**Scrubbing down on Surgical Site Infections: Decreasing the incidence of surgical site infections in children**

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**Introduction:**

Despite advancements in medical sanitation and sterilization practices over the past several decades, surgical site infections (SSI) continue to be a leading cause of hospital acquired infections. Studies have indicated that SSIs can account for up to 31% of hospital-acquired infections, greatly attributing to the morbidity and mortality of our patient population. Since the development of the National Nosocomial Infection Surveillance Group back in the 1970s, the Centers for Disease Control (CDC) has been dedicated to improving infection control practices across the country. Several noteworthy advancements have been made over the past several years, including the implementation of pre-operative and post-operative antibiotic administration in 2002. In May 2012 Ohio Children’s Hospitals’ Solutions for Patient Safety National Network (OCHSPS) developed a team of hospital professionals dedicated to producing specific pediatric guidelines for prevention of harm secondary to surgical site infections. As part of a national collaboration, these guidelines have been instituted in hospitals across the country.

In 2013 Palmetto Health Children’s Hospital (PHCH) became part of the OCHSPS national initiative to reduce the overall incidence of SSIs in high-risk surgeries. SSIs continue to be a preventable cause of harm at PHCH. High-risk surgeries, such as spinal fusions and ventricular shunt placements, place our patients at risk for infection-related morbidity and mortality. Overall, our aim is to implement an evidence-based bundle of elements to prevent SSIs in our pediatric patients. The first goal of this project is to implement and improve compliance with the SSI prevention bundle and decrease SSIs to less than three in the year 2014.

**Methods:**

The PHCH SSI team utilized OCHSPS operational definitions to define SSI, and the SSI prevention bundle developed and piloted by the collaborative. OCHSPS focused on preventing SSIs in children undergoing ventricular shunt placements or revisions, spinal fusions and cardiothoracic surgeries. At PHCH we do not have a cardiothoracic surgery program and therefore our efforts have been focused on neurosurgical and orthopedic procedures. Operational definitions of SSI include superficial, deep and organ/space infections and are defined as follows:
<table>
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<tr>
<th>Classification of SSI</th>
<th>Definition</th>
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| **Superficial Incisional** | Infection occurs **within 30 days** after the operative procedure AND involves only skin and subcutaneous tissue of the incision AND patient has at least one of the following:  
  a. purulent drainage from the superficial incision.  
  b. organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.  
  c. at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and superficial incision is deliberately opened by surgeon, and is culture-positive or not cultured. A culture-negative finding does not meet this criterion.  
  d. diagnosis of superficial incisional SSI by the surgeon or attending physician.                                                                                          |
| **Deep Incisional**        | Infection occurs **within 30 days** after the operative procedure if no implant is left in place or **within 90 days** if implant is in place and the infection appears to be related to the operative procedure AND involves deep soft tissues (e.g., fascial and muscle layers) of the incision AND patient has at least one of the following:  
  a. purulent drainage from the deep incision but not from the organ.space component of the surgical site  
  b. a deep incision spontaneously dehisces or is deliberately opened by a surgeon and is culture-positive or not cultured and the patient has at least one of the following signs or symptoms: fever (>38°C), or localized pain or tenderness. A culture-negative finding does not meet this criterion.  
  c. an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination  
  d. diagnosis of a deep incisional SSI by a surgeon or attending physician.                                                                                              |
| **Organ/Space**            | Infection occurs **within 30 days** after the operative procedure if no implant is left in place or **within 90 days** if implant is in place and the infection appears to be related to the operative procedure AND infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure AND patient has at least one of the following:  
  a. Purulent drainage from a drain that is placed through a stab wound into the organ.space  
  b. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ.space  
  c. An abscess or other evidence of infection involving the organ.space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination  
  d. Diagnosis of an organ.space SSI by a surgeon or attending physician.                                                                                               |
We performed a chart review of all surgical procedures performed at PHCH from Jan 2012 through October 2013 matching the ICD-9 codes provided by the collaborative for spinal fusions and shunt procedures. EMR review included looking at progress notes, operative notes, cultures, vital signs and laboratory values. Patients were excluded if they did not meet above criteria or were found to have a documented infection at the time of the designated procedure. Potential SSIs were documented by those collecting data and reviewed by an infection prevention nurse for verification. The SSI rate was defined as number of SSIs in that specific surgical category divided by number of patient trips to the OR for the surgical procedure over the reporting period. Charts were reviewed for 90 days after the index surgical case and any infections during this time were attributed to the month of the index surgical procedure.

Once data was collected and initial goals were established, steps to implement the SSI prevention bundle checklist began. Based on OCHSPS bundle, a checklist was developed that would best address the issues needed to prevent SSIs. Several changes were made to the checklist while under development and during distribution of the bundle to the OR. Once the checklist was finalized (Figure 1), it was distributed to the preoperative area. Initially we implemented the checklist with one group of surgeons to identify barriers that may need to be overcome before spreading. One of our pediatric orthopedic surgeons provided input regarding upcoming surgeries and ways to ensure completion of the checklist.

