World J Surg (2019) 43:331–338
https://doi.org/10.1007/s00268-018-4785-5

ORIGINAL SCIENTIFIC REPORT

Reducing Healthcare Costs Using ACS NSQIP-Driven Quality Improvement Projects: A Success Story from Sheikh Khalifa Medical City (SKMC)

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Published online: 12 September 2018

Abstract

Introduction Surgical complications increase hospital length of stay and costs and lead to poor patient experience. We aim to evaluate our complication rates over time and the financial impact of joining the adult multi-specialty American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) at Sheikh Khalifa Medical City (SKMC).

Methods Sheikh Khalifa Medical City is a Joint Commission International-accredited ACS NSQIP member since 2009. For the purpose of quality improvement, we have established several task forces (2010–2014) to decrease high rates of venous thromboembolism (VTE), urinary tract infection (UTI), surgical site infection (SSI), unplanned intubation (UI), and ventilator more than 48 h (Vent > 48 h). Our aim is to evaluate our complication rates over time and calculate the cost savings from prevented occurrences in VTE, UTI, SSI, UI, and Vent > 48 h. Cost savings are calculated using the return on investment calculator from ACS NSQIP. In addition, the cost of joining and maintaining ACS NSQIP at SKMC is calculated to determine the total cost savings after subtracting these costs.

Results During the study period, we performed 8842 cases (2009–2015) and our overall morbidity improved significantly from observed/expected (O/E) 1.61% to (O/E) 0.85%. We prevented 12 VTE cases (2011–2015), 56 UTI cases (2013–2015), 12 SSI cases (2013–2015), 4 UI cases (2014–2015), and 7 Vent > 48 h cases (2014–2015). The cost saving from all these four task forces was $1,680,000. The cost of joining and maintaining ACS NSQIP at SKMC since 2009 was $336,000. Hence, the total saving for SKMC was $1,344,000.

Conclusion ACS NSQIP-driven quality improvement projects have resulted in reduction in complications and healthcare costs at SKMC over a 6-year period.

Abbreviations

ACS NSQIP	American College of Surgeon National Surgical Quality Improvement Program
VTE	Venous thromboembolism
SSI	Surgical site infection
UTI	Urinary tract infection
UI	Unplanned intubation
Vent > 48 h	Ventilator > 48 h
ROI	Return on investment

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Introduction

Reducing healthcare costs is extremely important in the era of shrinking reimbursement for healthcare delivery and value-based healthcare delivery [1–3]. The true value of a healthcare organization is to provide superior quality of care, excellent patient and staff experience while maintaining low costs of care to maintain an adequate profit margin [4]. In health care, surgical complications increase length of stay and costs and lead to poor patient experience [2]. In addition, studies have shown that ACS NSQIP-driven quality improvement projects decrease surgical complications, lower costs, and lead to better quality of surgical care [5, 6]. Similarly, we have been able to reduce surgical complications using several ACS NSQIP-driven quality improvement projects [7–10]. We aim to evaluate our complication rates over time and the financial impact of joining and maintaining ACS NSQIP to SKMC's bottom line by evaluating our cost savings.

Methods

SKMC is a tertiary referral teaching hospital with 790 beds accredited by Joint Commission International (JCI). Our surgery institute has been an ACS NSQIP Adult multi-specialty participating site since August 2009. ACS NSQIP is a risk-adjusted clinical registry that includes more than 617 hospitals in the USA, 62 hospitals in Canada, 8 hospitals in Middle East region (Lebanon, United Arab Emirates, Kingdom of Saudi Arabia, and Jordan) [11]. One of the requirements of ACS NSQIP for all participating hospitals is to obtain 30-day follow-up in more than 80% of patients enrolled [11]. In addition, ACS NSQIP requires an independent surgical clinical reviewer (SCR) to randomly select surgical cases for submission to the ACS NSQIP database [11].

We submit our cases to the ACS NSQIP portal using a systematic sampling process and an 8-day cycle schedule tool [12]. It is mandatory that this schedule be followed to assure proper systematic sampling using the daily hospital printed operative schedule.

Process of random case sampling for ACS NSQIP cases (inclusion and exclusion criteria)

The Common Procedural Terminology (CPT) code for surgical procedures is used to exclude any cases that meet one or more of the exclusion criteria. [13].

