Original Research Article

# Surgical Site Infections(SSI) in Non Traumatic Abdominal Operations

**Indrani Dutta[1*], Atima Bharti[2]**

*[1]Senior Resident, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India*
*[2]Associate Professor, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India*

**Received: 26-11-2021 / Revised: 28-12-2021 / Accepted: 05-01-2022**

## Abstract

**Background:** Nosocomial infections are a matter of immense concern to healthcare sector. Control of SSI is an important area for improving quality in health care sector. Hence its important to analyse the magnitude of the problem, study preventive measures and apply them in day to day practise in health care set up. **Aims and Objectives**: To study incidence, evaluate risk factors of SSI and formulate preventive strategies in surgical and gynecological wards of Rajendra Institute Of Medical Sciences, Ranchi, Jharkhand. **Methodology:** Cross sectional study(March 2019-February 2020). **Results:** Most of the patients were from 20-49yrs.(75.8%). Male-female ratio was 1.42:1. Most incidences of SSI was found in duodenal ulcer repair for perforation(50%), herniotomy and herniorrhapy (42.86%), resection of volvulus of sigmoid colon(42.86%)..Cases operated by junior resident 1 (50%) and junior resident 2(64.29%) had most incidences of SSI. Extended midline incisions (45.45%) had maximum SSI and pfannensteil (21.05%) had least when taking out percentages from respective operative incisions. E.coli(muddy thin pus) was mostly present (44%) among pus discharges from wound site. **Conclusion:** The overall incidence of SSI was 27.42%. The risk factors associated with SSI were: length of preoperative hospital stay greater than 24 hours; a longer duration of surgery; level of contamination, comorbidity of patient, expertise of surgeon, delay in initiating surgery and level of contamination. It is important the early recognition of the risk of developing SSI in patients undergoing surgery, so that preventive measures can be adopted with the aim of reducing surgical site infections.

**Keywords:** Surgical site, Infection, Comorbidity, Nosocomial, Contamination.



### Introduction

Nosocomial infections are a matter of immense concern to healthcare sector. Surgical site infections comprise a sizeable chunk of all nosocomial infections. As per study of National Healthcare Safety Network(NHSN) comprising of 850000 general surgeries in United States, incidence of SSI was seen to be 1.9%[1]. As per one Brazilian study ,incidence of SSI was found to be 1.4%to 38.8%.[2]. All these studies took into account general surgeries only. A 3-15% rate of SSI was seen in women undergoing caesarean deliveries[3-5]. As per reports from lower and middle income countries , SSI was found to be 16.2% from Nigeria, 19% from Kenya, 10.9% from Tanzania and 9.7 % from Vietnam[6-7]. Most post operative adverse events can be attributed to SSI[8-9]. It leads to increased duration of hospital stay and financial burden for the patient and hospital too[10-12]. SSI varies from hospital to hospital and country to country also[13-15]. As per an estimate a hospital with annual surgical volume of 10000 operations, if reduces SSI load by 50%, could save $450,000 annually[16]. Control of SSI is an important area for improving quality in health care sector. Hence its important to analyse the magnitude of the problem, study preventive measures and apply them in day to day practise in health care set up. Henceforth the present study was undertaken**.**

### Aims and Objectives

1. To study incidence of SSI in surgical and gynecological wards of Rajendra Institute Of Medical Sciences, Ranchi, Jharkhand.
2. To evaluate risk factors of SSI.
3. To formulate preventive strategies to curb incidences of SSI and reduce morbidity burden of healthcare sector.

*Correspondence
**Dr. Indrani Dutta**
Senior Resident, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India.

### Materials and Methods

**Study type**
Cross sectional Study**.**

**Study Place**
Dept of Surgery and Dept of Obstetrics and Gynecology, Rajendra Institute of Medical Sciences(RIMS), Ranchi, Jharkhand, India**.**

**Study Duration**
March 2019 to February 2020 (1 year).

**Study Population**

**a) Inclusion Criteria**
All patients undergoing emergency and elective non traumatic abdominal operations in the Dept of Surgery and Dept of Obstetrics and Gynecology, RIMS, Ranchi.

**b) Exclusion Criteria**
Patients with trauma were excluded from the study**.**

**Sampling Size Determination**
Sample size $n= z^2*p*q/d^2$
Z= standard normal deviate usually set at 1.96 ,confidence interval=95% and$\alpha$=0.05
p=prevalence
Studies in India have show prevalence of SSI to range from 23% to 38%.[17-18].So prevalence in this study has been taken to 30% which is average of the prevalence range.
q=1-p=1-0.03=0.97
d=degree of accuracy=$\sqrt{4*p*q/100}$=0.034
n= 1.96*1.96*0.03*0.97/0.03*0.03=124

**Study Procedure**
Method of sampling was non-random, purposive. Only very essential investigations were done urgently for taking decision about the management. Patients requiring emergency and elective abdominal surgery and fulfilling the inclusion criteria were offered to participate

in the study. Informed written consent was taken from the patients or their guardian willing to participate in the study. Detailed history was taken from the study group to establish proper diagnosis and to know about the presence of the risk factors regarding surgical site infection. All of the preoperative factors related to SSI present in the patient were noted. After proper pre operative preparation, patients were sent to operation theatre for operation. Strict aseptic precautions werefollowed during the operation. Meticulous techniques were practiced as far as possible. The operation procedure and related peroperative factors were observed and recorded. During the postoperative period all thepatients were closely monitored everyday up to the discharge of the patient from thehospital. If any symptom or sign of infection appear during this period then properinvestigation was instituted for the diagnosis of infection and to assess the type andseverity of the infection. If any collection of pus identified it was drained out and sent forculture and sensitivity test. Proper antibiotic was given to every patient both pre- operative and post-operative periods. Appropriate management was given to each of thepatients of surgical site infection. Antibiotic was changed where necessary after gettingthe report of culture and sensitivity test. Postoperative events were recorded in the datasheet during every day follow up.

