroplasties, infection control practices need to be taken seriously. Within this institution, the Johns Hopkins Model and guidelines were used to guide an interdisciplinary team on how to address a clinical problem, seek evidence, and develop a process to translate the evidence into practice. The EBP of nasal screening for MSSA and MRSA was done preoperatively on all arthroplasty patients. Appropriate treatment to decolonize patients who were positive was established with the potential of eliminating the risk of SSI, preventing complications, and avoiding unwanted costs to the patient and the institution. Infection prevention is an interdisciplinary collaborative process to help prevent SSIs in TKA and THA patients.

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