Exclusion criteria

Patient under the age of 18, ASA score of 6, cases involving hyperthermic intraperitoneal chemotherapy, acute trauma cases, transplant cases, maxillofacial, ophthalmic, dental surgery cases, and surgical procedures that are related to an occurrence of a prior procedure.

The definitions of VTE, UTI, SSI, UI, and Vent > 48 h

All ACS NSQIP sites use the same definition for VTE, UTI, SSI, UI, and Vent > 48 h from the ACS NSQIP manual chapter 4 version of 2016 [14]. For example, VTE is defined as any new diagnosis of blood clot or thrombus within the venous system (superficial or deep) which may be coupled with inflammation and requires treatment [14].

During the study period, we established four task forces as ACS NSQIP-driven quality improvement (QI) projects. These task forces were: VTE task force in 2010 in response to high rates of VTE, UTI in response to high rates of UTI and SSI task forces in 2012 in response to high rates of SSI and UI/Vent > 48 h in 2014 in response to high rates of UI and Vent > 48 h.

Results

During the study period (2009–2015), we performed 8842 cases (Fig. 1). The denominator of cases for occurrences reported by our different task forces included 7196 cases for the VTE task force (2011–2015), 4065 cases for the UTI and SSI task forces (2013–2015), and 1202 cases for the UI and Vent > 48 h task forces in 2015 (Table 1 and Fig. 1). Our overall morbidity improved significantly from observed/expected (O/E) 1.61% to (O/E) 0.85% (Fig. 2).

We prevented 12 VTE cases (2011–2015), 56 UTI cases (2013–2015), 12 SSI cases (2013–2015), 4 UI cases (2014–2015), and 7 Vent > 48 h cases (2014–2015). The cost saving from all these four task forces was $1,680,000. The cost of joining and maintaining ACS NSQIP at SKMC since 2009 was $336,000. Hence, the total saving for SKMC was $1,344,000 (Table 2).

VTE cost savings

The number of VTE cases and rates before we started the VTE task force was 7 after 1646 surgical procedures (0.53%) between 2009 and 2010, and after the VTE task force recommendations were implemented, the number of VTE cases and rates dropped to 26 cases (0.36%) after 7196 surgical procedures between 2011 and 2015. Cost per VTE occurrence is $28,000 based on the ACS NSQIP cost calculator [15]. Between 2011 and 2015, if our VTE rates remained the same (0.53%) without implementing the recommendations of the VTE task force, we would have encountered 38 VTE occurrences. Hence, the estimated

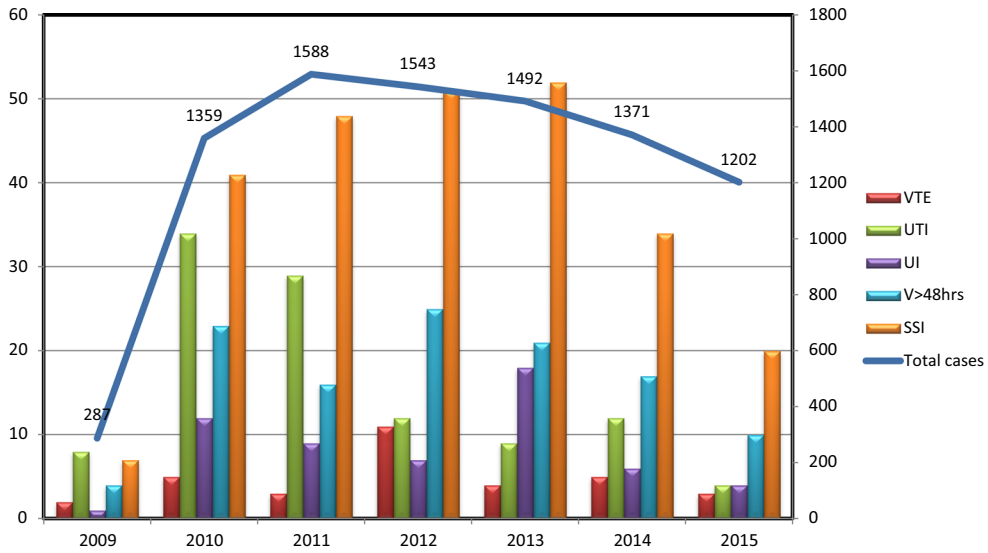

Fig. 1 Volume and occurrences over time

Table 1 SKMC case volume and occurrences per year

Total cases	287	1359	1588	1543	1492	1371	1202
Year	2009	2010	2011	2012	2013	2014	2015
VTE	2	5	3	11	4	5	3
%	0.70	0.37	0.19	0.71	0.27	0.36	0.25
UTI	8	34	29	12	9	12	4
%	2.79	2.50	1.83	0.78	0.60	0.88	0.33
UI	1	12	9	7	18	6	4
%	0.30	0.80	0.50	0.90	1.20	0.40	0.33
Vent > 48 h	4	23	16	25	21	17	10
%	1.39	1.69	1	1.62	1.40	1.23	0.83
SSI	7	41	48	51	52	34	20
%	2.40	3	3	3.30	3.90	2.40	1.66