**Data Analysis**

Calculated data were arrangedin systemic manner, presented in various table and figures and statistical analysis wasmade to evaluate the objectives of this study with the help of Statistical Package forSocial Science (SPSS).

**Results**

This cross-sectional study was carried out to determine factors responsible for surgical site infections following emergency and elective non-traumatic abdominal operations that will be helpful in reducing rate of surgical site infections. One hundred and twenty four patients with emergency and elective nontraumatic abdominal operations were selected from the dept of Surgery and Gynaecology of Rajendra Institute of Medical Sciences, who met the selection criteria during the study period from March 2019 to February 2020 . All cases were evaluated clinically. Postoperatively swab was sent for culture and sensitivity test in every cases with discharge from the wound or collection of pus anywhere in the abdominal area.

**Table 1.Age Distribution of Patients.**

| Age in years | No of patients | percentage |
|---|---|---|
| 20-29 | 34 | 27.42% |
| 30-39 | 30 | 24.19% |
| 40-49 | 30 | 24.19% |
| 50-59 | 20 | 16.12% |
| 60-69 | 10 | 8.06% |
| total | 124 | 100% |

Most of the patients were from 20-49yrs.(75.8%)

**Table 2. SSI distribution by different age.**

| Age in years | SSI present | SSI absent | total |
|---|---|---|---|
| 20-29 | 6 | 28 | 34 |
| 30-39 | 11 | 19 | 30 |
| 40-49 | 10 | 20 | 30 |
| 50-59 | 4 | 16 | 20 |
| 60-69 | 3 | 7 | 10 |
| total | 34 | 90 | 124 |

Most of SSI were from age group 30-49 yrs(61.7% of total SSI).

**Table 3. Regarding sex distribution, out of 124 patients, 74 (59.68% %) were male and 52 (41.94 %) were female. Male-female ratio was 1.42: 1.In this study female 21(40%) and males 13 (17.5%) had SSI.**

**Table 4. Distribution of SSI based on educational level.**

| Education level | SSI present | SSI absent |
|---|---|---|
| 1.illiterate | 12 | 34 |
| 2. primary school | 10 | 60 |
| 3. intermediate | 7 | 20 |
| 4.graduate and above | 5 | 10 |
| Total SSI | 34 | 90 |

Most SSI were found in illiterate patients (35.3%).

**Table 5 Distribution of SSI based on Occupation.**

| Occupation | SSI present | SSI absent |
|---|---|---|
| 1.Unemployed | 13 | 40 |
| 2.private | 7 | 23 |
| 3.government | 6 | 7 |
| 4.self employed | 8 | 20 |
| Total | 34 | 90 |

Most SSI was found among umemployed and self employed (61.76%).

**Table 6.Distribution of SSI based on Ethnicity.**

| Ehnicity | SSI present | SSI absent |
|---|---|---|
| 1.tribal | 13 | 46 |
| 2. non tribal | 21 | 44 |

| | | |
|---|---|---|
| Total | 34 | 90 |

Non tribals (61.76%) had more SSI.

**Table 7.Distribution of SSI based on Religion.**

| Religion | SSI present | SSI absent |
|---|---|---|
| 1.hindu | 7 | 20 |
| 2.muslim | 6 | 20 |
| 3. christian | 7 | 17 |
| 4. others | 14 | 33 |
| Total | 34 | 90 |

No correlation could be established between religious background and prevalence of SSI.

**Table 8. Distribution of SSI based on residence.**

| Residence | SSI present | SSI absent |
|---|---|---|
| 1.Urban | 22 | 46 |
| 2. Rural | 12 | 44 |
| Total | 34 | 90 |

Urban population(64.7%) had more SSI.

**Table 9. Distribution of SSI according to type of operation**

| Type of operation | SSI present | SSI absent | total |
|---|---|---|---|
| 1.LSCS | 8(14.8%) | 36 | 54 |
| 2.Laparotomy (rupture ectopic, rupture uterus) | 3(33.33%) | 6 | 9 |
| 3.elective gynecologicalprocedure( abdominal hysterectomy, ovarian malignancy) | 4(33.33%) | 8 | 12 |
| 4. Appendicectomy with peritoneal toiletting | 2 (16.67%) | 10 | 12 |
| 5.Adhesiolysis or resection and anastomosis | 2(0.2%) | 8 | 10 |
| 6.Herniotomy and herniorrhaphy | 6(42.86%) | 8 | 14 |
| 7.Resection of Volvulus of sigmoid colon and primary anastomosis/ Hartmans procedure | 3(42.87%) | 4 | 7 |
| 8.Repair of duodenal ulcer perforation and thorough peritoneal toileting | 4(50%) | 4 | 8 |
| 9.Repair of ileal perforation / Ileostomy and thorough peritoneal toileting | 2(25%) | 6 | 8 |

Most incidences of SSI was found in duodenal ulcer repair for perforation(50%), herniotomy and herniorrhapy(42.86%), resection of volvulus of sigmoid colon(42.86%).

