

## Successful Strategies for Prevention of Bariatric and Colectomy Surgical Site Infections

Sharon M. Bradley, RN, CIC  
Senior Infection Prevention Analyst

Regina M. Hoffman, RN, BSN,  
CPHRM, CPPS  
Patient Safety Liaison

Pennsylvania Patient Safety Authority

### ABSTRACT

The Pennsylvania Patient Safety Authority and Pennsylvania hospitals participating in the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) entered into a joint quality improvement collaboration to reduce surgical site infections (SSIs) among Pennsylvania NSQIP member hospitals and to share successful strategies and lessons learned with other Pennsylvania hospitals. Using an SSI prevention assessment tool based on the ACS best practices relevant to bariatric and colectomy surgery, analysts identified variances between implementation of best practices in hospitals with high SSI rates (outliers) and hospitals with low SSI rates. The outlier hospitals monitored and documented their process steps, barriers, successes, and outcome measures for implementation of SSI prevention practices in bariatric and colectomy procedures selected from the variance assessment. Both the colectomy and the bariatric outlier sites demonstrated substantial improvement in their SSI rates from the 2010 baseline period to March 2013. This improvement was accompanied by enhanced implementation of best-practice systems and processes. (*Pa Patient Saf Advis* 2014 Jun;11[2]:82-7.)

### Corresponding Author

Sharon M. Bradley



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### INTRODUCTION

Healthcare-associated infections (HAIs) have a significant impact on patients and healthcare organizations. According to the Centers for Disease Control and Prevention, the socioeconomic impacts of HAIs are divided into three categories: direct medical costs, indirect costs, and intangible costs (loss of quality of life). Annual direct medical cost benefits after adjusting for infection prevention strategies are estimated at a low of \$5.7 billion to a high of \$31.5 billion. Annual attributable inpatient hospital costs for surgical site infections (SSIs) are estimated at \$3.45 billion to \$10.07 billion.<sup>1</sup>

In December 2010, the Pennsylvania Patient Safety Authority and the Pennsylvania National Surgical Quality Improvement Project (PA-NSQIP) initiated a collaboration targeting reduction of SSIs in the collaborative member group. By June 2013, the success of the project was demonstrated by the substantial reduction of SSIs for a sustained period, improvement in implementation of SSI evidence-based best practices, and improvement in the NSQIP decile place.

### GOALS

The collaborative's short-term goal was performance improvement related to the evidence-based process measures in each of the hospitals with high SSI rates (outliers). The long-term goal was to reduce bariatric and colectomy surgery SSIs in the outlier hospitals. This would be demonstrated by a reduction in the SSI rate for each facility, as well as an improvement in the decile place on the American College of Surgeons (ACS) NSQIP national observed-versus-expected (O/E) ratio. The decile rank is a comparative rank by which individual hospital surgical outcome performance is compared with those of peer hospitals and with national averages in the ACS NSQIP national database. ACS NSQIP considers decile 1 to be "exemplary" performance, deciles 2 through 9 indicate a hospital is performing "as expected," and decile 10 is flagged as "needs improvement."

In addition to the reduction of SSIs in the outlier facilities, the lessons learned from the process and outcome successes would be shared with other Pennsylvania hospitals. Other hospitals would then be able use this information when implementing improvement plans to reduce SSIs.

### METHODS

In the first phase of the project, each of the eight PA-NSQIP member hospitals provided SSI data from two ACS NSQIP sources—the 2009 ACS NSQIP annual report and a completed survey on the O/E ratio and decile ranking for the surgical categories listed in that report. Those surgical categories included general surgery, vascular surgery, and colorectal surgery. Authority analysts identified two high-performer hospitals (with SSI rates lower than expected) and two outlier hospitals (with SSI rates higher than expected) in the general surgery category. Facilities were selected based on their reported O/E ratio, decile ranking, and individual performance in the selected categories. Authority staff conducted a secondary analysis of the two outlier hospitals with the highest SSI rates in the general surgery category and established that the highest rate of SSIs was in colectomy surgery for one outlier and in bariatric surgery for the second outlier.

