BURDEN OF SSI IN GASTROINTESTINAL, CARDIAC AND ORTHOPAEDIC SURGERIES IN KOREA

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Introduction

A surgical site (wound) infection (SSI) is a type of hospital-acquired infection that arises following surgery. Patients who develop an SSI are more likely to have an extended hospital stay which implies that the cost of their treatment is higher.

There is relatively wide range of non-expensive interventions which may imply the significant reduction of SSI rate. Those include for example the use of antimicrobial sutures [1–6], antibiotics prophylactics, a safety checklist and many other [7]. All such strategies may both improve the quality of inpatient stay and provide a substantial economic benefit. According to Korean standards of hospitalisation and relatively long inpatient stay (compared to European model of treatment) any action that could reduce the length of stay is important and awaited.

Objectives

The aim of this analysis was to evaluate the burden of surgery site infection (SSI) in common surgeries in Korea. There were three types surgeries considered:

- Gastrointestinal surgery, which was chosen as a representative for high SSI-risk procedure),
- Coronary Artery Bypass Grafting (CABG), which was chosen as a representative for a medium SSI risk procedure,
- Orthopaedic surgeries, which represents a low SSI-risk procedures.

Within the range of gastrointestinal surgery there were three subtypes analysed: gastric surgery or gastrectomy, colon or bowel surgery and hepatobiliary surgery. Additionally, within the orthopaedic surgery it was possible to mark out the details for knee and hip replacement separately.

Methods and data

SSI data

Probability of SSI for particular surgeries was obtained on the basis of studies included in systematic review Lee 2011 [8]. Probability of SSI within aggregated categories of surgeries defined in the model (general surgery, orthopaedic surgery) was calculated on the basis of all records that were assigned for those aggregated categories (weighted by the number of patients in particular studies). The crude incidence data are stated in the Table 6.

The calculated risk of SSI for the considered categories in the model is presented in Table 1.

Table 1. Probability of SSI – main surgery categories

Surgery type	Probability of SSI
GENERAL SURGERY	4.8%
Gastric surgery / gastrectomy	5.5%
Colon/bowel surgery	3.8%
Hepatobiliary surgery	3.4%
CABG	4.0%
ORTHOPAEDIC SURGERY	1.8%
Hip replacement	1.6%
Knee replacement	1.2%

Length of stay (LOS)

Data on mean LOS are based on data from HIRA [10]. The LOS for particular categories was calculated as the arithmetical mean of LOS for each surgical procedure that belongs to that category. The obtained data on mean LOS for each category are stated in the Table 2 (mean LOS).

There is statistically significant difference in LOS for patients with and without SSI. According to data from Park 2005 [9] (as stated in Lee 2011 [8]), hospitalisation of patients with SSI is about **60% longer** than for patients without SSI (14.15 vs. 8.96 days). Assuming that this proportion is constant for any surgery, the mean LOS for patient with and without SSI were recalculated to meet this relation (Table 2). It was assumed that the probability of SSI is as stated before (Table 1).

Table 2. Length of stay [days]

Category	LOS – mean*	LOS – SSI**	LOS- no SSI**
GENERAL SURGERY	16.1	24.7	15.7
Gastric surgery / gastrectomy	13.9	21.3	13.5
Colon/bowel surgery	14.6	22.5	14.3
Hepatobiliary surgery	20.6	31.9	20.2
CABG	14.9	22.9	14.5
ORTHOPAEDIC SURGERY	16.9	26.5	16.8
Hip replacement	17.5	27.4	17.3
Knee replacement	16.4	25.6	16.2

**data from HIRA*
***calculated according to data from HIRA, SSI probability and relation of LOS for patients with SSI and without SSI*

Costs

The analysis was conducted from the hospital perspective. The hospital policy towards SSI risk reducing strategies plays the crucial role in the process of lowering the burden of SSI. Moreover the hospital is the first beneficent of the financial profit related to reduced costs of hospitalisation due to SSI.

Costs of hospitalisation were calculated on the basis of data from Health Insurance Review and Assessment Service – HIRA [10]. The costs are presented in Table 3.