The checklist was distributed to preoperative areas and the staff was instructed on its use and importance. The form was placed on top of the patient charts and was not part of the medical record. The preoperative team was instructed to review the checklist and document whether recommended bundle elements were completed. As the patient was moved from preoperative care to surgery to postoperative care, the form was to accompany the patient’s chart. Once the patient was in postoperative care and form was completed, the staff was instructed to return the form to a designated area for further review. Several small changes were made to the form including wording, order of checklist items and color of the sheet. These changes made it easier to comply with our instructions and make sure the list was not lost in transit.

While developing the checklist, part of the team worked diligently on making sure that parents were aware of the above process and aware of the need to prevent SSIs. Chlorhexidine bathing is recommended preoperative for these selected procedures and some orthopedic practices are providing the chlorhexidine product along with instructions at the preoperative visit. However, this is not being done in all applicable practices. Furthermore, some procedures are emergent, and occasionally families are not compliant with this recommendation. Thus, we have encouraged preoperative staff to perform the chlorhexidine bath but not all preoperative rooms have sinks. Additionally, there are often significant time restraints in the preoperative arena.

Once checklists were received an SSI team member reviewed the forms and completion and compliance with infection control guidelines were assessed. Data was reviewed monthly and the number of correctly completed forms were recorded for each month. Feedback regarding checklist completion was then given to preoperative, postoperative, and surgical team members caring for that
patient. During the launch of our SSI bundle checklist, we continued to collect data on the incidences of the SSIs. Shortly after implementation of the form with our pediatric orthopedic group it was decided to add supplementary measures to ensure completion of the checklist. SSI team members were designated to specific surgical dates and instructed to contact the hospital teams taking care of the patients and verify checklist completion. We contacted the preoperative team specifically regarding chlorhexidine bathing and if it had not been completed, we encouraged the hospital team to perform this prior to surgery. Additionally, we contacted the operating rooms and post-operative care sites to make sure the form was still with the chart and postoperative antibiotics were given in a timely manner. We also posted signs in the OR to remind nursing to complete these bundles. After the first few cases with one pediatric orthopedic surgery group, we reached out to the other surgeons for involvement with the SSI bundle checklist. As of April 2014 all applicable surgeons are participating.

A multidisciplinary team is essential to the success of this project. Nursing education was a crucial part of our project. Our team consisted of several nurses who educated fellow nurses in their department on the importance of this quality improvement project. Pharmacy was also involved in hopes to help with timing of antibiotics and correlating these times from different areas of the hospital and different systems on the EMR. In Jan 2014 a family member whose child had an SSI in 2012 was added to the team to help give input from a parent’s perspective. The parent was available for meetings and gave us input on the ease of administering chlorhexidine baths and suggested ways to make the process easier.
Pediatric Surgical Site Infection Prevention Bundle

Applies to: any children’s hospital patient having any ventricular shunt, spinal fusion, or cardiothoracic surgery (placement, removal, revision, washout, I&D, etc.).

Place Patient Label Here

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**Date of surgery:**

<table>
<thead>
<tr>
<th>Pre-Operative (if coming from home, prop to complete; if already inpt, floor to complete)</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Confirmation by guardian of Hibidens bath either the night before or the morning of surgery.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>2. Confirmation by guardian of shampooing of hair performed either the night before or the morning of surgery.</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

**Intra-Operative (anesthesia to complete)**

| 3. Was a razor used for site preparation (NOT RECOMMENDED)? | Yes / No |
| 4. Appropriate skin antisepsis (chlorhexidine, povidone iodine, etc.) utilized per product guidelines. | Yes / No |
| 5. Were pre-op antibiotics given within the appropriate timeframe? | Yes / No |
| *Vancomycin, fluoroquinolone (med ends in "-floxacin") must be given 0-120 min prior to incision* | Drug: ________ |
| *Cefazolin or clindamycin must be given 0-60min prior to incision* | Time given: ________ |
| Incision time: ________ |

| 6. Were antibiotics re-dosed as appropriate (if still in surgery after FOUR hours) | Yes / No |
| *Cefazolin and clindamycin given within FOUR hours of first dose* | Time 2nd antibiotic dose given: ________ |
| *Vancomycin within SIX hours, and then scheduled q6hours* | (If case longer than 4h after incision) |
| *If other antibiotic indicate amount of time from first dose to second dose* | |

**Post-Operative (receiving unit i.e. PICU or CH4 to complete)**

| 7. Was the first dose of antibiotic post-op given at the correct time as ordered? | Yes / No |
| *If ordered antibiotic is q8 hrs must be given within 8 hrs of previous dose* | Time 1st dose given after OR: ________ |

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Once 1st post-op antibiotic is given and checklist is completed, please place completed form in quality/SSI folder at your unit desk for Lori Nuelken, RN, CPC to pick up.
Results:

Process and outcomes data were reported by month for November 2013 – April 2014 (Figure 2). Outcomes data were identified based on the OCHSPS operational definition of SSI. For our surveillance period of 2012 there were four confirmed SSIs: 3 spinal fusions, and 1 ventriculoperitoneal (VP) shunt placement. In 2013 there were five confirmed SSIs: 1 primary VP shunt, 1 secondary VP shunt, and 3 spinal fusions. In 2014 there has been one spinal fusion infection to date.