**Table 10.SSI based on operating surgeon**

| Operating surgeon | SSI present | SSI absent | total |
|---|---|---|---|
| 1.junior resident 1 | 6(50%) | 6 | 12 |
| 2.junior resident 2 | 9(64.29%) | 14 | 23 |
| 3.junior resident 3 | 8(28.57%) | 20 | 28 |
| 4.senior resident | 6(21.43%) | 22 | 28 |
| 5.assistant professor | 1(7.69%) | 12 | 13 |
| 6.associate professor and above | 1(5.88%) | 16 | 17 |
| Total | 34 | 90 | 124 |

Cases operated by junior resident 1 (50%) and junior resident 2(64.29%) had most incidences of SSI. Assistant (7.69%) and Associate professor (5.88%) had least incidences of SSI**.**

**Table 11.SSI based on incision type.**

| Incision type | SSI present | SSI absent | total |
|---|---|---|---|
| 1.Extended lower midline | 5(45.45%) | 6 | 11 |
| 2.pffalansteils | 8(21.05%) | 30 | 38 |
| 3.Mid midline | 4(28.57%) | 10 | 14 |
| 4.Lower right para- median | 6(33.33%) | 12 | 18 |
| 5.Rutherford Morison | 3(33.33%) | 6 | 9 |
| 6.Upper midline | 2(25%) | 6 | 8 |
| 7.Extended upper midline | 3(27.27%) | 8 | 11 |
| 8.Grid iron | 3(33.33%) | 6 | 9 |
| 9.Lenz | 0 | 4 | 4 |
| 10. inguinal | 0 | 2 | 2 |
| Total | 34 | 90 | 124 |

Extended midline incisions (45.45%) had maximum SSI and pffalansteils(21.05%) had least when taking out percentages from respective operative incisions. For other incisions SSI was 28.57% for mid midline, 33.33% for lower right paramedian, 33.33% for Rutherford Morison, 25% for upper midline, 27.27% for extended upper midline,and 33.33% for grid iron incision.

**Table 12.SSI based on delay in initiating operation.**

| Delay before operating | SSI present | SSI absent | total |
|---|---|---|---|
| <6hrs | 6(11.11%) | 48 | 54 |
| 6-12hrs | 18(45%) | 22 | 40 |
| >12hrs | 10(33.33%) | 20 | 30 |
| Total | 34 | 90 | 124 |

Most incidences of SSI was found when delay in initiating operation was between 6 to 12 hours(45%). Least incidences were found when surgery was initiated <6hours from time of admission. About 33.33% of SSI was found when delay was >12 hours.

**Table 13.SSI based on length of operation**

| Duration of operation | SSI present | SSI absent | Total |
|---|---|---|---|
| <1hr | 8(15.38%) | 44 | 52 |
| 1-2 hrs | 16(40%) | 24 | 40 |
| >2 hrs | 10(31.25%) | 22 | 32 |
| Total | 34 | 90 | 124 |

Maximum incidence of SSI was present when length of operation was 1-2 hours(40%). 31.25% of SSI was found when surgery was >2 hours duration , 15.38% of SSI was present when surgery was <1 hour duration.

**Table 14.SSI based on day of postoperative period.**

| Postoperative day | SSI present | SSI absent | total |
|---|---|---|---|
| $1^{st}$-$3^{rd}$ | 6(17.65%) | 28 | 34 |
| $4^{th}$-$7^{th}$ | 18(36%) | 32 | 50 |
| $8^{th}$ onwards | 10(25%) | 30 | 40 |
| Total | 34 | 90 | 124 |

Most SSI was found on $4^{th}$ to $7^{th}$ postoperative day(36%).17.65% present on $1^{st}$ to $3^{rd}$ postoperative day and 25% was present on $8^{th}$ postoperative day.

**Table 15. SSI based on degree of contamination**

| Contamination | SSI present | SSI absent | total |
|---|---|---|---|
| Clean | 1(4.35%) | 22 | 23 |
| Clean contaminated | 3(7.69%) | 36 | 39 |
| Contaminated | 5(16.13%) | 26 | 31 |
| Dirty | 25(80.65%) | 6 | 31 |
| Total | 34 | 90 | 124 |

Dirty wounds had maximum SSI (80.65%).Contaminated wounds 16.13%, clean contaminated 7.69% and clean wounds 4.35% SSI.

**Table 16.SSI based on comorbidities**

| Types of comorbidity | SSI present | SSI absent | total |
|---|---|---|---|
| 1.Malnutrition | 12(25%) | 36 | 48 |
| 2.obesity | 3(20%) | 12 | 15 |
| 3.diabetes | 3(8.57%) | 33 | 35 |
| 4.COPD | 1(5.56%) | 17 | 18 |
| 5.Jaundice | 4(57.14%) | 3 | 7 |
| Total | 23 | 101 | 124 |
| | | | |

Jaundice patients had maximum prevalence of SSI followed by malnutrition.(57.17%) , followed by malnutrition 25%, obesity 20%, diabetes 8.57%, COPD 5.56%.

**Table 17.Frequency of PUS discharge from wound site**

| Colour of pus | Frequency | Organism isolated |
|---|---|---|
| 1.Serosanguineous | 4% | No growth |
| 2.Blue green | 8% | Pseudomonas aeruginosa |
| 3.yellow fishy | 8% | Klebsiella pneumonia |
| 4.Thick creamy | 36% | Staphylococcus aureus |
| 5.Muddy thin | 44% | E.coli |

E.coli(muddy thin pus) was mostly present (44%) among pus discharges from wound site, Staphylococcus aureus (thick creamy ) 36%, Klebsiella pneumonia (yellowfishy) 8%, Pseudomonas (blue green) 8% and no growth (serosanguineous pus) in 4% cases of SSI noted.

**Table 18. Antibiotic and sensitivity in percentage**

| Organism | Ciprofloxacin | ceftriaxone | gentamicin | Amikacin | levofloxacin | imipenem | cotrimoxazole | nitrofurantoin |
|---|---|---|---|---|---|---|---|---|
| 1.E.coli | 45% | 72% | 30% | 90% | 55% | 80% | 45% | 90% |
| 2.Pseudomonas | 50% | 90% | 55% | 0 | 0 | 80% | 0 | 50% |
| 3.Klebsiella | 0 | 90% | 0 | 0 | 70% | 90% | 0 | 55% |
| 4.Staphylococcus | 45% | 45% | 0 | 30% | 5 | 90% | 0 | 33% |

As for antibiotic sensitivity, a single pathogen had varied sensitivity. E coli was sensitive to ciprofloxacin45%,ceftriaxone 72%,gentamicin 30%, levofloxacin 55%,imipenem 80%,cotrimoxazole 45%, amikacin 90 % ,nitrofurantoin 90%.Pseudomonas was sensitive to

ciprofloxacin 50%, ceftriaxone 90%,gentamicin 55%,imipenem 80%,nitrofurantoin 50%.Klebsiella was sensitive to ceftriaxone 90%,levofloxacin 70%, imipenem 90%, nitrofurantoin 55%. Staphylococcus was sensitive to ciprofloxacin 45%, ceftriaxone 45%, amikacin 30%, imipenem 90%, nitrofurantoin 33%.

**Discussion**

Prevalence of SSI in this study was 27.42% which was well within the range of Indian standards[17-18]. This was higher than studies carried out in USA[19] 1.9%, France, 1%[20] and Italy 2.6%[21], Turkey 4.1%[22]. Two Brazilian studies involving SSI showed incidences ranging from 6.4%[23] to 11.0%[24].In a study conducted at Mymensingh Medical College , Bangladesh by Rabeul Karim et al[25] prevalence was found to be 17.4% which was similar to studies by Razavi et al[26], 17.4% and Renvall et al, 12.4%[27].

This wide variation in our study as compared to others may be attributed to the presence of different epidemiological differences and surveillance variations[19-21], post discharge follow up lacunae[28-29] and under reporting. Studies have shown that absence of post discharge follow up impacts actual incidence of SSI which may be three times higher when performed only during hospitalisation of the patient[30].

Age of the study patients ranged from 20- 69 years. Maximum patients were from 20-29 years(27.42%), minimum were of age group 60- 69 years(8.06%). In a similar study conducted in an Iranian teaching hospital average age of the patients was 46.70 years (Razavi et al. 2005) [26] which was much higher than the present study with highest percentage of 25.20 % in > 65 years age group. In a study conducted at Mymensingh Medical College , Bangladesh by Rabeul Karim et al[25] most of the patients (89.29 %) were in between 10-49 years; with mean age 32.93 years, highest 26.47 % in the 40-49 years age group which was not consistent with our study. In a study conducted by Carvalho RLR et al[31], mean age was 54.2 years ± 16.4 (18-99), with a median of 55 years. This difference in different studies may be attributed to diverse epidemiological and cultural differences.

Regarding sex distribution, out of 124 patients, 74 (59.68% %) were male and 52 (41.94 %) were female. Male-female ratio was 1.42: 1. In this study female 21(40%) and males 13 (17.5%) had SSI.

In the study by Rabeul Karim et al[25] rate of SSI in males were 17.98 %, whereas among females it was 15.69 % . Rate of SSI was slightly higher in females in our study, which was not statistically significant. This finding is consistent with that of Razavi et al[26] where they could not find any significant correlation between sex ratio and SSI. Moreover, rate of SSI in males were 19.6 %, whereas in females it was 15.1 %. So, SSI is not correlated with sex (Razavi et al. 2005). We could not find any similarity between our study and comparison groups which could be attributed to the sample cross section who visited us during study period.

Most SSI were found in illiterate patients (35.3%), 29% attended primary school, 20.6% had intermediate education, 14.7% were graduates. Incidence of SSI decreased with level of education. Results of our study was consistent with Rabeul Karim et al[25] who found 24% SSI in illiterate population.

Most SSI was found among unemployed and self employed (61.76%). Non tribals (61.76%) had more SSI. No correlation could be established between religious background and prevalence of SSI. Urban population(64.7%) had more SSI. No studies to support our findings were found. These may be attributed living standards, orientation and nutritional status and lifestyle of study population.

Most incidences of SSI was found in duodenal ulcer repair for perforation(50%), herniotomy and herniorrhapy (42.86%), resection of volvulus of sigmoid colon(42.86%). Rest of the procedures like adhesiolysis(0.2%),repair of ileal perforation(25%), appendicectomy with peritoneal toileting (16.67%), laparotomy for elective gynecological procedures(33.33%) and emergency procedures like ruptured ectopic pregnancy and rupture uterus(33.33%).All percentages were calculated from total number of respective operations.

In the study conducted by Rabeul Karim et al[25] out of 140 patients with emergency nontraumatic abdominal operations, rate of SSI in different operations were as follows: 5 among 60 (8.33%) acute appendicitis cases, 3 among 30 (10.00%) small intestinal obstruction, 8 among 19 (42.10%) ileal perforation, 3 among 15 (20.00%) duodenal ulcer perforation, 4 among 12 (33.33%) burst appendix, 1 between 2 (50.00%) sigmoid volvulus and no SSI occurred in 2 obstructed inguinal hernia cases. The highest rate of infection (50.00%) was in volvulus cases and lowest in obstructed hernia operations whose findings were consistent with the result of Surgical Site Infection Surveillance (SSIS) for general surgery which was published as Wexford General Hospital Surgical Site Infection (SSI)[32] data report in 2009 showing number of SSI and rate of SSI (%) by category of operations. They done 132 appendicectomy, among them SSI occurred in 7 (5.3%) cases. SSI occurred in 10 (19.2 %) cases among 52 Colonic surgeries, 4 (23.5%) cases among 17 Small bowel surgery and 5(26.3%) cases among 19 Laparotomies. No SSI was reported among 82 herniorrhaphy cases (Surgical Site Infection Surveillance for general surgery.

Findings in our study were much different than the above mentioned studies which could again be attributed to epidemiological differences and the sample size which we studied in the study duration.

Cases operated by junior resident 1 (50%) and junior resident 2(64.29%) had most incidences of SSI. Assistant (7.69%) and Associate professor (5.88%) had least incidences of SSI. The rate of SSI decreased with the increase in experience of the operating surgeon which was consistent with studies of Rabeul Karim et al[25] and Paul in 2004[33], where rate of SSI in operations done by Assistant Registrars and IMOs was 18.33%; whereas for registrar it was 12.50% and for professor it was nil.

Extended midline incisions (45.45%) had maximum SSI and pfannenstiel(21.05%) had least when taking out percentages from respective operative incisions. Lenz and inguinal incisions had no incidences of SSI. For other incisions SSI was 28.57% for mid midline, 33.33% for lower right paramedian, 33.33% for Rutherford Morison, 25% for upper midline, 27.27% for extended upper midline, and 33.33% for grid iron incision. In present study infection rate was higher in midline incisions that may be attributed to less vascularity of the linea alba and most contaminated and dirty cases were operated through these incisions. The findings were not consistent with the findings of study carried out by Rabeul Karim et al and Paul in 2004, where the infection rate was 50.00 per cent for Rutherford Morison, 25 per cent for each of right para median and extended midline, 18.18 per cent for upper midline, 9.38 per cent for grid iron incision and nil for inguinal incision (Paul 2004)[33].

Most incidences of SSI was found when delay in initiating operation was between 6 to 12 hours(45%). Least incidences were found when surgery was initiated <6hours from time of admission. About 33.33% of SSI was found when delay was >12 hours. With regard to delay to initiate operation and rate of SSI, as per study of Rabeul Karim it was observed that the surgical site infection rate was 9.09%, 10.53%, 15.63%, 18.42%, 19.35% and 33.33% when operation was initiated 6, 12, 24, 48, and 72 hours later respectively. The rate of SSI increased as the time lapse between first manifestation of symptoms and initiation of operation prolonged. Huda M.N.[34] who conducted a study in Dhaka Medical College in 2005. In that study SSI rate was 15.25%, 21.73%, 27.27%, 40% and 50% respectively when operations were done 6, 12, 24, 48, and 72 hours later (Huda 2005). A study conducted in a Peruvian hospital; in which patients with SSI had a longer hospital stay than did non-infected patients (14.0 Vs 6.1 days; $p < 0.001$); as prolonged preoperative hospital stay increases SSI rate and occurrence of SSI causes prolonged postoperative stay ( Hernandez et al 2005)[35]. In our study direct correlation was not found between delay in initiating surgery and SSI which may be attributed to either expertise of surgeon, infectivity and complexity of case or immunity of patient.

Maximum incidence of SSI was present when length of operation was 1-2 hours(40%). 31.25% of SSI was found when surgery was >2 hours duration , 15.38% of SSI was present when surgery was <1

hour duration. With respect to duration of operation and percentage of SSI it was observed that the infection rate varies with duration of operation. Study by RabeulKarim[25] SSI was only 4.6 % when the duration of operation was < 1 hour, 32.5% when it was 1-2hours, 60% when it was >2 hours duration. It may be due to the prolonged exposure of the wound to the environment leading to more chance to inoculation of micro-organisms. Findings of a study conducted in the Imam Khomeni Hospital, Tehran, where the authors comment the duration of surgical operation also proved to be a significant factor: only 3 % of operations lasting 30 minutes or less led to infection, while for operations lasting more than 6 hours this rate leapt to 18 %î (Razavi et al. 2005)[26].

Most SSI was found on 4th to 7th postoperative day (36%).17.65% present on 1st to 3rd postoperative day and 25% was present on 8th postoperative day. In relation to appearance of infection by features like fever, excessive pain, tenderness or discharge from the wound on postoperative days it was observed that most of the infections were started between 4th and 8th post operative days (PODs) and it was highest (33.33%) on 5th POD.

Dirty wounds had maximum SSI (80.65%). Contaminated wounds 16.13%, clean contaminated 7.69% and clean wounds 4.35% SSI. 10 years prospective study of 62,963 wounds by Cruse and Frood in 1980 found infection rate was 1.5%, 7.7%, 15.2% and 40% in clean, clean contaminated, contaminated and dirty wounds respectively (Cruse and Frood 1980)[36]. Study conducted by Ali and Khan in 1983 at Chittagong Medical College Hospital observed SSI 25.00%, 28.60% and 54.80% respectively in clean, clean contaminated and contaminated wounds (Ali and Khan 1983)[37]. In addition, Renvallet al[27]. in 1980 in a prospective study carried out on 696 patients estimated SSI rates were 4.2%, 9.1% and 14.4% in clean, clean contaminated and dirty wounds respectively (Renvall et al.1980). Hence level of contamination is directly related to SSI.

Jaundice patients had maximum prevalence of SSI followed by malnutrition (57.17%), followed by malnutrition 25%, obesity 20%, diabetes 8.57%, COPD 5.56%. Out of total 34 cases of SSI 23 had SSI (67.64%). Israelsson and Jonsson identified increased rate of SSI among overweight patients (Israelsson and Jonsson 1997[38]. Another study by Cruse and Frood showed that clean wound infection rate rises to 10.7% in patients with diabetes, 13.5% in obesity and 16.6% in malnourished patients (Cruse and Frood 1980)[36]. Rabeul Karim et al found infection rate was 45.12 per cent in clinically malnourished patients, whereas it was 28.57 per cent in COPD cases and 33.33 per cent in obese patients. Hence comorbidity played a vital role in SSI.

E.coli(muddy thin pus) was mostly present (44%) among pus discharges from wound site, Staphylococcus aureus (thick creamy ) 36%, Klebsiella pneumonia (yellowfishy) 8%, Pseudomonas (blue green) 8% and no growth (serosanguineous pus) in 4% cases of SSI noted. Study by Sultan et al[39]. in 2007. detected Esch. Coli as principal incriminated organism for SSI. Distribution of microflora involved was E. coli 47.7 %, Proteus 14.8%, Pseudomonus 11.8%, Klebsiella 11.8%, Streptococcus 6.7%, Staphylococcus 5% and Enterococi 2.4% (Sultan et al. 2007). Study by Rabeul Karim found E.Coli were found in 45.83% cases, the commonest organism causing surgical site infections (SSI). Staph. Aureus were the second most common organism found in 37.50% cases. Each of klebsiella and pseudomonas were causing 8.33% cases of SSI which was consistent with our findings.

As for antibiotic sensitivity, a single pathogen had varied sensitivity. E coli was sensitive to ciprofloxacin45%, ceftriaxone 72%, gentamicin 30%, levofloxacin 55%, imipenem 80%,cotrimoxazole 45%,amikacin 90%, nitrofurantoin 90%. These findings are consistant with that of Iqbal et al(40) and Rabeul Karim et al. Iqbal et al studied sensitivity pattern on 378 isolates of E. coli from different sources and found susceptible to imipenem (99.7%), Tazobactum (99%), Amikacin (99%), Nitrofurantoin (92%), Ceftriaxone (66%) and ciprofloxacin (55%). Majority of the isolates were resistant to Cotrimoxazole (72%) and Ampicillin (76%) (Iqbal et al 2002).

Pseudomonas was sensitive to ciprofloxacin 50%, ceftriaxone 90%, gentamicin 55%,imipenem 80%,nitrofurantoin 50%. This findings is somewhat comparable with that of Ozumba, Nigeria, who studied antibiotic sensitivity pattern on 229 clinical isolates of Pseudomonus aeruginosa. Majority of isolates tested were susceptible to Ceftazidim (88.5%), Colistin (83.75%), Ciprofloxacin (62.1%) and Ofloxacin (62.5%). These were less susceptible to Ceftriaxone (45.1%), Gentamycin (44.1%), Cotrimoxazole (0.7%) and Nitrofurantoin (6.7%) (Ozumba2003)[41].

Klebsiella was sensitive to ceftriaxone 90%, levofloxacin 70%, imipenem 90%, nitrofurantoin 55%. These findings are similar to that of Sultan et al. They stated in their study result that, the micro flora of intra abdominal infections was usually found sensitive to 3rd generation cephalosporins, tazobactum, Imipenem, quinolones, clindamycin and amikacin (Sultan et al. 2007)

Staphylococcus was sensitive to ciprofloxacin 45%, ceftriaxone 45%, amikacin 30%, imipenem 90%, nitrofurantoin 33%. This findings can be compared with the findings of a national survey in Ireland done in 1993. The overall percentage of S. aureus sensitivity to the tested antibiotics were as follows: Methicillin 85%, penicillin 8%, gentamycin 89%, ciprofloxacin 85%, erythromycin 80%, fusidic acid 96 % and mupirocin 98% (Moorhouse et al. 1996)[42]. Results are inconsistent with that of present study; it may be due to variation in the methodology and patient to patient characteristics.

**Conclusion**

The overall incidence of SSI was 27.42%. The risk factors associated with SSI were: length of preoperative hospital stay greater than 24 hours; a longer duration of surgery; level of contamination, comorbidity of patient, expertise of surgeon, delay in initiating surgery and level of contamination of wound. Among the SSI cultures analyzed, the most prevalent microorganism was E. coli. It is important the early recognition of the risk of developing SSI in patients undergoing surgery, so that preventive measures can be adopted with the aim of reducing surgical site infections.

**Limitations**

This study has been carried out over a limited period of time with a limited number of patients, hence may have significant variations when compared with other studies.

**References**

1. CentersFor Disease Control And Prevention (CDC). Procedure-Associated Module: surgical site infection event [Internet]. Atlanta; 2016. 29 p. [Access 2016 Ago 17].
2. Gomes AEB, Cavalcante RS, Pavan ECP, Freitas ES, Fortaleza CMCB. Predictive factors of post-discharge surgical site infections among patients from a teaching hospital. Rev Soc Bras Med Trop. [Internet]. 2014 [Access 2016 Ago. 16]; 47(2): 235-8.
3. Allegranzi B, Bischoff P, Kubilay Z, de Jonge S, Zayed B, Sudan R, et al.Global guidelines for prevention of surgical site infection. World Health Organization.2016.
4. Kirchengast S,Carsareansection:from the viewpoint of evolutionary medicine ;2017.
5. Saeed KBM, Greene RA, Corcoran P, O"NeillSM.Incidence of surgical site infection following caesarean section :a systematic review and meta-analysis protocol. BMJ Open.2017;7(1):e013037.
6. Jaiyeoba O.Postoperative infections in obstetrics and gynecology.ClinObstet Gynecol.2012:55(4):904-13.
7. Mpogoro FJ, Mshana SE, Mirambo MM, Kidenya BR, Gumodoko B, ImirzaliogluC.Incidence and predictors of surgical site infections following caesarean sections at Bugando medical Centre, Mwanza, Tanzania. Antimicrob Resist Infect Control.2014;391):25.
8. Watanabe A, Kohnoe S, Shimabukuro R, Yamanaka T, Iso Y, Baba H, et al. Risk factors associated with surgical site infection

