Extra Charge and Extra Length of Postoperative Stay Attributable to Surgical Site Infection in Six Selected Operations

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Background: *Information concerning the economic impact of surgical site infection (SSI) is very rare in Thailand. As the national health care financial system has been changing, the need for such data is critical.*
Objective: *The purpose of this study is to estimate the extra charge and excess postoperative hospitalization attributable to SSI in six surgical operative procedures comprising appendectomy, herniorrhaphy, mastectomy, cholecystectomy, colectomy, and craniotomy.*
Material and Method: *The study population consisted of patients undergoing major operations admitted to Songklanagarind Hospital from January, 1998 to December, 2003. Data were prospectively collected to identify demographic data, surgical operations, development of SSI, and outcomes of SSI. The study used one-to-one matched-pair strategy to compare case (patient with SSI) and controls (patient without SSI). The matching criteria were same final diagnosis, same operative procedure, and same American Society of Anesthesiologists (ASA) score. Data were calculated for mean difference, median difference, and 95% confidence intervals (95% C.I) of hospital charge and postoperative stay.*
Results: *The study could identify 140 matched-pairs of case and control. When compared to matched controls, cases had higher hospital charge and greater postoperative length of stay. Mean of extra hospital charge attributable to SSI was 43,658 (95% C.I; 30,228-57,088) baht and mean of excess postoperative stay was 21.3 (95% C.I; 16.6-26.0) days. Median of extra expenditure was 31,140 (95% CI; 17,327-49,081) baht and median of prolongation of postoperative stay was 14 (95% C.I, 12-18) days.*
Conclusion: *This study supports the findings of the previous published reports that patients who have SSI incur enormous excess cost and hospital stay.*

Keywords: *Cost of illness, Costs, Cost analysis, Cross infection, Surgical site infection*

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Postoperative wound infections have been a problem for as long as humans have used surgery as a disease treatment. Many revolutions in medicine have prevented or brought some types of infection under control. The introduction of antiseptics has been considered to be one of the great milestones of surgery. The discovery of antimicrobial agents enabled us to operate in many conditions that we would have not been able to do before the antibiotic era because of risk of infection. Advances in modern medicine, on the other hand, have created a new kind of patient population with immunocompromised hosts and implantation. With the emergence of highly antibiotic-resistant microorganisms and the expanding complexities of modern surgery, postoperative infection remains a major public health problem.

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Infections developing in surgical patients have continued to produce important effects on the final result of the surgical treatment, morbidity, mortality and economic impact. Delayed healing, disability, deformity, prolonged hospital stay, increased cost of health care, and even death have resulted from such infection. Information regarding the effects of surgical site infection is essential for infection control personnel in priority setting and planning nosocomial infection control surveillance and control programs. Many authors have reported the adverse effects of surgical site infections in terms of extra charge and extra length of hospital stay [1-10], but the figures vary from country to country, from hospital to hospital and from time to time, due in part to the different health care financial systems and monetary value. Thus, each country and hospital should periodically assess their own data. The authors conducted a study with the primary intention of elucidating the extra charge and extra length of postoperative stay attributable to surgical site infection in six selected surgical procedures including appendectomy, herniorrhaphy, mastectomy, cholecystectomy, colectomy, and craniotomy.

Material and Method

Setting

Songklanagarind Hospital is a 750-bed, government-owned hospital. It serves as a referral center for the southern part of Thailand, medical school and residency-training institute. The hospital belongs to the Faculty of Medicine, Prince of Songkla University. The infection control unit of the hospital was established in the year 1986 and has continuously conducted surgical infection surveillance activities until the present time. Nosocomial infection surveillance has been performed by three full-time infection control nurses (ICNs).

Data collection

Since 1998 the surveillance of surgical site infections has been limited to six major surgical procedures including craniotomy, appendectomy, herniorrhaphy, cholecystectomy, mastectomy, and colectomy. The ICNs reviewed the log book of the operative theatre every day for operations that met the inclusion criteria. The name of the patient, hospital number, and ward where the patient resided were identified via the records of the operative rooms. Each of the three infection control nurses visited each ward, including the intensive care unit, twice a week. The medical records of the patients, operative notes, anesthetic records, diagnostic imaging reports, microbiology investigation data and other laboratory results were reviewed. Information on variables associated with operative procedure (time, duration, type of operation, and degree of wound contamination) were also recorded. After discussion with the nurses and attending physicians in that ward, the pertinent data were recorded on preprinted data collection forms. The physical status classification of the patients according to the American Society of Anesthesiologists (ASA) was identified from anesthetic records[11]. Medical records of the discharged patients in the outpatient department and medical records of the readmitted patients were also reviewed for evidence of infection developing after hospital discharge. If the patient was lost to follow up, there was no other system for detection of post-discharge infection. The criteria of National Nosocomial Infection Surveillance (NNIS) system were employed for diagnosing surgical site infection[12]. The operative procedures were classified according to degree of contamination into one of four classes (clean, clean-contaminated, contaminated, or dirty/infected). The patients' final diagnoses and operations were coded according to the International Classification of Disease 10th Revision (ICD-10) and the International Classification of Disease 9th Revision, Clinical Modification (ICD-9 CM), respectively. The operative procedures were also classified and assigned risk index categories according to the NNIS [13]. Data on hospital charges were retrieved from the central financial department of the hospital.

Research design

The authors employed a matched-pair research design to evaluate the excess hospital charge and excess postoperative stay resulting from surgical site infection. In order to provide fair comparison, the study employed the one-to-one matched-pair strategy for comparing the patients with SSI and patients without SSI. The difference between the two comparison groups was assumed to be attributable to SSI.

The matching variables were first identified by assessing the strength of association with increased hospital charge and postoperative hospital stay. The method used to identify the factors associated with increased hospital charge and prolonged postoperative stay was multiple linear regression model analysis. The independent variables included in the models were presence of SSI, ASA score more than 2, surgical procedures, preoperative stay more than 1 day, emergency operation, age more than 45 years, wound class more than clean-contaminated wound, and sex.

The two variables, other than operative procedure and diagnosis, that were identified as most strongly associated with both increased hospital charge and prolonged postoperative stay were used as the matching variables.

Matching scheme

The authors defined a patient with SSI as a case and a matched patient without SSI as a control. For each case, a matched control was selected from the patients without SSI. The criteria used in the matching procedure were based on type of operation, diagnosis, and variables identified from multiple linear regression models. The matching criteria were same final diagnosis, same surgical operation, same operative year, and same ASA score. The diagnosis and operation were matched close to three digits of ICD-10 and ICD-9-CM respectively[4]. The cases that could not be matched were discarded from analysis. If the matching scheme could identify more than one control, additional matching criteria were applied in a stepwise fashion. The additional matching criteria included emergency operation, preoperative stay, wound class, and age.

Statistical analysis

Data are expressed as percentages for demographic data. Multiple linear regression analysis was used to assess significant variables associated with hospital charge and postoperative stay. Because data distribution of hospital charge and postoperative stay were highly skewed, log transformation was performed before being included in the multiple linear regression model. The continuous and ordinal independent variables, preoperative stay, age, ASA score, and wound class, were modified to dichotomous variables before modeling in multiple linear regression. Only variables that showed statistically significant ($p < 0.05$) association with hospital charge and postoperative stay were included in the multivariate model. Comparisons of mean and median were made in terms of mean difference and median difference, and their 95% confidence intervals (95%CI), of hospital charge and postoperative stay between the two groups using mean difference analysis and paired t-test to compare means, and percentile difference analysis and Wilcoxon signed-rank test to compare medians. Statistical analyses were performed using Stata version 7 (Stata Corp, College Station, Tex).

Results

There were 150 SSIs identified in 4,689 operations during the study period from January 1998 to December 2003, accounting for an overall crude SSI rate of 3.2%. Ten SSIs (6.7% of SSIs) were discarded because of no suitable controls available, leaving 140 pairs to be recruited in the present study. The multiple linear regression models revealed that SSI, ASA score more than two, and surgical procedure were among the factors most highly associated with increased hospital charge and prolonged postoperative stay (Tables 1, 2).

Based on the results of multiple linear regression analysis, the primary criteria used for matching were same operation, same diagnosis, and same ASA score. One hundred and forty matched-pair controls could be selected from the patients without SSI.

The differences between cases and matched controls are shown in Table 3 (comparing mean) and Table 4 (comparing median). Infection in craniotomy could result in the highest health care expenditure and hospital stay.

Table 1. Multiple linear regression model for logarithm of hospital charge

Variables	Coefficient (β)	p
Intercept	8.245	<0.001
Surgical site infection	0.542	<0.001
ASA score > 2	0.503	<0.001
Surgical procedures	0.341	<0.001
Preoperative stay > 1 day	0.291	<0.001
Emergency operations	0.275	<0.001
Age > 45 years	0.193	<0.001
Wound class > clean-contaminated	0.139	<0.001

Table 2. Multiple linear regression model for logarithm of postoperative stay

Variables	Coefficient (β)	p
Intercept	0.571	<0.001
Surgical site infection	0.884	<0.001
ASA score > 2	0.339	<0.001
Wound class > clean-contaminated	0.294	<0.001
Surgical procedures	0.291	<0.001
Emergency operations	0.286	<0.001
Preoperative stay > 1 day	0.199	<0.001
Age > 45 years	0.065	0.002

Table 3. Mean of hospital charge (baht) and postoperative stay (days) among cases and controls

	Cases (n = 140)		Controls (n = 140)		Difference		Paired t-test
	Mean	95%CI	Mean	95%CI	Mean	95%CI	p
Craniotomy (n = 62 pairs)							
Hospital charge	117,135	96,735-137,534	50,018	42,366-57,670	67,116	45,547-88,686	<0.0001
Postoperative stay	48.0	40.6-55.5	16.8	13.4-20.2	31.2	23.1-39.3	<0.0001
Colectomy (n = 23 pairs)							
Hospital charge	69,958	35,055-104,861	27,642	21,893-33,392	42,316	7,940-76,691	0.0170
Postoperative stay	27.4	18.6-36.3	8.7	7.3-10.1	18.7	10.0-27.5	0.0001
Cholecystectomy (n = 13 pairs)							
Hospital charge	52,975	24,758-81,193	22,812	15,120-30,504	30,163	2,459-57,868	0.0341
Postoperative stay	16.7	10.5-22.9	8.1	4.6-11.6	8.6	1.9-15.4	0.0147
Appendectomy (n = 21 pairs)							
Hospital charge	27,647	17,349-37,945	8,482	6,863-10,100	19,165	9,065-29,265	0.0004
Postoperative stay	17.2	13.1-21.3	4.2	3.3-5.1	13.0	8.9-17.1	<0.0001
Mastectomy (n = 11 pairs)							
Hospital charge	23,413	14,583-32,242	16,699	12,309-21,090	6,713	2,518-15,945	0.1449
Postoperative stay	20.5	13.7-27.4	9.8	7.3-12.4	10.7	3.9-17.6	0.0038
Herniorrhaphy (n = 10 pairs)							
Hospital charge	17,801	12,053-23,548	6,882	4,960-8,804	10,919	5,290-16,547	0.0007
Postoperative stay	13.0	9.8-16.2	2.0	1.4-2.6	11.0	7.9-14.1	<0.0001
Total (n = 140 pairs)							
Hospital charge	75,544	62,854-88,234	31,886	27,313-36,460	43,658	30,228-57,088	<0.0001
Postoperative stay	32.5	28.1-36.8	11.2	9.4-13.0	21.3	16.6-26.0	<0.0001

95%CI = 95% Confidence intervals

Table 4. Median of hospital charge (baht) and postoperative stay (days) among cases and controls

	Cases (n = 140)		Controls (n = 140)		Difference		Wilcoxon signed-rank test
	Median	95%CI	Median	95%CI	Median	95%CI	p
Craniotomy (n = 62 pairs)							
Hospital charge	91,584	83,248-114,130	40,424	35,719-48,726	49,637	37,338-63,247	<0.0001
Postoperative stay	39.5	33.0-50.0	13.0	9.8-16.2	25.0	19.0-33.0	<0.0001
Colectomy (n = 23 pairs)							
Hospital charge	41,828	33,026-74,281	23,345	19,285-32,822	18,535	6,278-36,882	0.0002
Postoperative stay	22.0	16.3-27.5	8.0	7.0-9.7	13.0	8.0-18.0	<0.0001
Cholecystectomy (n = 13 pairs)							
Hospital charge	36,518	28,594-74,373	22,253	11,745-28,078	15,374	5,909-29,362	0.0037
Postoperative stay	16.0	10.4-17.0	7.0	4.4-9.0	8.0	3.0-11.0	0.0018
Appendectomy (n = 21 pairs)							
Hospital charge	19,314	11,723-30,438	7,375	6,170-10,184	12,836	5,113-21,152	0.0001
Postoperative stay	15.0	11.3-23.5	3.0	3.0-5.5	12.0	8.0-18.0	0.0001
Mastectomy (n = 11 pairs)							
Hospital charge	17,487	12,808-35,713	13,816	11,563-23,770	4,577	3,687-17,720	0.0505
Postoperative stay	16.0	13.3-31.6	10.0	6.7-13.0	9.0	3.0-20.0	0.0163
Herniorrhaphy (n = 10 pairs)							
Hospital charge	17,327	9,504-26,909	6,692	4,575-9,687	10,498	4,372-16,948	0.0051
Postoperative stay	12.5	9.0-17.7	2.0	1.0-3.0	10.5	8.0-15.0	0.0050
Total (n = 140 pairs)							
Hospital charge	50,951	38,199-67,416	24,568	20,832-28,643	31,140	17,327-49,081	<0.0001
Postoperative stay	24.0	20.9-28.0	8.0	7.0-9.0	14.0	12.0-18.0	<0.0001

95%CI = 95% Confidence intervals

From Tables 3 and 4, it can be seen that the mean differences of hospital cost and postoperative stay are greater than the corresponding median differences.

Paired t-test and Wilcoxon signed-rank test were calculated and both tests showed statistical difference ($p < 0.0001$)

Discussion

In the present study, a matched-pair analysis was employed to control potential confounding factors. The matching variables were derived first from the multiple linear regression analysis for the strongest association with outcome of interest. The authors assumed that the matching scheme is appropriate and that the weak confounding factor is not included (overmatching).

The authors used postoperative stay as a surrogate marker of the outcome of SSI. Extra hospital stay is an important indicator of the impact of nosocomial infection. Extra hospitalization can be measured directly by expert rating in which an independent physician evaluates individual patients' file to determine the number of extra days spent in hospital due to an acquired infection. This approach is, however, subjective and therefore not reliable[15]. One approach used most frequently to estimate extra stay is based on comparison of patients with and without infection. The reason that the authors did not use total length of hospital stay was that it may be overestimated, because prolonged preoperative stay has been shown to be associated with SSI[16-19]. For this reason, Whitehouse et al, a study in the United States used postoperative stay as the indicator of the impact of SSI[4]. As in a study in Spain, Asensio et al measured the net effect of deep surgical site infection (DSSI) on postoperative stay among patients who had undergone open heart surgery[8]. Similarly in Germany, Schulgen et al used postoperative stay to estimate the outcome of nosocomial infection[15] as did a similar study in France[22].

Most previous studies have found that the estimate of the extra charge and increased postoperative stay due to SSI has generally been based on the arithmetic mean difference for corresponding pairs of patients[2,3,5,7,9,10,15]. It has occasionally been computed as the difference in median values[1,4,8]. Nevertheless, the distributions of the data on extra charge and prolonged postoperative stay due to SSI were positively skewed. The arithmetic mean could be heavily affected by extreme values, and the use of an associated symmetrical confidence interval as a mark of the credibility of the calculation could be misinterpreted[7,8]. Owing to the skewed distribution of the data, the median difference should be more appropriate to estimate the cost and extra postoperative stay attributable to SSI. It could be interesting to compare the results of the mean and median analysis of the differences in charge and duration of postoperative stay between cases and controls. Thus, in the present study the authors computed both mean and median of the differences between SSI and non-SSI patients.

Previous authors have reported the extra charge for SSI ranging from $ 858 to $ 17,708 per infection and the excess length of stay attributable to SSI ranging from 1 to 44 days[1-10,15,20-32]. The results of the present study confirm a significant increase in hospital charge and postoperative stay due to SSI. However, it is difficult to compare with the preceding studies because the assumptions used to determine the increased hospital charge and the prolongation of length of stay are vulnerable to some bias. First, the extent to which the results derived from the literature reflect the patient groups included here was not similar. Furthermore, the studies used to derive these values employed various methods for the attribution of additional charge and excess length of stay to SSI. Lastly, these studies were conducted in different countries and time periods. Clinical practice would vary and baseline cost and lengths of stay have certainly changed during the time period in which the studies were conducted. The results of a literature review to estimate extra cost and extra length of hospital stay attributable to SSI are shown in Table 5.

Currently, more patients undergo short-stay surgical procedures, many SSIs are detected after discharge from the hospital; therefore, resource utilization associated with these infections is often shifted to subsequent hospitalizations, as well as into the outpatient setting. For this reason, the authors included cost and length of readmission in our analysis of outcomes. In the present study, 13 cases (8.7%) SSIs were apparent post-discharge and ten cases (6.7%) required readmission. Of these, post-discharge SSI occurred mainly in patients who underwent appendectomy procedure (7 cases in 21 cases, 33.3%), followed by herniorrhaphy procedure (2 cases in 10 cases, 20.0%), cholecystectomy procedure (1 case in 12 cases, 8.3%), and craniotomy procedure (3 cases in 59 cases, 5.1%). However, the authors could not follow-up all the study patients because of some weakness of post-discharge surveillance system. This

Table 5. Results of literature review to estimate extra length of stay and extra cost attributable to surgical site infection

Authors	Country	Procedure	Extra length of stay (days)		Extra cost		Reference No.
			Mean Difference	Median Difference	Mean Difference	Median Difference	
Askarian et al, 2003	Iran	All admission	8.7	8.0	-	-	20
Whitehouse et al, 2002	United States	Orthopedics	-	1.0	-	$ 17,708	4
Astagneau, 2001	France*	Gastrointestinal, orthopedics, and gynaecology	8.5	-	-	-	9
Plowman et al, 2001	England*	All admission	6.5	-	1,618	-	21
Merle et al, 2000	France**	Digestive tract	7.2	5.0	-	-	22
Schulgen et al, 2000	Germany**	Cardiac surgery, general surgery	16.9	-	-	-	15
Asensio et al, 1999	Spain**	Cardiac surgery	9.1	25.0			8
Kirkland et al, 1999	United States**	Cardiac surgery, general surgery, and orthopedics	-	12.0	-	$ 5,038	1
Pena et al, 1996	Spain	All admission	-	10.0	-	310,310 pesetas	23
Poulsen et al, 1994	Denmark	General surgery	5.7	-	-	-	24
Coello et al, 1993	England+	General surgery, orthopedics, and gynecology	10.2	-	1,798	-	25
Mugford et al, 1989	England+	Cesarean section	2.1	-	1,170	-	26
Rubenstein et al, 1982	United States+	General surgery and orthopedics	12.9	-	1,912	-	27
Green et al, 1982	Israel	General surgery and orthopedics	12.9	-		-	7
Fabry et al, 1982	France*	General surgery	6.1	-	$ 973	-	28
Haley et al, 1981	United States	All admission	7.3	-	$ 838	-	29
Davies et al, 1979	England+	Orthopadics	17.0	-	2,015	-	30
Scheckler, 1978	United States+	All admission	7.5	-	3,400	-	31
Green et al, 1977	United States+	General surgery	6.0	-	1,425	-	32

All studies used matched control methods for attribution extra length of hospital stay to surgical site infection, except for these indicating in* which indicates that a cohort study with regression modeling was used, and** which indicates the estimation in term of extra postoperative hospital stay. + Costs have been converted into sterling using the OECD 'Health data database' (1996) and have been adjusted to 1999/00 prices by using a factor series that takes into account hospital input cost inflation in England

trend may in turn lead to underestimates of the rate of SSI, the cost, and the hospital stay of such infections.

Several limitations were inherent in the present study. Potential limitations relate to the matched-pair design that we used. First, it restricts the information from non-infected patients to one per infected patient, and cannot use information from other non-infected patients. Thus, the vast numbers of patients are lost as subjects in the present study. Second, complete matching is difficult and forces one to discard infected patients for whom those and no matched controls. The availability of a large pool of potential uninfected control patients enabled the authors to match successful 93.3% of the 150 infected patients. The ten unmatched patients in the present study had a higher charge and longer postoperative stay than infected patients who were matched successfully. Thus, if the exclusion had an effect on the outcome measures, it most likely led the authors to underestimate the extra charge and extra postoperative stay attributable to SSI.

Sample size is the other potential limitation of the present study since the numbers of SSIs in some operative procedures such as herniorrhaphy, mastectomy, and cholecystectomy are small. Thus, they lack the statistical power to confirm the results.

In addition, the accurate assessments of total cost could not be obtained in the present study because the only expenditure data available were hospital charges. Therefore, the additional costs in the present study are likely to be underestimated.

The authors recommend further research concerning post-discharge SSI, especially for short-stay surgical procedures such as appendectomy and herniorrhaphy procedures. Furthermore, the authors emphasize the need to be concerned about the skewed distribution of data and sample size when analyzing the data because they may lead to misinterpreting the results of the study. The authors suggest the use of median difference to compare hospital charge and postoperative stay because of these outcomes do not assume a normal distribution. Finally, not only the median difference should be presented but also the 95% confidence intervals.

