

**PROSPECTIVE STUDY ON SURGICAL SITE INFECTION IN POSTOPERATIVE PATIENTS***Ashwin Chand R<sup>1</sup>, V. Jeyaraman<sup>2</sup>, Achu Jacob Philip<sup>3</sup>*<sup>1</sup>*Assistant Professor, Department of General Surgery, Pondicherry Institute of Medical Sciences, Kalapet, Puducherry.*<sup>2</sup>*Associate Professor, Department of General Surgery, Pondicherry Institute of Medical Sciences, Kalapet, Puducherry.*<sup>3</sup>*Postgraduate, Department of General Surgery, Pondicherry Institute of Medical Sciences, Kalapet, Puducherry.***ABSTRACT****BACKGROUND**

Surgical site infection is one of the postoperative complication, which causes increased morbidity and mortality among patients. Various factors are involved and many more preventive methods are available. Pathogenicity of surgical site infection vary based on the type of infection. The sensitivity of organism to antimicrobial varying with time.

**MATERIALS AND METHODS**

This study was conducted in Pondicherry Institute of Medical Sciences from October 2010 to September 2011. A total of 150 patients undergoing surgery was taken up for the study. These patients were followed up postoperatively to look for any signs of surgical site infection. Wound swabs were taken and antimicrobials were started as per culture and sensitivity.

**RESULTS**

Among the 150 patients taken up for study, 11 patients developed surgical site infection that accounts to about 7.33%. Patients with comorbidities like diabetes had higher risk of developing SSI. Most common organism was found to be Staph. aureus.

**CONCLUSION**

The rate of surgical site infection has been decreasing compared to previous studies. The current problem faced is the increased resistance of microbials to antibiotics. Adequate diabetic control needed to control and avoid SSI. Reduction in SSI will directly reduce the rate of related morbidity and mortality.

**KEYWORDS**

Surgical Site Infection.

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**BACKGROUND**

Surgical site infection is a common postoperative complication and causes significant postoperative morbidity and mortality.<sup>1</sup> SSI prolongs hospital stay and adds between 10-20% hospital cost. The understanding of wound infection has come a long way from the days when pus was "laudable"<sup>2</sup> far reaching advances in therapeutics, techniques in surgery and maintenance of asepsis have contributed to controlling scourge of surgery, which is postoperative wound infection. Postoperative infection is the most common cause of morbidity following surgery and in the most severe forms leading to septicaemia, which endangers life. At its most basic level, overt clinical infection represents a shift of balance of forces comprising host defense and microbial invasion.<sup>3</sup> In fact, postoperative infections after modern elective operations represent in the absence of gross breaks in asepsis technical and host defense failures.<sup>4</sup>

The four most common sites of postoperative infections are surgical wounds, lungs, urinary tract, intravascular devices excluding surgical wound infections. The primary risk factor for the other sites of infection is the presence of foreign (e.g. intravascular catheter, urinary catheter) that compromises normal defence mechanisms. The longer such devices remain in place, greater is the risk of infection. Moreover, bacteraemia arising from one of these sites may seed the surgical wound leading to a secondary SSI.<sup>5</sup> Thus, the comprehension and manipulation of host defenses have become the central areas of surgical inquiry.<sup>6</sup>

Clear understanding of pathogens and their pathogenicity, advances in the field of asepsis and aseptic technique, the advent of antibiotics and reliable suture materials have furnished the surgical armamentarium in countering infection. Hence, a constant awareness of the ever present threat of infection must be a way life for the entire surgical fraternity. In 1992, the surgical wound Infection Task Force replaced the term 'Surgical Wound Infection' with 'Surgical Site Infection'-SSI.<sup>1</sup>

**AIMS AND OBJECTIVES**

To study the incidence of postoperative surgical site infection following different classes of surgery in selected patients who underwent surgery in Department of General Surgery and Specialties in PIMS.

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## OBJECTIVES

- To assess the rate of SSI.
- To study the microbiology of infections.
- To study the various factors influencing postoperative infections.
- To study various other causes of SSI.
- To study antibiotic sensitivity and antimicrobial prophylaxis.
- To study the outcome of SSI.

## MATERIALS AND METHODS

The study was conducted in the surgical wards of Pondicherry Institute of Medical Science between the period of October 2010 to September 2011 (1 Year). The study was focused on elective cases. Hence, all patients who underwent elective surgeries in PIMS were included in the study. Patients with clean and clean contaminated postoperative wounds were included in this study. Contaminated and dirty wounds were excluded. Children and patients with less than 20 years of age were not included in the study. Elective cases in other specialties like Urology, Plastic and Neurosurgery were also included in this study. Total of 150 elective surgeries were studied during this period.