number of VTE occurrences prevented was 12 (38–26), and cost saving is $336,000 (Fig. 3 and Table 2).

UTI and SSI cost savings

The number of UTI and SSI cases and rates before we started the UTI and SSI task forces was 83 UTI cases (2%) and 147 SSI cases (2.9%) after 4777 surgical procedures between 2009 and 2012. After the UTI and SSI task force recommendations were implemented, the number of UTI and SSI cases and rates dropped to 25 UTI cases (0.6%) and 106 SSI Cases (2.6%) after 4065 surgical procedures between 2011 and 2015. Cost per UTI and SSI occurrence is $13,000 and $28,000, respectively, based on the ACS NSQIP cost calculator [15]. Between 2013 and 2015, if our UTI and SSI rates remained the same (2%) and (2.9%), we would have encountered 81 UTI and 118 SSI occurrences. Hence, our estimated number of UTI and SSI occurrences prevented was 56 (81–25) and 12 (118–106). This translates into $1,064,000 ($728,000 and $336,000) of cost saving (Figs. 4, 5 and Table 2).

UI and Vent > 48 h cost savings

The number of UI and Vent > 48 h cases and rates before we started the UI and Vent > 48 h task forces was 53 UI cases (0.68%) and 106 Vent > 48 h cases (1.4%) after 7640 surgical procedures between 2009 and 2014. After the UI and Vent > 48 h task force recommendations were implemented, the number of UI and Vent > 48 h cases and rates dropped to 4 UI cases (0.33%) and 10 Vent > 48 h cases (0.83%) after 1202 surgical procedures between 2011 and 2015. Cost per UI and Vent > 48 h occurrence is $21,000 and $28,000 based on the ACS NSQIP cost calculator [15]. In 2015, if our UI and Vent > 48 h rates remained the same (0.68%) and (1.4%), then we would have encountered 8 UI and 17 Vent > 48 h occurrences. Hence, our estimated number of prevented UI and Vent > 48 h occurrences prevented was 4 (8–4) and 7 (17–10). This translates into $280,000 ($84,000 and $196,000) of cost savings (Figs. 6, 7 and Table 2).

Discussion

Reducing postoperative complications and costs while maintaining quality is a challenge for hospitals all over the world. SKMC's participation in the ACS NSQIP led to a significant improvement in postoperative complications and reduced morbidity across several divisions in the surgery institute [7–10]. In addition, the reduction in postoperative complications led to savings in healthcare costs.

