

# Chlorhexidine gluconate preoperative skin preparation initiated a 100% reduction of incisional Cesarean section infections while other risk factors were evaluated and corrected

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## Abstract

### Chlorhexidine gluconate preoperative skin preparation in obstetrical cesarean section patients results in 100% prevention of surgical site infections

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**Issue:** Cesarean section (C-section) is the greatest risk factor for postpartum maternal infection. Infectious complications occur 10 times more frequently following C-sections compared to vaginal deliveries, with maternal morbidity related to infections eight-fold higher. Incidence of C-section SSIs has been reported to reach beyond 18%, with a mean SSI cost reported as \$25,546.40, accounting for as much as \$10 billion annually in direct and indirect medical costs. C-section SSI rates at our hospital went above the National Nosocomial Infections Surveillance System Index (NNIS) from January 2006 through August of 2006. A detailed C-section SSI prevention action plan was developed and implemented to improve clinical practice and resulted in improved and sustained patient outcomes.

**Project:** The historical C-section SSI comparison to NNIS rates is demonstrated in Figure 1, demonstrating the critical need for a clinical intervention.

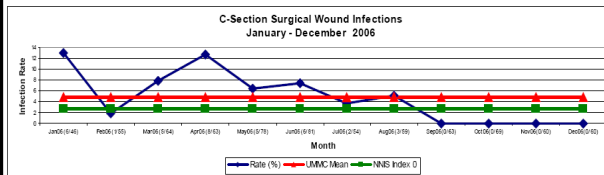


Figure 1. C-section SSI rates compared to NNIS index

The action plan included some of the following:

- Ongoing collaboration and communication with physicians and nurses to identify all potential causal elements, including ongoing feedback.
- Evaluation of practice competency for scrub and circulation practices.
- Evaluation and correction of surgical instrument management, including par levels, flash sterilization and competency skills
- Initiated preoperative skin antisepsis using 2% chlorhexidine gluconate (CHG) wipes.
- Initiated intra-operative skin preparation with 2% CHG and isopropyl alcohol 70%.

#### Results:

A multi-pronged approach to process improvement resulted in zero incisional SSIs associated with C-sections for greater than one year; September 2006 through September 2007. Four quarter 2007 reported one incisional infection in October and November and zero in December.

#### Lessons Learned:

- Negative patient outcomes can be successfully addressed through physician and staff collaboration, action planning, and process change/improvements
- Significant economic savings were realized as a result of the successful prevention of C-section-related SSIs
- Standardization of a CHG preoperative skin preparation contributed to rapid reduction of surgical infections while other action elements were implemented
- Evaluation and successful competency training of surgical scrub technicians and circulating nurses was conducted through the use of video scenarios and hands-on training sessions
- Standardization of intraoperative skin preparation protocols with physician support was important
- The confirmation of all action plan element implementation was necessary to sustain zero infections

## Background

Of the estimated 4,140,419 births in the United States in 2005, 30.2% (approximately 1,250,400) were by cesarean delivery (C-section).<sup>1</sup>

C-sections are associated with a higher morbidity than are vaginal deliveries.

- Women are 5 times as likely to develop a postpartum infection after undergoing a C-section than they are after undergoing a vaginal delivery.<sup>2</sup>
- These infections include surgical site infections (SSIs) and endometritis; the rate of SSIs after C-section is estimated to range from 8.9%<sup>3</sup> to 11.2%.<sup>4</sup>

Although we were unable to identify formal cost studies specifically for SSIs after C-section, studies of the costs associated with SSIs after other surgical procedures suggest that the attributable cost of these infections is high.

- In a review of the literature on SSIs, Stone et al<sup>5</sup> determined a mean attributable total cost of \$25,546 per SSI, which may include readmission and outpatient costs along with the inpatient stay associated with the C-section.
- The University of Minnesota Medical Center, Fairview (UMMC) reported a median direct cost of \$6,500/case with a \$131,000 increase during the first 6 months of 2006 in incremental costs just for the inpatient stay associated with birth – not including any readmissions or other outpatient costs. A savings of \$54,000 in incremental costs for inpatient stays associated with the birth was projected for 2007, following a return to infection rates that were below prior national benchmarks. Readmission and outpatient costs would increase the projected savings.

A reduction in SSIs is one of the goals of the 5-Million Lives campaign of the Institute for Healthcare Improvement (IHI). The 5-Million Lives Campaign seeks to improve the quality of health care by protecting patients from harm, and one of the ways identified to reach this goal is to reduce the rate of SSIs.<sup>6</sup>

- Appropriate skin antisepsis is one of the care initiatives designed to reduce SSI.