### Inclusion Criteria

- Patients underwent any type of major elective surgery in PIMS.
- Clean and clean contaminated surgeries.
- Definite infection signs like wound gapping, serous/pus discharge were considered as diagnostic criteria for SSI.

### Exclusion Criteria

- All emergency surgeries.
- Patients who were not willing for study.
- Patients with pre-existing infection, contaminated and dirty wounds.
- Signs of wound infection like inflammation, redness, local warmth were not included as diagnostic criteria for SSI.

All patients were explained about the study and were consented before participating. Uniformly, all patients received preoperative preparations on the day of surgery (preoperative hair removal). Cefazolin (belonging to the 1<sup>st</sup> generation cephalosporins) 1 gm IV was used as preoperative antimicrobial (antibiotic) prophylaxis administered one hour before surgery in selected cases. Another dose of antibiotic was repeated in longer duration surgeries. All comorbid conditions like diabetes, respiratory infections, urinary infections and anaemia were assessed with regular preoperative investigations. Betadine (povidone-iodine) used commonly for all patient as antimicrobial paint. A clinico-microbacterial study was conducted on all patients underwent surgery. A sterile swab for culture and sensitivity was taken intraoperatively

and sent to lab and assessed with normal culture technique followed in hospital.

Repeat swab for culture and sensitivity was done in patients with postoperative wound infection. All data were entered by the observer and team in the Department of General Surgery. Postoperatively, all patients were followed up to a minimum of 30 days to rule out occurrence of SSI later. The data obtained were interpreted and converted statistically using Student's 't' test and  $\chi^2$  test to assess sensitivity.



**Figure 1. Wound Infection Post-Laparotomy - SSI DEEP**



**Figure 2. Wound Gapping with Superficial Infection**



**Figure 3. Superficial Infection after Thyroidectomy**



**Figure 4. Wound Gapping Incisional Deep SSI**

## OBSERVATION AND RESULTS

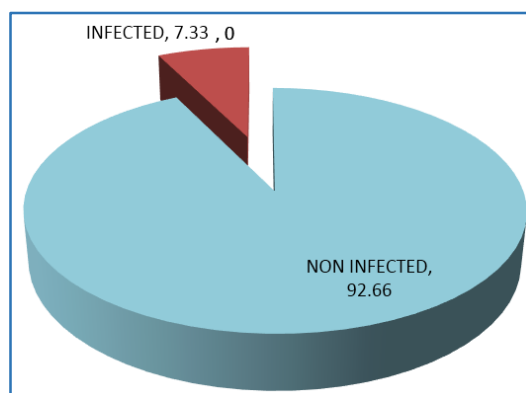
**Total Elective Case Studied-** N=150. Period: 2010 to 2011.

### 1. Incidence of Infection.

- N=150.

Sl. No.	Infection	Cases	Percentage (%)
1	Non-infected	139	92.66
2	Infected	11	7.33
	<b>Total</b>	<b>150</b>	<b>100</b>

**Table 1**



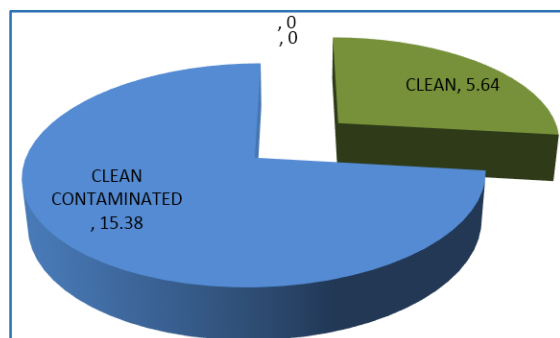
Total infection rate was- 7.33%

### 2. Types of Wound

- In our study, only elective cases were included. The cases studied fell into the category of clean and clean-contaminated cases.
- Cases separated into 2 groups.
  - Clean.
  - Clean Contaminated.

Sl. No.	Type of Wound	Cases	Infected	(%)
1	Clean	124	7	5.64
2	Clean Contaminated	26	4	15.38

**Table 2**



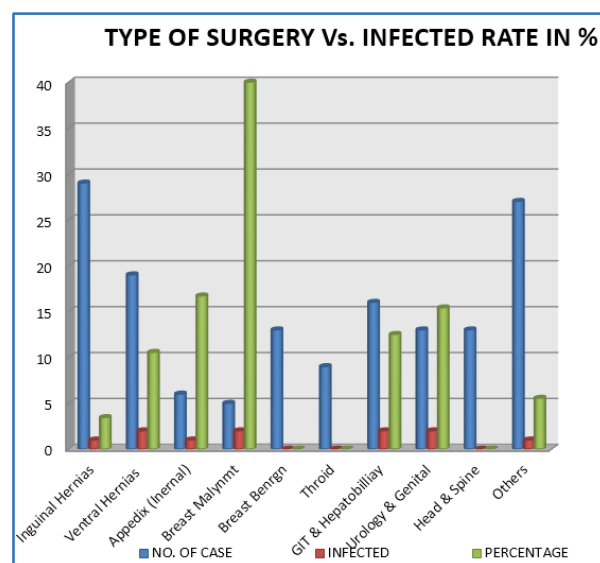
- Rate of incidence was higher in clean contaminated case compared to clean cases.
- Clean contaminated- 15.38%.
- Clean- 5.64%.

### 3. Type of Surgery vs. Infection Rate

Sl. No.	Surgery	No. of Cases	Infected	(%)
1	Inguinal Hernias	29 (19.33%)	1	3.44
2	Ventral Hernias	19 (12.7%)	2	10.53
3	Appendix (Interval)	6 (4%)	1	16.7
4	Breast Malignant	5 (3.33%)	2	40
5	Breast Benign	13 (8.67%)	--	--
6	Thyroid	9 (6%)	--	--
7	GIT and Hepatobiliary	16 (10.67%)	2	12.5
8	Urology and Genital	13 (8.67%)	2	15.4
9	Head and Spine	13 (8.67%)	--	--
10	Others*	27 (18%)	1	5.55

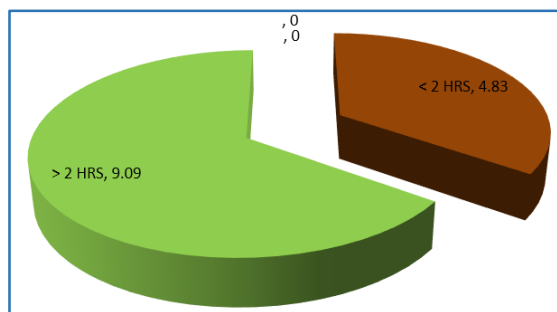
#### Others\* Include

(Plastic surgery, vascular surgery and thoracic surgery). Infected cases were common in breast surgeries for malignancy followed by interval appendix and urogenital surgeries under the category of clean contaminated case.



### 4. Duration of Surgery

- Divided into 2 groups.
- Group I- Time taken for surgery less than 2 hrs.
- Group II- Time taken for surgery more than 2 hrs.



There was slight increase in infection rate when the surgery prolonged more than 2 hrs. compared to the shorter duration surgeries.

Sl. No.	Duration	Cases	Infected	(%)
1	<2 hrs.	62	3	4.83
2	>2 hrs.	88	8	9.09

**Table 3**

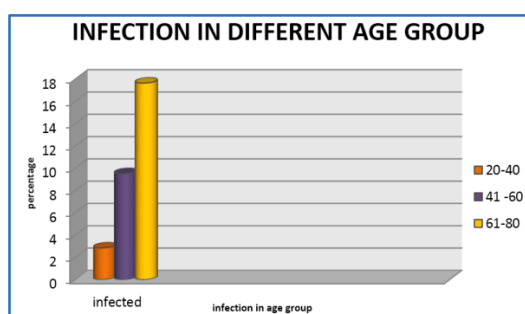
- Infection rate <2 hrs. 4.83%
- Infection rate >2 hrs. 9.09%

#### 5. Distribution of Infection in Different Age Group.

- N=150
- Age Distribution- Cases from age group of 20 to 80 years were present in the study.
- Subdivided into 3 subgroups.
- 20-40 years.
- II - 41-60 years.
- III - 61-80 years.

Sl. No.	Age Group	Cases	Infected	(%)
1	20-40	70	2	2.85
2	41-60	63	6	9.52
3	61-80	17	3	17.64

**Table 4**



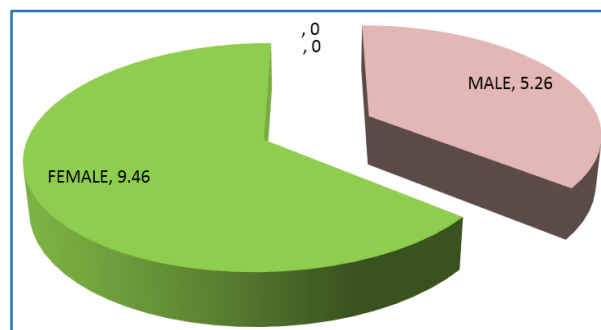
The incidence of infection was much higher in case of older age group compared to that of younger age group. 17.64% in 61-80 (Group III), whereas 2.85% in 20-40 (Group I).

#### 6. Sex Distribution

- Total number of case N=150.
- Males - 76.
- Females - 74.

Sl. No.	Sex	Cases	Infected	Percentage (%)
1	Male	76	4	5.26
2	Female	74	7	9.46

**Table 5**



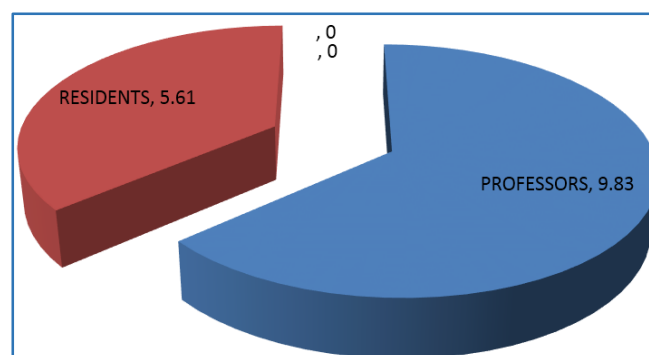
Females showed slight higher rate of infection than male. It is justified because more cases of incisional hernias with mesh repair done for females compared to males.

- Female infection rate - 9.46%.
- Male infection rate - 5.26%.

#### 7. Surgeon Factor

Sl. No.	Surgeon	Cases	Infection	Percentage (%)
1	Professors	61	6	9.83
2	Residents	89	5	5.61

**Table 6**



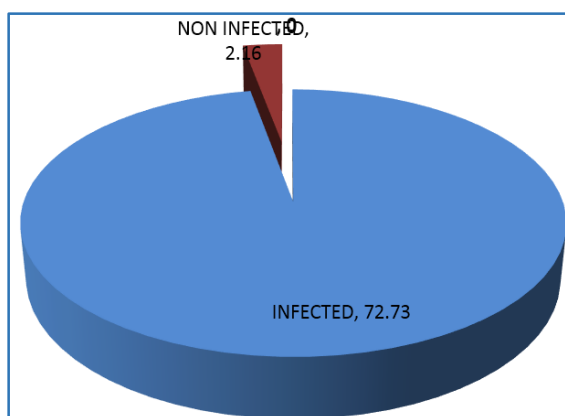
- Incidence in Prof. operated cases 9.83%.
- Incidence in residents operated cases 5.61%.
- Infection rate slightly higher in cases operated by professors than residents.

#### 8. Relation with Fever

- Total no. of case N=150.
- Infected patient = 11.
- Non-infected patient = 139.

Sl. No.	Category	Cases	Fever	(%)
1	Infected	11	8	72.73
2	Non-infected	139	3	2.16

**Table 7**



- Fever was one of the major associated symptoms among the infected cases (72.73%).
- In non-infection cases, which was not significant (2.16%).

#### 9. Comparison of all Comorbid Conditions Contributory to SSI

Sl. No.	Comorbidities	Infection Percentage (%)
1	Anaemia	9.37
2	UTI	16.66
3	RI	18.18
4	DM	18.18

**Table 8. Comorbid Conditions Comparison**

The above table shows that there is a significant role of all comorbid conditions in increasing the risk of postsurgical site infections.

#### 10. Antibiotic Prophylaxis (AMP)

Category	Cases	Infections	Percentage
AMP Received	86	3	3.48
AMP Not Received	64	8	12.5

No. of infected cases in patients not received AMP is significantly high (4 fold) in comparison with the infected cases in AMP received patients. This stresses the importance of AMP treatment preoperatively.

#### 11. Bacteriological Surveillance

Among 11 cases of wound infection, gram-negative bacilli were very often responsible for postoperative wound infection than gram-positive organisms.