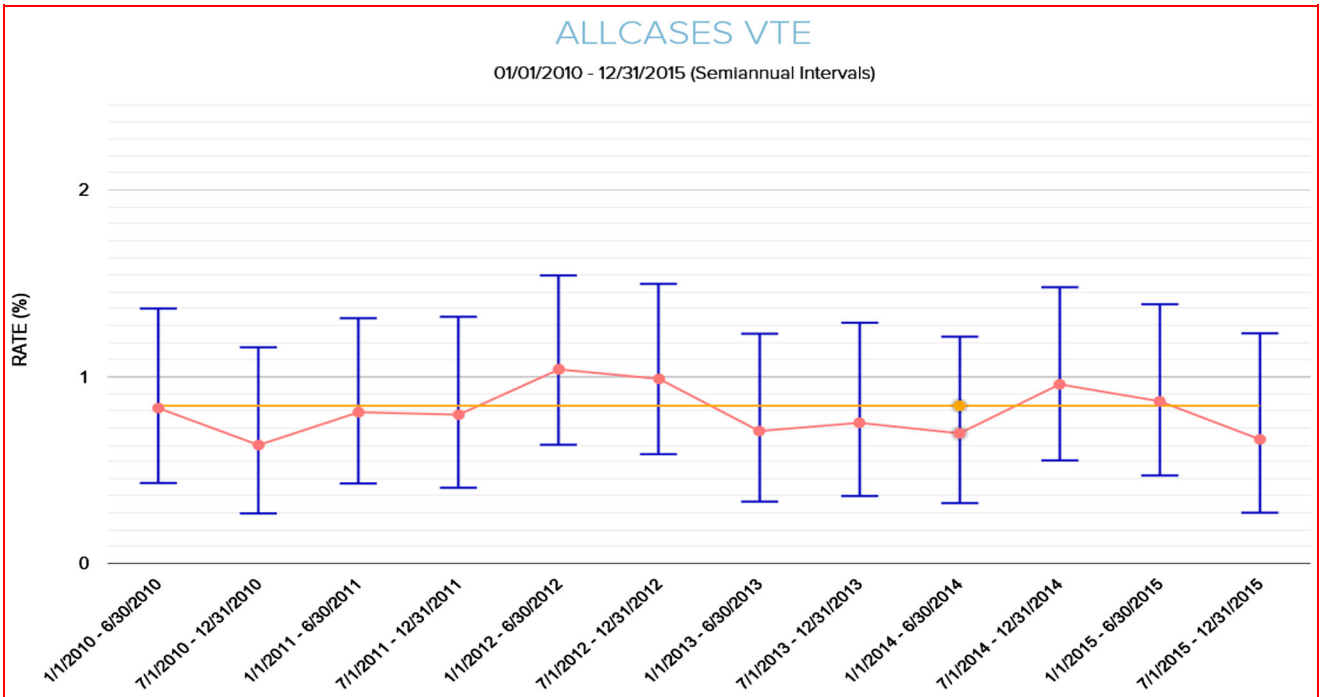

Fig. 2 Odds ratio and confidence interval of VTE in the surgery institute from 2010 to 2015

Table 2 Cost calculation of savings from prevented occurrences

Postoperative occurrences (2009–2015)	Task force (TF) year of establishment	No. of events (cumulative rate) before implementation of TF	No. of events (cumulative rate) after implementation of TF	No. of averted events after establishment	Cost per case	QI cost savings
UTI	2012	83 (2%)	25 (0.60%)	56	$13,000	$728,000
Total patients		4777	4065			
SSI	2012	147 (2.9%)	106 (2.6%)	12	$28,000	$336,000
Total patients		4777	4065			
Vent > 48 h	2014	106 (1.4%)	10 (0.83%)	7	$28,000	$196,000
Total patients		7640	1202			
VTE	2010	7 (0.53%)	26 (0.36%)	12	$28,000	$336,000
Total patients		1646	7196			
UI	2014	53 (0.68%)	4 (0.33%)	4	$21,000	$84,000
Total patients		7640	1202			
Total SKMC QI cost savings						$1,680,000
Estimated savings to SKMC (total NSQIP cost 2009–2015:$336,000)						$1,344,000

Similarly, in the 1990s, the Veterans Health Administration (VA-NSQIP) demonstrated marked improvement in surgical quality, with postoperative complication rates declining by 30% between 1994 and 1997 after implementing the first pilot of VA-NSQIP [16].

We were able to reduce postoperative complications across the surgery institute using several quality improvement (QI) projects. These QI projects were aimed at reducing our VTE, UTI, SSI, UI, and Vent > 48 h rates in our surgical patients based on our own reasons for these complications (SKMC culture). Each QI project identified a specific area of improvement that we targeted and led to our improvement in that specific category. We estimated the cost savings by estimating the events prevented by these QI projects. To estimate the events prevented, we calculated the event