in upper and lower gastrointestinal surgery. Surg Today2008;38:404-12
9. Suljagić V, Jevtic M, Djordjevic B, Jovelic A. Surgical site infections in a tertiary health care center: Prospective cohort study. Surg Today 2010;40:763-71.
10. Urban JA. Cost analysis of surgical site infections. Surg Infect (Larchmt)2006;7(suppl 1):S19-22.
11. Reichman DE, Greenberg JA. Reducing Surgical Site Infections: A Review. Rev ObstetGynecol2009;2:212-21.
12. Eriksen HM, Chugulu S, Kondo S, Lingaas E. Surgical-site infections at Kilimanjaro Christian Medical Center. JHosp Infect 2003;55:14-20.
13. Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. Indian J Med Microbiol2005;23:249-52.
14. Anvikar AR, Deshmukh AB, Karyakarte RP, Damle AS, Patwardhan NS, Malik AK, et al. A one year prospective study of 3280 surgical wounds. Indian J Med Microbiol1999;17:129-32.
15. Patel SM, Patel MH, Patel SD, Soni ST, Kinariwala DM, Vegad MM. Surgical site infections: Incidence and risk factors in a tertiary care hospital, Western India. Natl JCommunity Med 2012;3:193-6.
16. Available from: http://www.chcanys.org/clientuploads/downloads/ Clinical_Conf_2007/TracksMay/SIPNorthwestCollaborativeHandbook. pdf [Last cited on 2013 May 14].
17. Ganguly PS, Khan Y, Malik A(2000) Nosocomial Infections and hospital procedures. Indian J Commun Med Accessed.
18. Vatavati SR,Kampli MS(2020) Surgeries and surgical site infection in India:An analysis of health management Information System 2019-2020. J Surg Surgical Res 6(2):146-148.
19. Mu Y, Edwards JR, Horan TC, Berrios-Torres SI, Fridkin SK. Improving risk-adjusted measures of surgical site infection for the National Healthcare Safety Network. Infect Control Hosp Epidemiol. [Internet]. 2011; 32(10): 970-86.
20. Saunders L, Perennec-Olivier M, Jarno P, L'Heriteau F, Venier A, Simon L, et al. Improving prediction of surgical site infection risk with multilevel modeling. Plos One. [Internet]. 2014 [Access 2016 Ago. 16]; 9(5): e95295.
21. Marchi M, Pan A, Gagliotti G, Morsillo F, Parenti M, Resi D, et al. The Italian national surgical site infection surveillance programme and its positive impact, 2009 to 2011. Euro Surveill. [Internet]. 2014 [Access 2016 Ago. 16]; 19(21): 1-7.
22. Isik O, Kaya E, Dundar HZ, Sarkut P. Surgical site infection: re-assessment of the risk factors. Chirurgia. [Internet]. 2015[Access 2016 Ago. 16]; 110(5): 457- 61.
23. Gomes AEB, Cavalcante RS, Pavan ECP, Freitas ES, Fortaleza CMCB. Predictive factors of post-discharge surgical site infections among patients from a teaching hospital. Rev Soc Bras Med Trop. [Internet]. 2014 [Access 2016 Ago. 16]; 47(2): 235-8.
24. Agência Nacional de VigilânciaSanitária (ANVISA). (BR). Critériosdiagnósticos de infecçãorelacionada à Assistência à Saúde [Internet]. Brasília (DF): Ministério da Saúde; 2013.
25. Rabeul Karim et al Factors Responsiblefor Surgical Site Infectionfollowingemergencynon traumaticabdominaloperation, Mymensingh Medical CollegeAnd Hospital, Mymensingh, Bangladesh., 2011.
26. Razavi, S. M., Ibrahimpoor, M., Sabouri, A., Kashani, Jafarian A, 2005. Abominal surgical site infections: incidence and risk factors at an Iranian teaching hospital, BMC surgery, 5(2),
27. Renvall S., Niinikoskij, Aho, A.J., 1980. Wound infection in abdominal surgery: a prospective study on 696 operations. Acta Chir Scand .146 (1), 25-30.
28. Gomes AEB, Cavalcante RS, Pavan ECP, Freitas ES, Fortaleza CMCB. Predictive factors of post-discharge surgical site infections among patients from a teaching hospital. Rev Soc Bras Med Trop. [Internet]. 2014 [Access 2016 Ago. 16]; 47(2): 235-8.
29. Pathak A, Saliba EA, Sharma S, Mahadik VK, Shah H, Lundborg CS. Incidence and factors associated with surgical site infections in a teaching hospital in Ujjain, India. Am J Infect Control. [Internet]. 2014 [Acesso 2016 Ago. 16]; 42: e11-e15.
30. Franco LMC, Ercole FF, Mattia A. Infecçãocirúrgicaempacientessubmetidos a cirurgiaortopédica com implante. Rev SOBECC. [Internet]. 2015[Acesso 16 ago 2016]; 20(3): 163-70.
31. Carvalho RLR, Campos CC, Franco LMC, Rocha AM, Ercole FF. Incidence and risk factors for surgical site infection in general surgeries. Rev. Latino-Am. Enfermagem. 2017;25:e2848.
32. Surgical Site Infection Survillance for general surgery, 2009. Wexford General Hospital Surgical Site Infection (SSI) data report.
33. Paul D., 2004. A study of wound infection following emergency GIT surgery and their bacteriological study, Dissertation (FCPS). Bangladesh College of Physician and Surgeons. 125-138.
34. Huda M. N., 2005. Wound infection profile in different non-traumatic emergency abdominal operations. Dissertation (FCPS). Bangladesh College of Physicians and Surgeons. P 60-6.
35. Hernandez, K., Ramos, E., Seas, C., Henostroza, G., Gotuzzo, E., 2005. Incidence of and risk factor for Surgical site infections in a Peruvian Hospital, Chicago Journals, 26 (5) 473-477.
36. Cruse, P.J.E., Frood, R., 1980. The epidemiology of wound infection . Surgical clinics of North America, 60 (1), 27-40.
37. Ali, S.L., Khan, A.N.G.A., 1983. Pattern of surgical infection at Chittagong Medical College Hospital. Journal of BCPS, 1(1), 17-20.
38. Israelsson, L. A., Jonsson, T., 1997. Overweight and healing of the midline incisions: the importance of suture technique . Eur J Surg., 163 (3), 175-80.
39. Sultan, J., Bilal, H. B., Kiran, H., Bilal, B. B., Yusuf, A., 2007. Emergency Abdominal Surgery; incidence of intra abdominal sepsis and its management, Professional Med J, 14(1), 10-16.
40. Iqbal, M., Patel, K., Ain, Q., Barney, N., Kiani, Q., Rabbani, K., Z.et al.2002. Susceptibility Patterns of Escherichia coli: Prevalence of Multidrug ñresistant Isolates and Extended Spectrum Beta-Lactumase Phenotype, JPMA 52(407), 1- 4.
41. Ozumba, U. C., 2003. Antibiotic sensitivity of isolates of pseudomonus aeruginosa in enugu, Nigeria, African journal of clinical and experimental microbiology, 4 (1), 48-49.
42. Moorhouse, E., Fenelon, L., Hone, R., Smyth E., McGahon, J., Dillon, M., 1996. Staphylococcus aureus sensitivity to various antibioticsóa national survey in Ireland 1993, Ir J Med Sci,165(1),40-3.

**Conflict of Interest: Nil Source of support: Nil**