On-site visits were conducted at each of the two high-performer hospitals and the two outlier hospitals to determine if there were differences in implementation of surgical best practices in bariatric and colectomy surgery. On-site visits were conducted by two separate bariatric and colectomy teams consisting of key Authority and PA-NSQIP

staff. The on-site visits were conducted using the framework of an SSI prevention assessment tool that was based on the ACS comprehensive list of existing evidence-based guidelines. The practices most relevant to bariatric and colectomy surgery were selected for the assessment tool. Interviews with nursing staff, surgeons, and anesthesia providers were conducted during the on-site visits. Authority staff analyzed the on-site assessment results and determined that the high-performing facilities (those with the low SSI rates) had stricter adherence to the best-practice guidelines.

The on-site assessment interviews identified major differences between the high-performer and the outlier hospitals for bariatric and colectomy procedures. These differences were published in a December 2012 *Pennsylvania Patient Safety Advisory* article. The *Advisory* article and assessment tool are available on the Authority's website at <http://patient.safetyauthority.org/EducationalTools/PatientSafetyTools/ssi/Pages/home.aspx>.

Both provider-specific and organizational variations in practice were observed when high performers were compared with outliers in both bariatric and colectomy surgeries. Bariatric outlier interviews revealed variation in preoperative measurement of arterial blood gas and hemoglobin A1c, postoperative upper gastrointestinal studies, and the involvement of residents in the procedure. Colorectal outlier interviews revealed variation in history of steroid use, albumin checks, patient and site preparation, decisions of diversion versus colostomy, wound protection and closure methods, antibiotic timing with prolonged procedures, operating room (OR) cleaning, traffic control, and handoffs. Provider-specific variation in bowel preparation was identified in both groups. In addition, on-site interviews identified organizational variations in both the bariatric and colectomy outliers regarding communication, safety briefings, and transport.

Collaborative teams from each of the two outlier hospitals selected process measures for implementation and measurement from the on-site assessment analysis of the differences between the high performers' and the outliers' implementation of best practices.

The bariatric outlier initially selected the following process measures:

- Number of patients who have glycosylated hemoglobin A1c drawn prior to surgery
- Number of patients with a hemoglobin A1c level over 8% who had surgery
- Number of patients who received chlorhexidine gluconate (CHG) wipes on the morning of the procedure
- Number of patients who received a Peridex swish on the morning of the procedure

The colectomy outlier initially selected the following process measures:

- Number of patients who have documentation that the surgical bundle was fully implemented
- Number of patients who have skin edge protection used during surgery
- Number of patients who have antibiotic redosing for a procedure lasting more than four hours

In the second phase of the project, from July 2012 through March 2013, the two outlier hospitals monitored and documented steps, barriers, successes, and outcome measures for implementation of the selected SSI prevention practices in bariatric and colectomy procedures.

Key Authority staff provided the collaboration with overall coordination, project management, and technical support. The Authority served as an independent facilitator to analyze facility-level SSI data, to collect any additional data provided directly by the participating hospitals, and to produce reports for the collaborative. The Authority hosted monthly topic-specific coaching and content calls

for collaborative leadership and team members. The Patient Safety Knowledge Exchange (PassKey), a password-protected, dedicated website created and maintained by the Authority, provided a virtual collaboration forum to post tools, bibliographies, and data analysis information.

The two outlier hospitals in bariatric and colectomy surgery SSIs developed hospital-specific implementation strategies based on their selected process measures identified from the variance assessment. The Authority developed a facility-specific, three-part data collection tool that provided the two outlier hospitals with a secure, web-based location to document, track, and measure progress. The tool included data on monthly implementation of selected process measures, SSI rates over time, a comparison of ACS NSQIP decile placement, and a monthly narrative of steps and barriers to implementation. Confidential PA-NSQIP internal hospital reports provided information on wound class and SSI category.

Outcome measures included raw numbers of SSIs, rate of SSIs per 1,000 patient-days, and the ACS NSQIP decile ranking based on the O/E ratio for SSIs data from the available national ACS NSQIP reports. Authority staff analyzed process measure implementation based on the number of processes correctly implemented for each surgical procedure during the same period. Results were further quantified by the specific type of SSI (superficial, deep incisional, or organ/space) and by wound category (clean, clean/contaminated, contaminated, or dirty/infected).

## RESULTS

The baseline period for measuring SSI rates was calendar year 2010. The baseline process measurement period was July through August 2012, followed by the process implementation measurement period of September 2012 through March 2013. The SSI rate outcome period was

July 2012 through March 2013. The ACS NSQIP national 2010 and 2012 decile reports with O/E ratios for SSIs were used to determine improvement in the O/E ratio for SSIs compared with ACS NSQIP hospitals nationwide.

### Bariatric SSI Outcome Improvement

In the baseline period, the bariatric outlier hospital's SSI rate was 2.3 per 100 cases of bariatric surgery. Further baseline measures included the following:

- Superficial SSIs accounted for 66.7% (6 of 9) of the SSIs in the baseline period. Organ/space SSIs accounted for 33.3% (3 of 9) of the SSIs.
- All 9 SSIs were in the clean/contaminated wound category.
- The hospital was in the 10th decile according to the ACS NSQIP national O/E ratio for SSIs.

At the end of the implementation period, the bariatric outlier hospital's SSI rate decreased from 2.3 per 100 cases to 0.3 per 100 cases (p value = 0.036). See Figure 1. Additional findings are as follows:

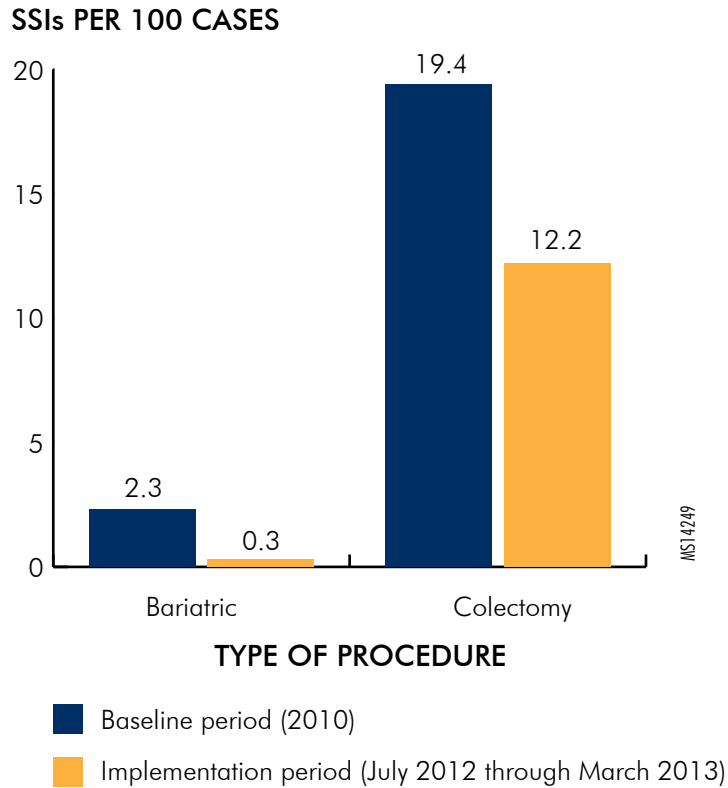
- The 1 SSI in the implementation period was a superficial SSI in the clean/contaminated wound category.
- There were no deep incisional or organ space SSIs.
- The hospital improved to the eighth decile according to the ACS NSQIP national O/E ratio for SSIs.

### Bariatric Surgery Process Improvement

In the baseline period, analysis of the bariatric outlier hospital's process implementation of the selected process measures demonstrated that

- 62.5% of patients (40 of 64) took a CHG bath the night before surgery,
- 68.8% of patients (44 of 64) received a Peridex oral swish the morning of the procedure, and

**Figure 1. Bariatric and Colectomy Surgical Site Infection Outcomes**



- 71.9% of patients (46 of 64) received CHG wipes the morning of the procedure.

At the end of the implementation period, analysis of the bariatric outlier hospital's implementation of the selected process measures demonstrated the following (see Figure 2):

- The percentage of patients who took a CHG bath the night before surgery increased to 72.8% (166 of 228). This measure was added in response to the decision to not implement the hemoglobin A1c measure within the project time frame due to multiple system issues.
- The percentage of patients who received a Peridex oral swish the

morning of the procedure increased to 90.8% (207 of 228).