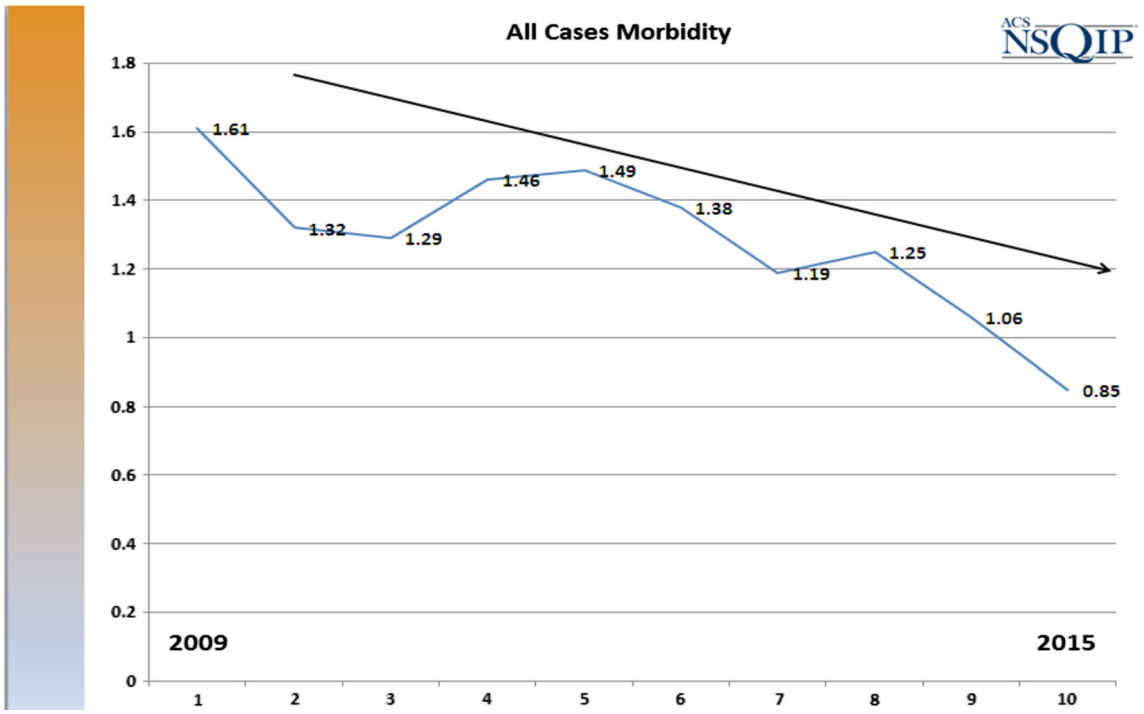

Fig. 3 Odds ratio of overall morbidity over time

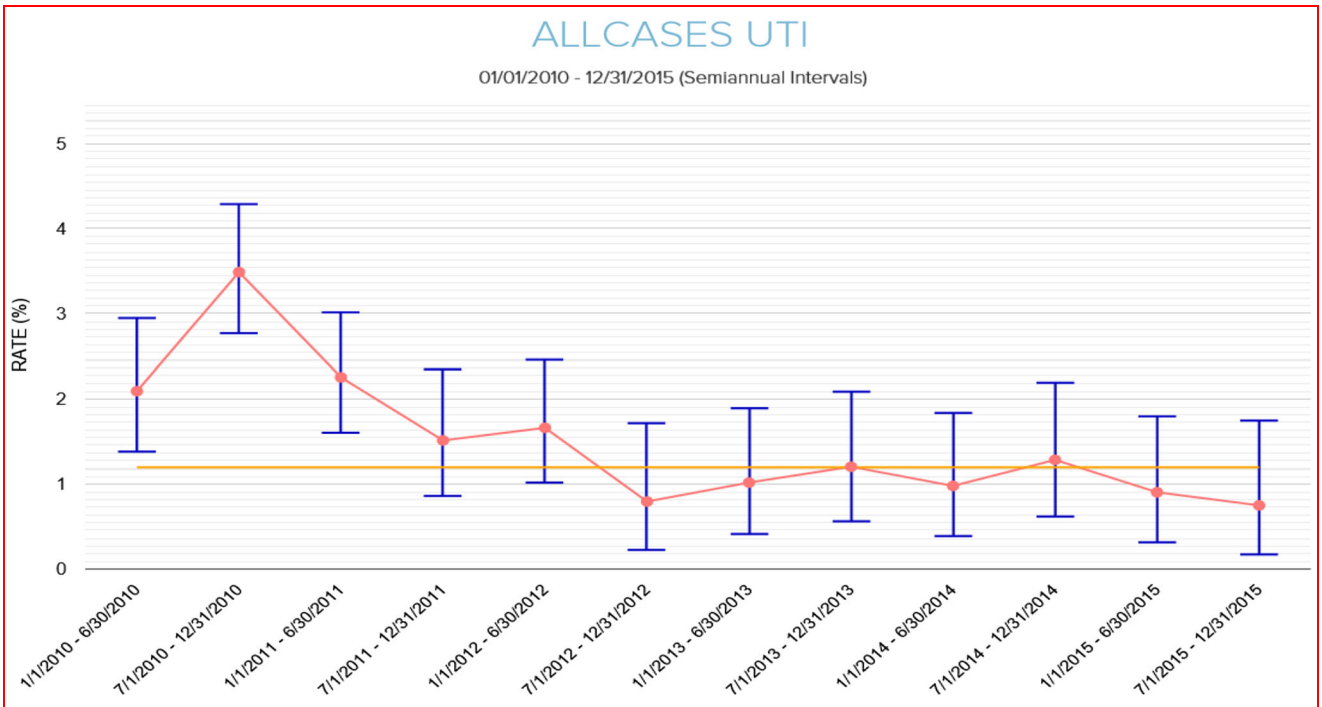

Fig. 4 Odds ratio and confidence interval of UTI in the surgery institute from 2010 to 2015

rates before and after establishing each QI project and then used the ACS NSQIP cost calculator to estimate the cost savings. Similarly, Lawson et al. [2] have used ACS NSQIP to reduce complications utilizing our approach by using quality improvement projects and procedures specific efforts to save costs.

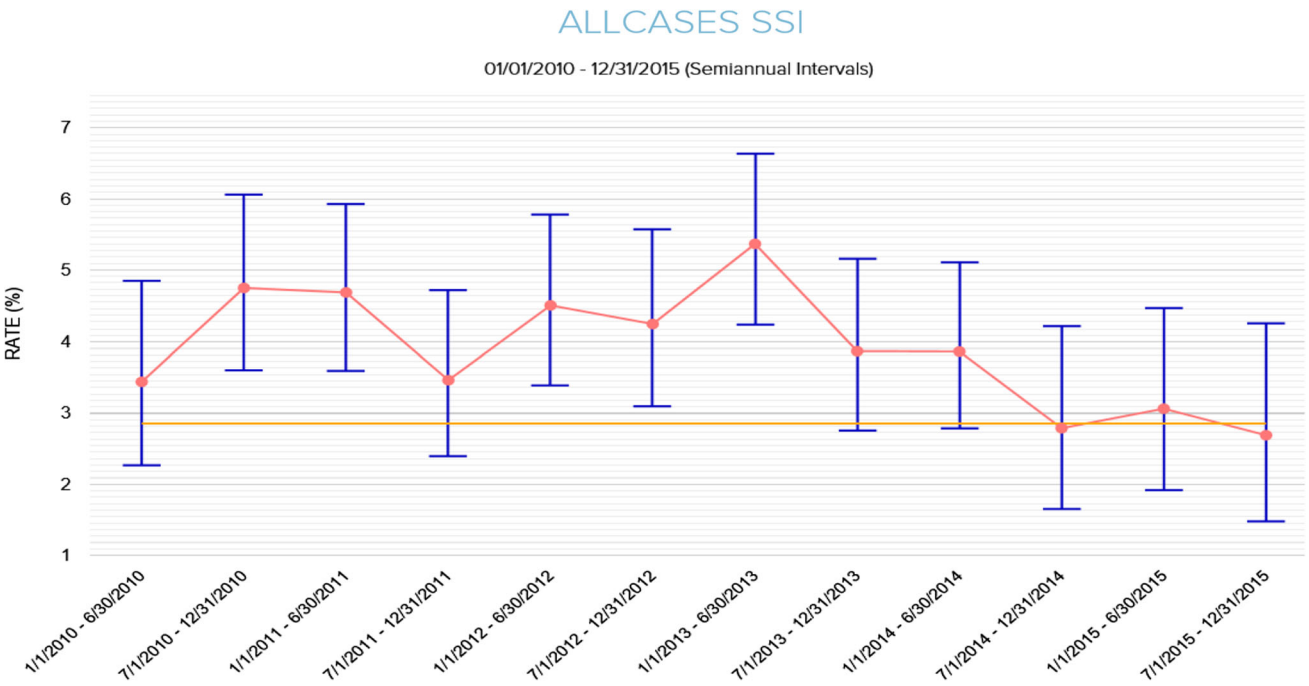

Fig. 5 Odds ratio and confidence interval of SSI in the surgery institute from 2010 to 2015

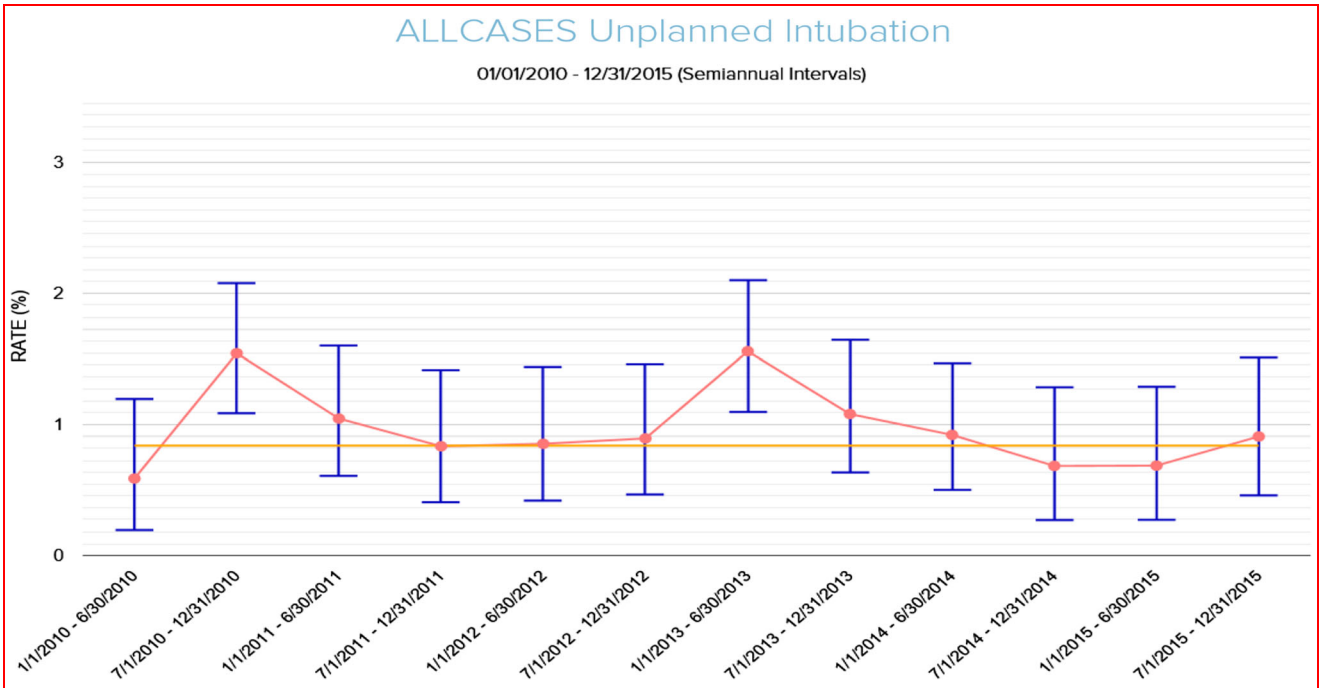

Fig. 6 Odds ratio and confidence interval of UI in the surgery institute from 2010 to 2015

We developed a theme in the way we structure our quality improvement projects and tackle areas with high morbidity. In addition, we discovered that some complications (SSI, UI, and Vent > 48 h) need more complex strategies for QI projects than others (VTE and UTI). Our efforts start by performing a comprehensive chart review of our own occurrences