Summary

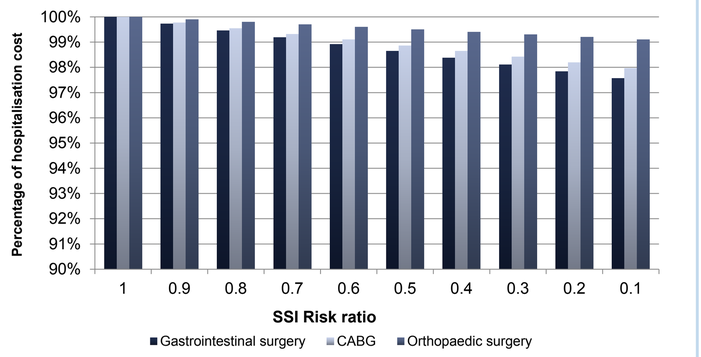
OBJECTIVE: To evaluate the burden of SSI (surgery site infection) in common surgeries in Korea. The considered surgeries: gastrointestinal surgery, Coronary Artery Bypass Grafting (CABG) and orthopaedic surgery represent the procedures with high, medium and low SSI risk. **METHODS**: The analysis was conducted from the hospital perspective. Costs were evaluated on the basis of Health Insurance Review Agency (HIRA) data. Risk of SSI and the influence of SSI on hospital length of stay (LOS) were calculated according to studies from a review Lee 2011. The influence of prolonged hospitalisation on expenses was obtained with an assumption that the costs are evenly distributed during the stay. **RESULTS**: The risk of SSI depends on surgery type. Among the procedures considered, the highest SSI rate – 5% was related to gastric surgery and the lowest SSI rate – 1% to knee replacement. LOS in case of SSI is prolonged for about 60%. According to current data on hospitalisation cost from HIRA, the influence of SSI on providers' budget could be substantial. The estimated increase in hospitalisation cost induced by SSI is about 3.9 million won (2 700 €) for gastrointestinal surgery, 4.3 million won (3 000 €) for orthopaedic surgery and even 10.0 million won (6 900 €) for CABG. Halving the SSI rate would reduce the mean expenses for about 1%. **CONCLUSION**: The burden of SSI in Korea is high as SSI implies the significant prolongation of LOS. The detailed analysis should then be carried out in order to define the possible ways of minimizing the infection risk. The possible range of relatively non expensive risk-reducing interventions which may imply the substantial reduction of SSI rate include the use of antimicrobial sutures, antibiotics prophylactics, a safety checklist and other. The increased cost of SSI prevention would be probably broadly offset by the decreased costs of hospital stay.

Table 3. Hospitalisation cost (mean)

Category	Costs in KRW	Costs in EUR
GASTROINTESTINAL SURGERY	₩6.91 mln	€ 4 800
Gastric surgery / gastrectomy	₩5.91 mln	€ 4 100
Colon/bowel surgery	₩6.52 mln	€ 4 500
Hepatobiliary surgery	₩8.48 mln	€ 5 900
CABG	₩17.66 mln	€ 12 200
ORTHOPAEDIC SURGERY	₩7.57 mln	€ 5 200
Hip replacement	₩7.03 mln	€ 4 900
Knee replacement	₩8.11 mln	€ 5 600

**data from HIRA*
***calculated according to data from HIRA, SSI probability and relation of LOS for patients with SSI and without SSI*

Chart 2. Influence of SSI risk ratio on mean surgery cost



Results

The costs per procedure according to SSI status were estimated assuming the expenses are evenly distributed during the hospital stay. According to data from Park 2005 [9] (as presented in Lee 2011 [8]) it was assumed that SSI in Korea prolongs the hospitalisation by 60%. The same increase was then adopted both for LOS and costs.

The obtained mean of hospital expenses related to particular surgeries in Korean perspective both for patients with and without infection are presented in tables below (Table 4, Table 5) and Chart 1. The biggest increase in cost in case of SSI: ₩10.00 mln (c. a. € 6 900) was ascribed to CABG surgery.

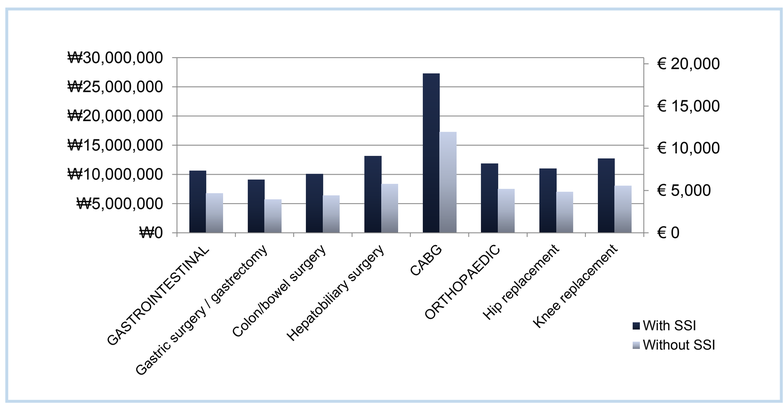
Table 4. Cost of hospitalisation – Korean Won