The Centers for Disease Control and Prevention (CDC) recommends that patients shower or bathe with an antiseptic on the night before surgery and that an antiseptic be applied to the skin at the incision site.<sup>7</sup>

- The CDC notes that chlorhexidine gluconate (CHG) is a commonly used skin antiseptic with a broad range of antimicrobial activity and is not flammable.<sup>7</sup> CHG is a bactericidal agent effective against Gram-positive and Gram-negative bacteria, is able to bind the skin and remain active for up to 6 hours, and is not inactivated in the presence of blood and other organic material.<sup>8</sup>
- The use of CHG in the form of a no-rinse cloth has been shown to reduce microbial counts on the skin,<sup>9</sup> and the no-rinse cloth appears to be as or more effective than a wash-rinse preparation containing 4% CHG at reducing skin bacterial counts.<sup>10</sup>
- UMMC found that assuring compliance with pre-C-section showering and bathing with an effective antiseptic is not always feasible given the frequency of home bedrest and unscheduled/unanticipated C-section cases.

Between January of 2006 and August 2006, UMMC noted that our SSI rates after C-section were greater than the benchmarks set by the National Nosocomial Infections Surveillance System Index (NNIS). Therefore, UMMC initiated a team approach to identify and address the problems that might contribute to the high rate of SSIs. Due to the benefits associated with the use of CHG-containing skin preparations, UMMC explored the use of such products as part of the initiative to reduce SSIs in C-section patients.

## Objective

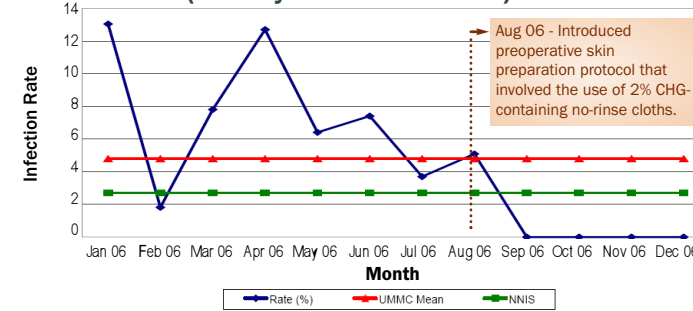
UMMC had a pre-intervention rate of SSIs after C-sections of between 1-2% and 8%. Between January of 2006 and August 2006, the SSI rates were greater than the NNIS benchmarks. UMMC used a team approach to develop interventions to reduce the SSI rates in C-section patients.

## Methods

The UMMC infection control team first identified problems that might contribute to SSIs and then developed a core team of administrators, staff, physicians, and infection control personnel to address these problems. The team collaborated periodically to discuss methodology and outcomes. **The first action and the action with the greatest positive impact was the development of a preoperative skin preparation protocol that involved the use of CHG-containing no-rinse cloths.** We instituted the following interventions:

- Introduced (in August 2006) a new product – 2% CHG-containing cloths – required for use on the skin of all C-section patients before entering the operating room (scheduled cases) and on the skin of all patients at risk of having a C-section (e.g., those with prolonged labor and premature rupture of the membranes – unscheduled cases).
- Developed a quick reference sheet to educate staff on the use of the CHG-containing cloths.
- Implemented ongoing communication with direct-care staff in the form of meetings, posters/fliers including monthly graphs, and updates to the action plan.
- Educated obstetrical scrub technicians and nurse assistants on the principles of sterilization, processes, and documentation requirements; increased the availability of surgical instruments; and shifted the responsibility for sterilization of surgical instruments back to central processing.
- Developed a knowledge base assessment tool and an educational video to train staff about appropriate antiseptic practices in the operating room; topics included hand scrubbing techniques, room set up, proper attire, and surgical preparation techniques.
- Appointed a light duty nurse from the Post-Anesthesia Care Unit to assist in review the 31 charts to help identify common risk factors for SSIs after C-Section. case-control of 144 non-infected C-section infections was also conducted.
- Initiated the use of a solution containing 2% CHG gluconate and 70% alcohol instead of alcohol alone for intraoperative skin preparation after obtaining agreement from the surgeons.
- Celebration of successes, pizza party and recognition certificate for outstanding support and performance.

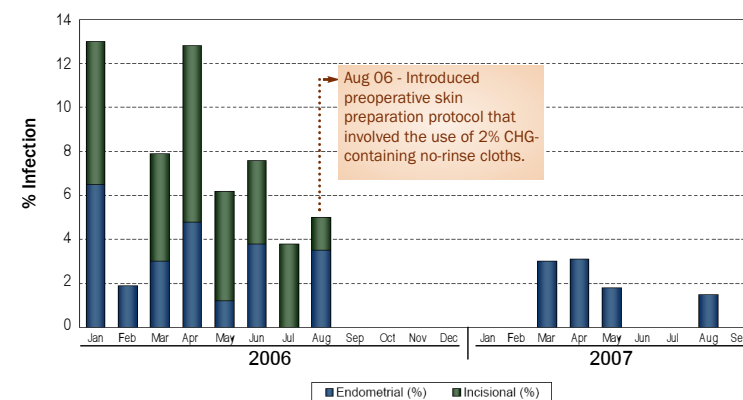
**C-Section SSI Rates at UMMC Compared to NNIS Average (January - December 2007)**