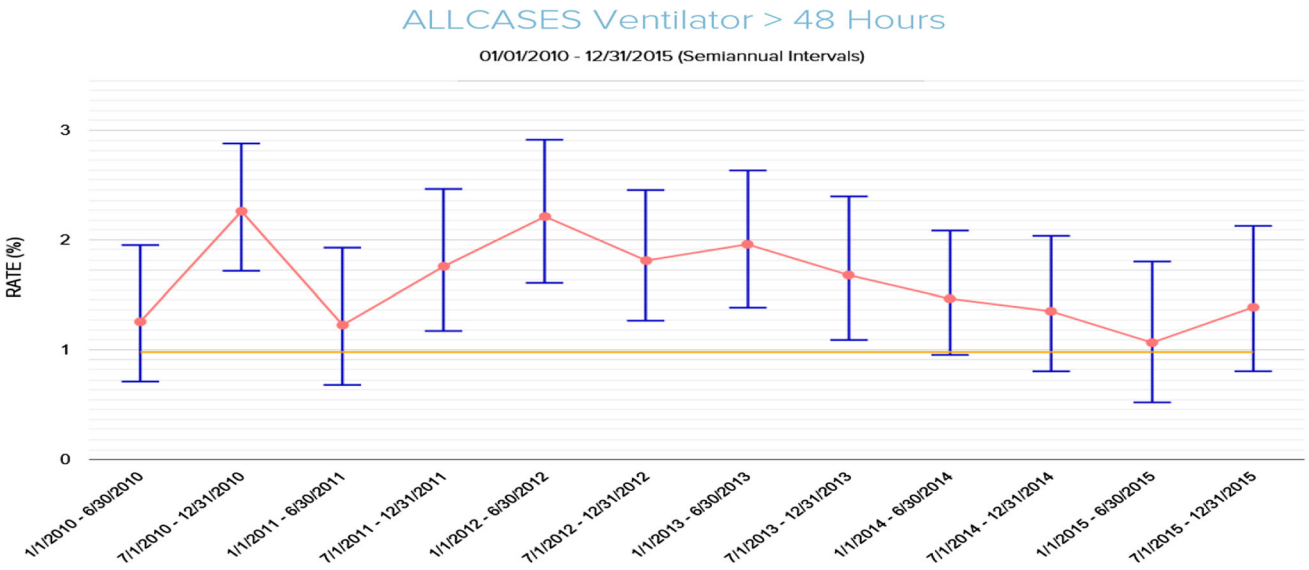

Fig. 7 Odds ratio and confidence interval of Vent > 48 h in the surgery institute from 2010 to 2015

compared to the published best practice guidelines of ACS NSQIP [17–19]. Next, we establish a multi-disciplinary task force to identify our own reasons for having these complications (our culture at SKMC). Then, we design the quality improvement projects aiming at addressing the reasons identified by the different task forces starting with the simplest, easiest, lowest hanging fruits. For example, in VTE, we identified lack of risk assessments as a major deficiency in our patient evaluation as a simple reason to address. Hence, we identified risk assessment as the target and used a compulsory risk assessment tool (Caprini risk assessment) to stratify patients risk of VTE before surgery into low, moderate, and high risk. The decision for the type of chemoprophylaxis as well as the duration after discharge from the hospital was based on this risk stratification. This method has led to an overall improvement in our VTE rates in the entire surgery institute including neurosurgery, orthopedic, general, vascular, and bariatric surgery patients [7].

Similarly, in UTI, we identified catheter-associated UTIs as well as poor staff education as our main deficiencies. Hence, we instituted an educational program for CAUTI prevention, an order set for urine catheter insertion, default removal, and limited catheter insertion in the operating room to the nursing staff. We reduced UTIs by avoiding unnecessary catheter placement, prompt removal, an educational program, and competency sessions for the nursing and medical staff dealing with urinary indwelling catheters [9].

In contrast to VTE and UTI, in SSI, UI, and Vent > 48 h no simple easy reasons or solutions were identified for our higher than expected postoperative complication rates. We found several areas of concern that we designed our QI projects to address. For example, in SSI we found that wound classification inaccuracies as well as lack of standardization in prepping the patients, hair removal before surgery, consistency with achieving normothermia, and normoglycemia after surgery as areas of concern. Our task force recommendations included an extra step in the EMR documentation to discuss wound classification between nursing and surgeon [10]. In addition, we unified our prepping practices using alcohol-based solutions and unified clipping of hair just prior to surgery, instituted an antibiotics stewardship program and intraoperative and postoperative measures to improve normothermia and normoglycemia after surgery.

Despite SKMC being an international ACS NSQIP site, we feel that being a JCI-accredited hospital and the fact that our staff were familiar with the CPT codes for surgical procedures helped in establishing and maintaining our ACS NSQIP.

Our study has several limitations, and our cost savings are an estimate of the rates of complications had we not initiated the different task forces. However, this estimate assumes that our rates would continue to be high if we did not develop our QI projects. In addition, our estimate might be inaccurate and inflate our savings. Furthermore, the study only represents a random sample of our patients as selected by ACS NSQIP random sampling method. Finally, the actual costs of these complications are an estimate based on the ACS NSQIP cost calculator.

Conclusion

Joining ACS NSQIP has resulted in a significant cost saving for SKMC over 6 years. In addition, there has been a significant improvement in surgical complications. ACS

NSQIP has helped us to decrease our rates of urinary tract infection, venous thromboembolism, surgical site infection, unplanned intubation, and ventilator more than 48 h through multiple initiative projects.

Acknowledgements We would like to thank the chairs of the quality improvement committees, chairs of surgery, and our previous SCRs (Nidal Dehni, Ahmed Maasher, David Spence, Michel Bussieres, Mohamed Hobeldin, Zoe Barrat, and Karen Mckenna).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with the human participants or animals performed by any of the authors. For this type of study, formal consent is not required.

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