Source of cost	Without SSI	With SSI	Difference
GASTROINTESTINAL SURGERY	₩10.61 mln	₩6.72 mln	₩3.89 mln
Gastric surgery / gastrectomy	₩9.04 mln	₩5.73 mln	₩3.32 mln
Colon/bowel surgery	₩10.08 mln	₩6.38 mln	₩3.70 mln
Hepatobiliary surgery	₩13.13 mln	₩8.32 mln	₩4.82 mln
CABG	₩27.25 mln	₩17.26 mln	₩10.00 mln
ORTHOPAEDIC SURGERY	₩11.83 mln	₩7.49 mln	₩4.34 mln
Hip replacement	₩11.00 mln	₩6.96 mln	₩4.03 mln
Knee replacement	₩12.72 mln	₩8.06 mln	₩4.67 mln

Table 5. Cost of hospitalisation – EURO

Source of cost	Without SSI	With SSI	Difference
GASTROINTESTINAL SURGERY	€ 7 300	€ 4 600	€ 2 700
Gastric surgery / gastrectomy	€ 6 300	€ 4 000	€ 2 300
Colon/bowel surgery	€ 7 000	€ 4 400	€ 2 600
Hepatobiliary surgery	€ 9 100	€ 5 700	€ 3 300
CABG	€ 18 800	€ 11 900	€ 6 900
ORTHOPAEDIC SURGERY	€ 8 200	€ 5 200	€ 3 000
Hip replacement	€ 7 600	€ 4 800	€ 2 800
Knee replacement	€ 8 800	€ 5 600	€ 3 200

Chart 1. Costs of hospitalisation according to SSI status



Basal risk of SSI is the main factor of possible reduction in hospitalisation burden due to improvement in the SSI rate. The possible influence of SSI rate reduction on cost of surgery according to surgery type is presented on a Chart 2.

The SSI rate depends mostly on surgery and wound type. However – there is a wide range of interventions that may improve the effectiveness and quality of operations by reducing the SSI rate without significant additional costs or impediments. Even halving the SSI rate seems to be attainable in many cases according to available data [1–7]. This level of SSI reduction implies that the mean total cost per surgery in Korea would be about 1% lower. This value – although it may seem to be relatively low – means a substantial benefit in the whole health care system. The issue should be considered with a great caution because there are potentially only minimal changes, costs and efforts needed to achieve the significant risk reduction.

Table 6. Incidence of SSI – data by surgical procedure

Surgery type	Study	Number of patients		SSI rate
		No SSI	SSI	
General surgery				
Abdominal surgery	Jeong 2008 [11]	330	17	4.9%
Biliary surgery	Kim 1999 [12]	104	5	4.6%
Bowel surgery	Hong 2008 [13]	154	6	3.8%
Colon surgery	Sakong 2009 [14]	519	18	3.4%
Colon surgery	Lee 2004 [15]	106	7	6.2%
Gastrectomy	Lee 2005 [16]	84	10	10.6%
Gastrectomy	Kim 2008 [17]	477	22	4.4%
Gastrectomy	Park 2008 [18]	279	21	7.0%
Gastric Surgery	Sakong 2009 [14]	560	29	4.9%
Hepatobiliary pancreas	Lee 2004 [15]	125	3	2.3%
Cardiovascular surgery				
OFF-PUMP CABG	Song 2008 [19]	96	4	4.0%
Orthopaedic surgery				
Hip or knee replacement	Sakong 2009 [14]	582	15	2.5%
Hip replacement	Choi 2008 [20]	224	3	1.3%
Hip replacement	Kim 2008 [17]	336	6	1.8%
Knee replacement	Choi 2008 [20]	206	3	1.4%
Knee replacement	Kim 2008 [17]	448	5	1.1%

Conclusions

SSI implies the significant prolongation of length of stay in hospitals in Korea. The increased length of hospitalisation entails the increased costs both for the provider and for the entire society. There is however a wide range of relatively non-expensive and simple risk-reducing interventions which may imply the substantial reduction of SSI rate. Those include for example the use of antimicrobial sutures, antibiotics prophylactics or a safety checklist. The increased cost of SSI prevention would be probably broadly offset by the decreased costs of hospital stay. It should be also noted that the reduced hospitalisation cost is only one result of possible improvement of SSI rate. The aspects not mentioned – the patients satisfaction, the risk of late complications or the indirect cost of prolonged hospitalisation are also the issues that are to be taken into consideration while assessing the SSI risk-reducing strategies.

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