We began collecting process data in November 2013 for one pediatric orthopedic surgery practice (Figure 3). Unfortunately, only one correctly completed and returned checklist has been documented at this time and it was in April 2014.
We will also track the number of Moore orthopedic SSIs by year. There were two in 2012, one in 2013, and one in 2014. This information will be important in the future when analyzing process data and to determine success of decreasing SSIs with the SSI prevention bundle.

**Orthopedic Infections**

![Chart showing decrease in Moore Orthopedic SSI from 2012 to 2014]

**Discussion:**

SSIs are costly with high morbidity and mortality, especially in high-risk surgeries such as spinal fusions, VP shunts, and cardiovascular surgeries. Surgical care improvement project (SCIP) measures are mandatory in patients 18yo and older for selected surgical procedures; however, prior to the OCHSPS collaborative formation few evidenced-based guidelines existed for children. This OCHSPS national collaborative was created to help decrease these catastrophic events. This process could not be accomplished with only one small part of the hospital. We needed a cohesive, multidisciplinary team including staff from pre-operative, post-operative and pediatric inpatient areas to ensure that everyone was working together to help prevent infection. We believe that as being part of OCHSPS national collaborative that we will both save the hospital money and save lives.

Data in 2012 revealed a total of four SSIs, five SSIs in 2013, and so far in 2014 there has been one SSI. Process data collection began after November 1st 2013. Therefore we had 0/1 bundle checklists correctly completed for 2013. In 2014, 1 of 2 checklists was complete and compliant.

There have been many obstacles during this project. First, at Palmetto Health Richland there are several different electronic systems. For example, Surginet is the EMR in the surgical suites and Cerner is the
EMR in the children’s hospital. Although these systems work well in their separate parts of the hospital, they do not readily communicate with each other. This makes timing of antibiotics very difficult without human intervention, thus leading to the possibility of human error. The paper charting systems between pre-op and the hospital floors are different, requiring all information from one chart to be physically transferred to another. Since the SSI checklist is not part of the permanent medical record, it can be easily lost during this transition. We have tried to eliminate these issues by placing one team member in charge of calling each place to ensure initiation, proper implementation, and that the checklist ends up in the QI folder when finished. Even with this intervention, it has been very difficult to complete. We are currently discussing options to improve this process in the future.

Another obstacle faced during this project is that according to the OCHSPS definition, only specific procedure codes are included. However, there are slight nuances to coding and therefore a surgery may not meet definition by code but upon clinical review we determine the case should utilize the checklist. This leads to subjective decisions at the discretion of nursing staff to start the bundle and therefore inconsistent implementation. In addition, there is no good trigger to begin the checklist other than nursing staff remembering that it applies to certain cases. We are seeking an electronic trigger, but information technology has delayed this solution due to the fact that perioperative staff has not completely converted from paper charting to EMR. Eventually our perioperative services team will be using electronic documentation and will make an electronic trigger feasible. We are currently working on having the protocol initiated for every orthopedic spinal fusion and VP shunt case regardless of code to improve compliance. The easiest solution would be to use the bundle for all pediatric patients, but this would involve unnecessary costs and is not feasible at this time.

A third major obstacle at Palmetto Health Richland is not all pre-operative rooms have sinks with running water. Therefore our current chlorhexidine baths are difficult to give if not done prior to presenting for surgery because we only have the solution on formulary. We are currently trying to get the chlorhexidine wipes approved for use by the products committee.

This SSI prevention initiative is an ongoing quality improvement project. For the current year, our goal is to reduce SSI to <3 in 2014. We have had one SSI in a patient who underwent a spinal fusion in 2014. Our process goal for the second half of 2014 is to have > 90% compliance with the SSI bundle. To accomplish this, we have recently added a family member to our team. Her son suffered a SSI after a spinal fusion. She will help with family barriers to complying with the preoperative portion of the bundle. In April 2014 we spread the project to include the remainder of the surgeons involved in orthopedics and neurosurgery.

Although we have not yet shown a reduction in SSI during our project we feel that in the future this will be of great benefit to our patients. Even a small reduction in adverse events is a huge gain for the families and the hospital. Although we have run into many obstacles, we anticipate that once the checklist becomes routine it will make a bigger impact on patient safety.
References:
