

ECONOMIC IMPLICATIONS OF SURGICAL SITE INFECTION

Incidence

- Among surgical patients, SSIs are the most common nosocomial infection
- Microorganisms: *S. Aureus* (20%), *E. Coli* (10%), *S. Epidermidis*, *Pseudomonas*, *Streptococcus*, other anaerobes
- Foley et al. (Annals of Surgery, 2004) “Wound Infection after elective Colorectal Resection.”
 - Single surgical experience of Dr. Eugene Foley over 2-yr period (n=176) at the University of Virginia
 - 101(57%) – cancer
 - 35(20%) – IBD
 - 17(10%) – diverticular disease
 - 23(13%) – other
 - **25.6%** were diagnosed with incisional SSI
 - 51% were diagnosed as inpatients
 - 49% were diagnosed after discharge

Surgical Contamination Classification

- Clean: no visceral compartment has been entered, no gross contamination from endogenous or exogenous sources (i.e. breast biopsy, vascular case)
Infection rate ~1.5-5%
- Clean-contaminated: contaminated areas of the body are entered, but under controlled circumstances (i.e. pre-op bowel prep elective colon resection, gyn cases)
Infection rate~3-7% with prophylactic abx
- Contaminated: uncontrolled spillage of contaminants from hollow viscera, but with a short-duration of time before control makes invasive infection unlikely (i.e. penetrating trauma, unprepped colon)
Infection rate ~10-15%
- Dirty: wounds created under circumstances of already established infection (i.e. encountered bowel perforation, open drainage of abdominal abscess)
Infection rate ~ 15-40%

Risk factors

- Immune: diabetes, uremia, steroids, immunosuppression
- Malnutrition
- Injury: radiation, devitalized tissue, hypoxemia
- Operative: pre-operative severity of illness, duration of preoperative hospitalization, operative duration, intra-op hypotension
- Other: smoking, obesity, extremes of age, foreign body

Economic/Financial Implications

- Surgical site infections in the postoperative period can be very costly
 - **Cost to the hospital**
 - Delayed discharge (additional inpatient days)
 - Re-admissions (additional inpatient days)
 - Changes in hospital processes that result in better infection control
 - **Cost of community services**
 - Number of GP visits per episode of SSI
 - Number of visits from district nurses
 - One 1997 study (Public Health Laboratory Service, UK) showed that time spent with the patient's GP/surgeon was increased two-fold, and that by community nurses was five-fold or greater.
 - **Cost to the patient**
 - Direct costs: additional visits, transportation, dressings, abx prescriptions
 - Indirect costs: time lost from work, morbidity, depression
 - The literature usually omits the financial consequences for individual patients, because it's difficult to price

Reilly J et al. An economic analysis of surgical wound infection. J of Hosp Infect 2001. 49:245-249.

- prospective cohort study (n=2241)
- Breast surgery infection
 - Cost to Hospital - \$8504-34,018
 - Cost to Community - \$2529
 - Cost to patient - \$609
- Ventral hernia repair infection
 - Cost to Hospital - \$5009-20,038
 - Cost to Community - \$1460
 - Cost to patient - \$481
- Total costs: 89% hospital, 8% community, 3% patient

Kirkland et al. The impact of surgical-site infections in the 1990s: Attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiology. 1999. 20:725-730.

- Study performed at a university-affiliated community medical center (Durham Regional Hospital)
- Total additional costs for the 255 SSI cases were \$2 million of inpatient costs.

TABLE 2. COMPARISON OF TOTAL LENGTH OF STAY IN DAYS (LOS) AND MEDIAN TOTAL COSTS FOR PATIENTS WITH SURGICAL SITE INFECTION (SSI) WITH COSTS OF MATCHED UNINFECTED CONTROL PATIENTS

<i>Procedure</i>	<i>No. of pairs</i>	<i>Median increased LOS per SSI</i>	<i>Median increased cost per SSI</i>
Coronary artery bypass	20	11	\$3,856
Appendectomy	7	10	\$3,945
Colon surgery	29	6	\$2,671
Laparotomy	19	22	\$9,964
Laminectomy	24	10.5	\$3,273
Spinal fusion	20	20.5	\$11,001
Open reduction of fracture	8	11.5	\$3,623
Joint replacement	23	4	\$2,714
Vascular surgery	11	16	\$5,595

Data from Kirkland et al. [5].

Poulsen et al. Estimated costs of postoperative wound infections: A case-control study of marginal hospital and social security costs. *Epidemiol Infect* 1994. 113:283-295.

- Heterogeneous group of patients with SSIs from a Danish surgical experience (n=317)
- Infection rate=7%
- Control group matched by operation, gender and age
- SSI patients had 5.7-day greater length of stay
- Using a sophisticated mathematical model extrapolated to the entire Danish health system, it was estimated that SSIs account for 0.5% of the entire national hospital budget.