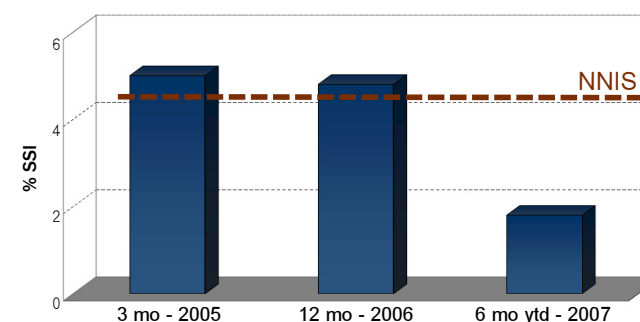
## Results

These interventions led to a reduction in the rate of SSIs after August 2006, when the use of the 2% CHG-containing no-rinse cloth was initiated. The incisional SSI rate decreased to 0% for a full year (September 2006 to September 2007). The rates dropped to zero immediately in response to initiation of the CHG-containing no-rinse cloth; allowing the team the additional time necessary to complete the action plan while continuing to deliver safe and effective care. For the remainder of 2007, there was 1 incisional SSI in October, 1 in November, and none in December.

**C-Section SSI and Endometritis Rates for January 2006 through September 2007**



**C-Section SSI Rates Compared to NNIS Average**



## Conclusions

Implementation of interventions led to a reduction in SSI rates in patients undergoing C-section. Of note, the incisional SSI rate decreased to 0% soon after the 2% CHG-containing no-rinse cloth for skin preparation was initiated in August 2006. UMMC also experienced a rapid reduction in rates of endometritis after August 2006. On the basis of the 36 SSIs that occurred at our institution from January to August 2006, the interventions may have prevented an estimated average of 4.5 infections per month. An additional savings of \$54,000 in case-related incremental costs was projected for 2007 following the return to infection levels below historical and NNIS rates.

## Lessons Learned

- Reduction of SSI rates was accomplished through the collaboration of staff and physicians and the implementation of procedural changes.
- Standardization of preoperative skin preparation techniques to include the use of CHG-containing products contributed to a reduction in SSIs.
- Education of the surgical scrub technicians and scrub nurses about operating room antiseptic, accomplished through the use of videos and hands-on training, contributed to a reduction in SSIs.
- Confirmation of an action plan to maintain the reduction in SSI rates was a necessary part of the process.

## References

- Hamilton BE, Martin JA, Ventura SJ. Division of Vital Statistics, Centers for Disease Control and Prevention. Births: preliminary data for 2005. Available at: <http://www.cdc.gov/nchs/products/pubs/pubhl/stats/prelimbirths05/prelimbirths05.htm>. Accessed April 12, 2008.
- Villar J, Carroll G, Zavaleta N, et al, for the World Health Organization 2005 Global Survey on Maternal and Perinatal Health Research Group. Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. *BMJ*. 2007;335(7628):1025.
- Opielen HK, Valbe A, Grinde-Andersen A, Walberg M. Post-caesarean surgical site infections according to CDC standards: rates and risk factors. A prospective cohort study. *Acta Obstet Gynecol Scand*. 2007;86(8):1097-1102.
- Johnson A, Young D, Reilly J. Caesarean section surgical site infection surveillance. *J Hosp Infect*. 2006;64(1):30-35.
- Stone PW, Braccia D, Larson E. Systematic review of economic analyses of health care-associated infections. *Am J Infect Control*. 2005;33:501-509.
- Institute for Healthcare Improvement. Getting Started Kit: Prevent Surgical Site Infections How-to Guide. Available at: [www.ihl.org](http://www.ihl.org)
- Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol*. 1999;24(4):250-278.
- Pollinger JM, Starks SE, Steelman VM. Skin preparation. *Postoperative Nurs Clin*. 2006;1:203-210.
- Vernon MD, Hayden MK, Trick WE, Hayes RA, Blom DW, Weinstein RA. Chlorhexidine gluconate to cleanse patients in a medical intensive care unit: the effectiveness of source control to reduce the burden of vancomycin-resistant enterococci. *Arch Intern Med*. 2005;165:306-312.
- Edmiston CE Jr, Seabrook GR, Johnson CP, Paulson DS, Beausoleil CM. Comparative of a new and innovative 2% chlorhexidine gluconate-impregnated cloth with 4% chlorhexidine gluconate as topical antiseptic for preparation of the skin prior to surgery. *Am J Infect Control*. 2007;35(2):99-96.