Sl. No.	Organism	No. of Cases	%
1	Staphylococcus	3	27.28
2	E. coli	2	18.18
3	Streptococci	1	9.09
4	Pseudomonas	1	9.09
5	Klebsiella	1	9.09
6	Contaminants	1	9.09
7	No pathogen	2	18.18

**Table 9. Bacteriological Surveillance**

Staphylococcus were the most common organism causing the wound infection (27.28%) followed by E. coli (18.18%).

#### 12. Antibigram

	Ampicillin	Amikacin	Ciprofloxacin	Ceftriaxone	Gentamycin	Norfloxacin	Amoxicillin	Imipenem	Vancomycin	Cephalexin
Staph. aureus	-	-	-	+	-	-	-	+	+	-
E. coli	-	-	+	-	+	-	-	+	+	-
Staphylococcus	-	-	-	+	-	-	+	+	-	+
Pseudomonas	-	+	-	-	+	-	-	+	+	-
Klebsiella	-	+	-	-	+	-	-	+	+	-

**Table 10**

Selection of antibiotics to treat the infected cases was done based on the antibiogram as per the choice of two treating surgeon.

#### 13. Duration of Postoperative Stay in Hospital

Duration	No. of Days Total	Median
Non-infected cases 139	794	5.71 days
Infected cases 11	250	22.73 days

Postoperative stay in hospital by infected cases are significantly extended almost 4 times (22.73 days) in comparison with non-infected cases (5.71 days).

#### 14. Infection in Cases Post Discharge

Sl. No.	Surveillance	Infected Cases	Percentage
1	Before Discharge	5	45.45
2	After Discharge	6	54.54



- Higher infection was seen in patients after discharge from hospital than during their stay in the hospital.
- After discharge, infection rate 54.54%.
- Before discharge, infection rate 45.45%.

## DISCUSSION

The rate of the surgical site infection reported by various studies has differed considerably. The overall infection rate in the study of 150 elective major cases conducted in our hospital (PIMS) from 2010 to 2011 was 7.33%, which compares favourably with other studies ranging from 2.5 to 41.9%.<sup>7</sup> In a similar study carried out by S.P Lilani et al (2002), a study group of 190 patients, the infection rate was 9.5%.<sup>1</sup> The overall infection rate in clean surgeries among number of studies conducted in India were ranging from 4.04 to 30% and 10.06 to 45% for clean - contaminated surgeries (Rao A.S et al 1975<sup>7</sup>, Kowli SS et al 1985,<sup>8</sup> Anvikar 1999<sup>9</sup>). In our study, out of 150 patients, 11 developed postoperative SSI in which the rate was 5.64% (7 cases) in clean surgeries and 15.38% (4 cases) in clean contaminated surgeries. The difference was found to be statistically significant. Maximum infection was seen in breast surgeries (mastectomies for malignancy) and meshplasty for incisional hernias among the clean cases; whereas surgeries performed for other clean cases (inguinal hernia, thyroid, etc.) had less or no SSI. In clean contaminated surgeries, most of the infection occurred in GIT and lower urinary tract surgeries. Our study showed directly proportional increase in infection rate with duration of surgeries.

Among 62 surgeries performed in less than 2 hrs., the infection rate was 4.83% (3 cases). When compared to 88 surgeries with more than 2 hrs. duration, had the infection rate of 9.09%, which was comparable with other studies. Cruse P.J.E and Floord studied the relationship between rate of infection and duration of procedure. It was 1.3% for surgeries lasting one hour or less and 4% for those lasting 3 hours or more (Cruse Peter J. E. et al,<sup>10</sup> Anvikar et al,<sup>9</sup> Nichols R. L et al<sup>11</sup>). In our study, 70 patients were in the age group of 20-40 yrs., 63 were in 41-61 yrs. and 17 were in 61-80 yrs. The rate of infection was higher (17.64%) among older age in comparison with the younger age group (2.85%). This corresponds with the study done by Kaye KS et al, Raymond DP et al<sup>12,13</sup> where 1,44,485 patients were studied with total SSI of 1.2% showed increasing age more than 60 yrs. independently predicted an increased risk of SSI.

Female (74 cases) had slightly higher infection rate 9.46% when compared with male (76 cases) 5.26% like the study done by Yalcin A.N et al (1995),<sup>14</sup> Sangrasi A K et al (2008).<sup>15</sup> It was inferred from our study that the infection rate was higher (2 fold) in patients with co-morbid conditions like diabetes (18.18%), respiratory infection (18.18%), UTI (16.66%) and anaemia (9.37%). In the study of Ashar Ata et al (2009), they found postoperative hyperglycaemia to be the most important risk factor for SSI. A sub analysis found that postoperative serum glucose level higher than 140 mg/dL was the only significant

predictor of SSI. Various studies showed that preoperative antimicrobial prophylaxis significantly reduces the postoperative SSI. (Saxer F et al (2009), Uckay, Harbarth et al (2010)).<sup>16,17</sup> Our study was aimed to standardise the use of prophylactic antimicrobial agents in association with surgical procedures and thus to reduce the incidence of wound infection and minimise the expenses and adverse reactions attributable to overuse of antibiotics (favouring the emergence of antimicrobial resistance). The agent was chosen in such a way that it is effective against the pathogen most often recovered from infections occurring after that specific procedure and against the endogenous flora of the region of the body being operated upon. Cefazolin was considered for AMP in our study because it belongs to the first generation cephalosporin and has coverage against both gram-positive and negative organisms. In present study, Staph. aureus was the commonest isolate from postoperative SSI. Many studies like Mangram A. J et al,<sup>18</sup> Olson M. M et al,<sup>19</sup> Prabhakar H. et al<sup>(20)</sup> have also reported Staph. aureus as the commonest isolate. In our study, among the 3 cases of Staph. Infection, 2 were resistant to penicillin and 1 resistant to methicillin.<sup>16,21,19</sup>

They were sensitive to 3<sup>rd</sup> generation cephalosporin-ceftriaxone and also to imipenem and vancomycin. It is isolated from postoperative wound of mastectomies (MRM), mesh repair for ventral hernias. In present study, gram-negative bacilli were also common isolates. Based on type of surgical procedure and the site of infection, the pathogens isolated vary Staph. aureus is the usual pathogen in clean surgeries from the exogenous environment or the patients skin flora, whereas in other categories of surgeries (clean-contaminated, contaminated and dirty) the most commonly isolated pathogens are gram-negative bacilli or the polymicrobial flora closely resembling the normal endogenous microflora of the surgically resected organ. Altemeier W. A et al<sup>22</sup> (1968), Koneman E.W et al<sup>23</sup> (1997), Shanson D.C et al (1999).<sup>5</sup> In our study also E. coli (2 cases), pseudomonas (1 case), Klebsiella (1 case) were isolated from clean contaminated surgeries (GIT and lower urinary and genital tract surgeries).<sup>11</sup> E. coli were sensitive to ciprofloxacin whereas Pseudomonas and Klebsiella were sensitive to amikacin and gentamycin.

## CONCLUSION

Incidence of surgical site infection (postoperative infection) in our study is 7.33% percent. In this study, among 11 infected cases, Staph. aureus species were most commonly isolated. Next in order are E. coli, Klebsiella, Pseudomonas, and then comes streptococci. Shift from gram-positive to gram-negative organisms due to liberal use of antibiotics.

In this study, most of the organisms were sensitive to ceftriaxone, Amikacin, ciprofloxacin and gentamycin in descending order of frequency. Wound gaping, burst abdomen, enterocutaneous fistula, incisional hernia were observed as post-operative complications due to wound infection. The best way to decrease wound infection is by

rigorous surveillance and reporting of wound infection rate. Surgical Site Infection (SSI) continues to be the most common complication following surgical procedures. These infections are the biological summation of several factors, the inoculums of bacteria introduced into the wound during the procedure, the unique virulence of contaminants, the microenvironment of each wound and the integrity of the patients host defense mechanisms.<sup>24</sup> Prevention of surgical site infection can be achieved by several methods. The viable inoculums of bacteria in the wound can be reduced via better preoperative preparations of the surgical site, sound infection-control practice while performing operations and adherence to principles of preventive antibiotic therapy, modified surgical technique can reduce the risk of haematoma, tissue injury and foreign bodies within the surgical site that amplify the risk of infection for a given level of inoculums.<sup>22</sup> Enhanced oxygen delivery, better core body temperature control and rigorous blood glucose control in the surgical patient's concomitant aggressive control of co-morbid conditions are new areas that the potential to even further reduce the incidence of surgical site infection.<sup>25,26</sup>

Although, surgical site infections cannot be completely eliminated reduction in the infection rate to a minimal level could have significant benefits by reducing postoperative morbidity and mortality and wastage of healthcare resources.

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