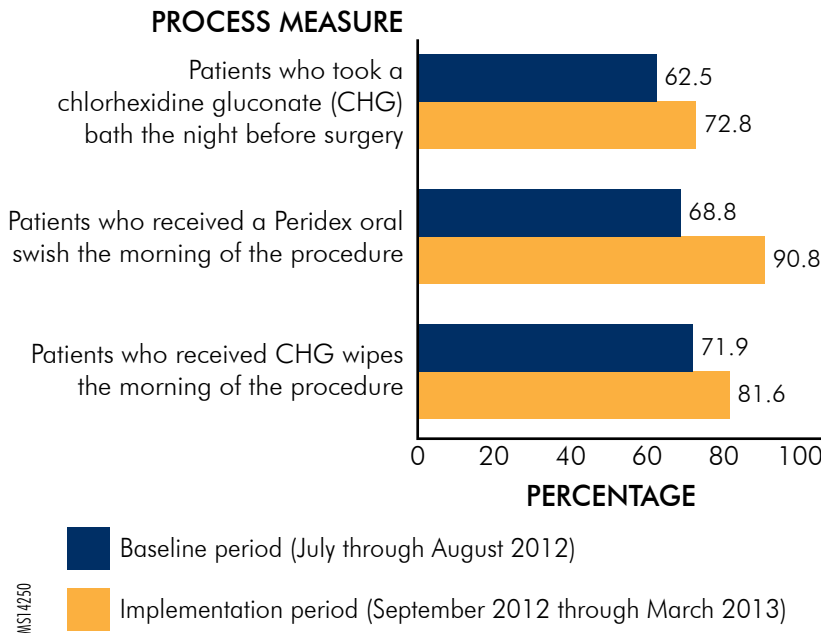
- The percentage of patients who received CHG wipes the morning of the procedure increased to 81.6% (186 of 228 patients).

### Colectomy SSI Outcome Improvement

In the 2010 baseline period, the colectomy outlier hospital's SSI rate was 19.4 SSIs per 100 cases of colectomy surgery. Further baseline measures included the following:

- Superficial SSIs accounted for 73.1% (19 of 26) of the SSIs in the baseline period. Of those, 78.9% (15 of 19) were clean/contaminated wounds, 5.3% (1 of 19) were contaminated

**Figure 2. Bariatric Process Measure Implementation**



- wounds, and 15.8% (3 of 19) were dirty/infected wounds.
- Organ/space SSIs accounted for 26.9% (7 of 26) of the SSIs in the baseline period. Of those, 71.4% (5 of 7) were clean/contaminated and 28.6% (2 of 7) were dirty/infected wounds.
- The hospital was in the 10th decile according to the ACS NSQIP national O/E ratio for SSIs.

At the end of the implementation period, the colectomy outlier hospital's SSI rate decreased from 19.4 per 100 cases to 12.2 per 100 cases (p value = 0.047). See Figure 1. Additional findings are as follows:

- Superficial SSIs accounted for 63.2% (12 of 19) of the SSIs in the implementation period. Of those, 83.3% (10 of 12) were clean/contaminated wounds, 8.3% (1 of 12) were contaminated wounds, and 8.3% (1 of 12) were dirty/infected wounds.

- Organ/space SSIs accounted for 36.8% (7 of 19) of the implementation period SSIs. Of those, 100% (7 of 7) were clean/contaminated wounds.
- The hospital improved to the eighth decile according to the ACS NSQIP national O/E ratio for SSIs.

### Colectomy Surgery Process Improvement

In the baseline period, analysis of the colectomy outlier hospital's process implementation of the selected process measures demonstrated that

- 33.3% of patients (2 of 6) with surgery time over four hours had an antibiotic redosed,
- 18.5% of patients (5 of 27) used CHG wipes the night before the surgery,
- 25.9% of patients (7 of 27) had skin edge protection during surgery,

- 77.8% of patients (21 of 27) were either nonsmokers or quit smoking more than two weeks prior to surgery,
- 70.4% of patients (19 of 27) had CHG wipes the morning of surgery, and
- 63.0% of patients (17 of 27) had intraoperative normothermia.

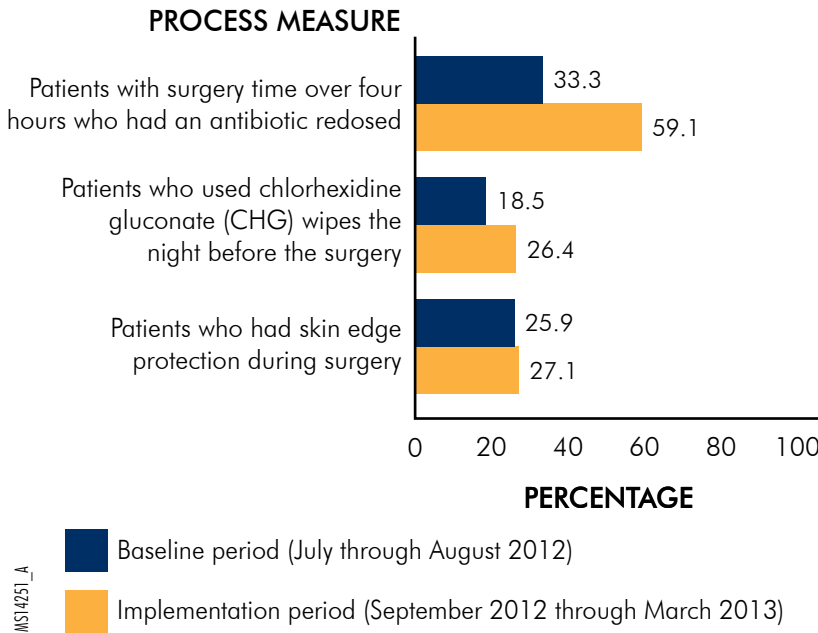
At the end of the implementation period, analysis of the colectomy outlier hospital's implementation of the selected process measures demonstrated the following (see Figures 3 and 4):

- The percentage of patients with surgery time over four hours who had an antibiotic redosed increased to 59.1% (13 of 22).
- The percentage of patients who used CHG wipes the night before the surgery increased to 26.4% (34 of 129).
- The percentage of patients who had skin edge protection during surgery increased to 27.1% (35 of 129).
- There were no improvements in the percentages of patients who were either nonsmokers or quit smoking more than two weeks prior to surgery, who had CHG wipes the morning of surgery, or who had intraoperative normothermia.

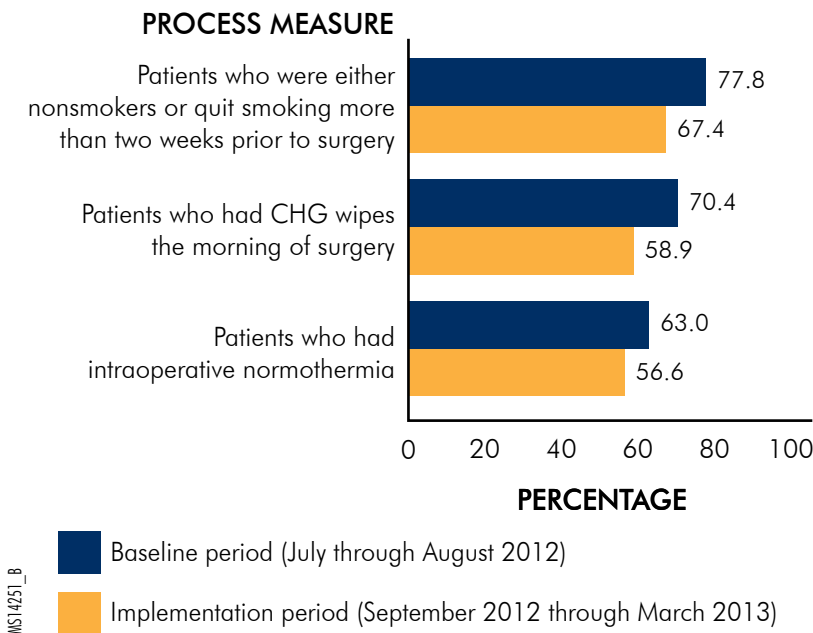
### DISCUSSION

In phase 2 of the project, the bariatric and colectomy outlier hospitals documented their monthly progress toward implementation of the process measures they selected from the comparison document. Recommendations for the use of preoperative CHG wipes and Peridex mouthwash for all bariatric patients were discussed with infection control staff and with the bariatric surgery director. All bariatric surgeons agreed to order CHG wipes and Peridex oral swish preoperatively, and these were added to the standard bariatric order sets. Documentation of both process measures was discussed with the OR director of education. The surgical staging

**Figure 3. Colectomy Process Measure Implementation—Improvement**



**Figure 4. Colectomy Process Measure Implementation—No Improvement**



area staff were instructed to document Peridex on the medication record and CHG wipes on the “ticket to the OR.” All patients were given a prescription for a CHG bath at their preoperative admission testing visit. All bariatric surgeons had also implemented wound edge protection in March 2010. This strategy was not selected as a new process measure, as compliance with this practice was tracked at 100% for the entire baseline and process implementation periods.

Information on differences in implementation of best practices between the outlier and the high-performing colectomy hospitals identified during the site visits was shared with the colectomy surgeons. Process measures that were agreed upon to monitor actual compliance included the bundle components (i.e., the percentages of patients who used CHG wipes the night before the surgery, who quit smoking within two weeks of surgery, who had CHG wipes the morning of surgery, and who had intraoperative normothermia), antibiotic redosing in cases lasting more than four hours, and wound edge protection. The implementation team identified discrepancies in the documentation of these practices and coordinated with the OR staff to provide education and to identify and overcome barriers to accurate and complete documentation of these measures.

Surgeon champions presented the chief of colorectal surgery and members of the colorectal surgery division with their most recent hospital-specific NSQIP SSI data. They also compared their results with the ACS NSQIP national average. A review was done of the colectomy best practices, derived from the site visits, and contrasted the implementation of different processes of the high-performing and outlier hospitals in colectomy SSI prevention. The chief of colorectal surgery presented a standardized data sheet to the attending surgeons to manually collect this data to ensure compliance. The data sheets were compared with the data input

into the “Surgical Care Bundle” screen by the OR nurses. Both outlier hospitals continue outcome and process improvement beyond the scope of this project by virtue of their continued participation in ACS NSQIP, a nationally validated, risk-adjusted, outcomes-based program to measure and improve the quality of surgical care across surgical specialties.

### Limitations

The original project end point was scheduled for June 2013, at which time only the June 2012 through March 2013 cases were available for process and outcome measurement. This was due to the ACS NSQIP data abstraction process, which begins 60 to 90 days after the case is completed.

The bariatric surgical staging area documentation process was revised to begin online documentation. It was unclear if documentation was absent or was not scanned into the chart. Medical records was contacted to follow up on documentation in the paper medication records. The surgical staging area educator was contacted to remind staff to document on the paper form. Implementation of the hemoglobin A1c measure was affected by the extended time frame between the blood draw at the initial visit and the date of the procedure, which is up to 24 months from enrollment to the surgery date, as well as by inconsistent ordering and multiple physician and nurse practitioner changes in the facility’s weight management center.

The outlier hospitals were encouraged to select three process measures from the phase 1 variance assessment. This strategy was suggested to ensure sufficient resource allocation to implementation activities. The colectomy outlier hospital endeavored to implement all four elements in the hospital’s SSI prevention bundle, including use of CHG wipes the night before and the morning of surgery, smoking cessation, and normothermia, as well as skin edge protection and antibiotic redosing for a procedure lasting more than four hours. There was initial inconsistency in the colectomy surgeons’ acceptance of the selected colectomy process measures. This cultural barrier affected the timing and progress of implementation of systems to achieve compliance with the process measures. Information technology issues were found that affected determining which cases lasting more than four hours required antibiotic redosing. This took several months to correct.

### CONCLUSION

In November 2013, the project’s successful outcome was shared with all PA-NSQIP consortium member hospitals and presented to the American College of Surgeons’ administrative director of the Division of Research and Optimal Patient Care (Quality Programs). The project was also selected for poster presentation at the December 2013 Institute for Healthcare Improvement 25th Annual National Forum on Quality Improvement

in Health Care in a poster titled “Using Cross-Institutional Learning to Reduce Surgical Site Infection Rates in Pennsylvania.” These activities demonstrated the lessons learned from the process implementation and outcome successes and facilitated the goal of sharing of the successes in implementation of improvement plans to reduce SSIs with other Pennsylvania hospitals. Cross-institutional learning about bariatric and colectomy SSI prevention was facilitated by arranging site visits and interactions among clinical teams from facilities struggling with implementation and their colleagues from institutions that have achieved and sustained low SSI rates.

The dedication and commitment of PA-NSQIP leadership and teams from each participating facility and collaboration with the Authority resulted in substantial beneficial outcomes in the prevention of bariatric and colectomy SSIs. Those outcomes included the substantial reduction of bariatric and colectomy SSIs for a sustained period, the creation of a collaborative learning network for the prevention of SSIs, and the creation of comparison reports to measure progress.

### Acknowledgments

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### NOTES

1. Scott RD 2nd. The direct medical costs of healthcare-associated infections in U.S. hospitals and the benefits of prevention [online]. 2009 Mar [cited 2013 Dec 27]. [http://www.cdc.gov/HAI/pdfs/hai/Scott\\_CostPaper.pdf](http://www.cdc.gov/HAI/pdfs/hai/Scott_CostPaper.pdf)

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