Zoutman et al. Total and attributable costs of surgical-wound infections at a Canadian tertiary-care center. *Infect Control Hosp Epidemiol* 1998.19:254-259.

- Canadian hospital
- Overall infection rate of 2% for clean-contaminated cases
- In 82 infections, a total of 1,116 hospital days attributable to infection were accrued. In-patient costs per SSI totaled \$3,937 (Canadian)

Coello et al. Adverse impact of SSIs in English hospitals. *J of Hosp Infect* 2005. 60:93-103.

- 140 English hospitals participated
- the first study to delineate costs per surgical category and to risk stratify by depth of infection
- 67,410 surgical procedures reported in 9 categories, with 2832 SSIs reported
 - Small bowel cases = 558 (56 infections)
 - Large bowel cases = 6528 (653 infections)
- The study did not take into account infections that occurred after discharge and therefore, cost calculations and LOS did not include readmissions

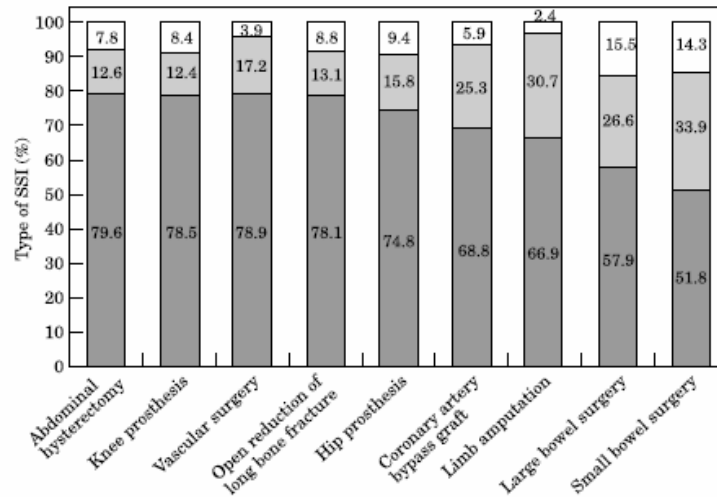


Figure 1 Distribution of surgical site infection (SSI) by type of SSI and category of surgery. ■, superficial incisional SSI; ▒, deep incisional SSI; □, organ/space SSI.

Table IV Adjusted* extra postoperative length of stay (LOS) and extra cost of hospitalization by type of surgical site infection (SSI) and surgical procedure

Surgical procedure	Extra LOS (95% CI) (days)		Extra cost per SSI (£)	
	Superficial incisional SSI	Deep incisional and organ/space SSI	Superficial incisional SSI	Deep incisional and organ/space SSI
Limb amputation	21.2 (12.3-33.6)	20.2 (8.3-39.2)	6161	5870
Vascular surgery	11.4 (8.8-14.3)	18.4 (11.7-27.3)	3313	5347
Small bowel surgery	12.9 (4.6-25.6)	13.4 (4.4-27.7)	3749	3894
Large bowel surgery	7.8 (6.4-9.4)	12.6 (10.1-15.3)	2267	3662
Coronary artery bypass graft	10.8 (9.7-11.9)	22.1 (19.2-25.2)	3138	6422
Hip prosthesis	8.9 (7.7-10.2)	22.8 (19.2-26.9)	2586	6626
Knee prosthesis	8.6 (6.6-10.7)	21.1 (15.5-27.9)	2499	6132
Open reduction of long bone fracture	8.4 (4.5-13.5)	15.4 (6.6-29.3)	2441	4475
Abdominal hysterectomy	2.8 (2.2-3.5)	6.7 (4.7-8.9)	814	1947

*Adjusted by age, sex, pre-operative length of hospital stay, American Society of Anesthesiology score, wound class, duration of operation, elective/emergency surgery, multiple procedures through the same incision, implants and operation due to trauma.

Perencevich et al. Health and economic impact of surgical site infections diagnosed after hospital discharge. Emerg Infect Dis. 2003. 9:196-203.

- BIDMC – attempt to measure the economic impact of SSI diagnosed after hospital discharge.
- With current trends favoring shortened post-op hospital stay, ambulatory surgery, office-based surgery, more SSIs are occurring after discharge and are therefore, beyond the reach of most hospital infection control surveillance programs
- An estimated 47-84% of SSIs occur after discharge

- Those with SSI, incurred an additional direct cost of \$3,382 (direct costs=output visits, inpatient care, pharmacy, radiology, home health aide, durable medical equipment) Cases were matched for age, surgery type, OR time.

Conclusion/Study Flaws

- Many studies that have been done attempting to estimate the cost of SSI are unreliable (as are most cost-of-illness studies) secondary to differences in data collection, calculation of direct and indirect costs and inflator/deflator values used. Appropriate pegging in retrospective studies involves the use of the healthcare consumer price indexes.
- Despite the increased efforts to manage more of these infections on an outpatient basis, non-hospital costs are not addressed in most published reports
- Prevention – wound opening and drainage, antibiotics, bowel preps

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