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ค่าใช้จ่ายและจำนวนวันนอนโรงพยาบาลหลังผ่าตัดที่เพิ่มขึ้นจากการติดเชื้อตำแหน่งผ่าตัด

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ที่มา*: ในประเทศไทยมีรายงานการศึกษาน้อยมากในเรื่องผลกระทบของการติดเชื้อตำแหน่งผ่าตัด ประกอบกับระบบบริการสุขภาพ และคุณภาพการดูแลผู้ป่วยซึ่งมีการเปลี่ยนแปลงอยู่ตลอดเวลา ทำให้โรงพยาบาลต่าง ๆ ต้องการทราบข้อมูลที่ทันสมัยเกี่ยวกับผลกระทบของการติดเชื้อตำแหน่งผ่าตัดในเรื่องค่าใช้จ่ายและจำนวนวันนอนโรงพยาบาลหลังการผ่าตัดที่เพิ่มขึ้น*

วัตถุประสงค์*: เพื่อประมาณค่าใช้จ่ายที่เพิ่มขึ้น และจำนวนวันนอนโรงพยาบาลหลังผ่าตัดที่นานขึ้นในผู้ป่วยที่มีการติดเชื้อตำแหน่งผ่าตัด*

วัสดุและวิธีการ*: ศึกษาในผู้ป่วยที่ได้รับการผ่าตัดใหญ่ 6 ชนิด ได้แก่ การผ่าตัดไส้ติ่ง ไส้เลื่อน เต้านม ถุงน้ำดี ลำไส้ใหญ่ และผ่าตัดสมอง ในโรงพยาบาลสงขลานครินทร์ ระหว่างเดือนมกราคม พ.ศ. 2543 ถึงธันวาคม พ.ศ. 2546 เป็นการศึกษาแบบไปข้างหน้า ทำการเก็บรวบรวมข้อมูลทั่วไปของผู้ป่วย ข้อมูลการผ่าตัด และข้อมูลผลกระทบของการติดเชื้อตำแหน่งผ่าตัด การวิเคราะห์เปรียบเทียบความแตกต่างระหว่างผู้ป่วยที่เกิดการติดเชื้อตำแหน่งผ่าตัดและผู้ป่วยที่ไม่เกิดการติดเชื้อตำแหน่งผ่าตัด ทำโดยการจับคู่แบบหนึ่งต่อหนึ่งระหว่างผู้ป่วยที่เกิดการติดเชื้อและผู้ป่วยที่ไม่เกิดการติดเชื้อซึ่งมีการวินิจฉัยโรค การผ่าตัด และสภาวะสุขภาพของผู้ป่วยก่อนการผ่าตัดเช่นเดียวกัน แล้วคำนวณหาค่าใช้จ่ายเฉลี่ย จำนวนวันนอนโรงพยาบาลหลังผ่าตัดเฉลี่ยในผู้ป่วยที่ติดเชื้อและไม่ติดเชื้อ หลังจากนั้นคำนวณหาค่าใช้จ่ายที่มากขึ้นและจำนวนวันนอนโรงพยาบาลหลังผ่าตัดที่เพิ่มขึ้น โดยใช้ค่าความแตกต่างของค่าเฉลี่ย ค่าความแตกต่างของค่ามัธยฐาน และค่าความเชื่อมั่น (95% confidence intervals)*

ผลการศึกษา*: มีผู้ป่วยทั้งหมด 140 คู่ ผู้ป่วยที่มีการติดเชื้อตำแหน่งผ่าตัดมีค่าเฉลี่ยของค่าใช้จ่ายเพิ่มขึ้น 43,658 (95%CI; 30,228-57,088) บาท และค่าเฉลี่ยของจำนวนวันนอนโรงพยาบาลหลังผ่าตัดเพิ่มขึ้น 21.3 (95%CI; 16.6-26.0) วัน มีค่ามัธยฐานของค่าใช้จ่ายมากขึ้น 31,140 (95% CI; 17,327-49,081) บาท และค่ามัธยฐานของจำนวนวันนอนโรงพยาบาลหลังผ่าตัดนานขึ้น 14 (95%CI, 12-18) วัน*

สรุป*: ผลการศึกษาครั้งนี้สนับสนุนผลการศึกษาที่ผ่านมาที่ว่าผู้ป่วยที่มีการติดเชื้อตำแหน่งผ่าตัดจะมีค่าใช้จ่ายเพิ่มขึ้นและจำนวนวันนอนโรงพยาบาลนานขึ้น ผู้วิจัยมีข้อเสนอแนะว่าควรมีการเฝ้าระวังการติดเชื้อตำแหน่งผ่าตัดหลังจำหน่าย โดยเฉพาะการผ่าตัดที่ผู้ป่วยนอนโรงพยาบาลสั้น เพราะจะทำให้มองเห็นผลกระทบชัดเจนยิ่งขึ้น*