Original article

Bacteriological Study on Surgical Site Infection in Rangpur Medical College and Hospital

Md. Hamidul Islam[1], Minim Parvin Mishu[2], Nusrat Afroze[3], MH Mahmud[4], Md. Shariful Islam[5], Md. Shahin Shah[6]

1. Assistant Professor
   Department of Surgery
   Rangpur Medical College
2. Registrar
   Department of Surgery
   Rangpur Medical College Hospital
3. Assistant Professor
   Department of Forensic Medicine
   Rangpur Community Medical College
4. Assistant Professor
   Department of Surgery
   Prime Medical College, Rangpur
5. Assistant Registrar
   Department of Surgery
   Rangpur Medical College Hospital
6. Assistant Professor
   Department of & Burn & Plastic Surgery
   Rangpur Medical College

Correspondence to:
Md. Hamidul Islam
Assistant Professor
Department of Surgery
Rangpur Medical College
Mobile: 01717136567
Email: dr.hamidul@gmail.com

Abstract

Background:
Surgical site infections (SSIs) is a major problem in both developed and developing countries. In developing countries like Bangladesh, infection in surgical patients has been appearing as a serious risk due to insurgence of drug resistance. Surgical site infections (SSIs) contribute significantly to increased health care costs in terms of prolonged hospital stay and lost working days. The problem was largely unexplored in Rangpur Medical College and Hospital, Rangpur.

Objective:
The aim of the study was to evaluate the bacteriological study on surgical site infections in Rangpur Medical College & Hospital.

Methods:
This cross-sectional observational study was conducted in the Department of Surgery at Rangpur Medical College Hospital. 72 patients of all ages, sex who developed surgical site infection were included through purposive sampling for observation and clinical follow up and wound swab was microbiologically evaluated.

Results:
Of the 72 cases, SSI developed 30.6% (22) following elective surgery and 69.4% (50) following emergency surgery. 7 cases were associated with co-morbid conditions like diabetes mellitus (2), malignancy (4) and tuberculosis (1). Most common organisms were Escherichia coli (30 /54) followed by Staphylococcous aureus (14/54), Pseudomonas (07/54) and Klebsiella (03/54).The antibiogram pattern of the organism isolated from wound swab of SSIs were analyzed with commonly used antibiotics. Resistance of Escherichia coli to Amoxycillin, Cotrimoxazole, Doxycycline and Nalidixic acid were 100%, 91.5%, 71.4% and 60.5% respectively.In case of, Staphylococcus aureus 87.5% were resistant to penicillin and Cotrimoxazole. Resistance of Pseudomonas spp. to Ciprofloxacin, Ceftazidime and Gentamicin were 31.2%. 6.3% and 50% respectively. In case of Klebsiella spp, it showed that 100% strains were resistant to Amoxycillin like Esch. coli but all strains were sensitive to both Ceftriaxon and Imipenem.

Conclusion:
The study emphasizes the need for the evidence-based infection control and antibiotic prescription policies in the hospital.

Keywords: Surgical site infections, Bacterial Infection, Antibiotic sensitivity

Introduction:

Surgical site infection (SSI) results from bacterial contamination during or after a surgical procedure.[1] The data from the National Nosocomial Infection Surveillance System (NNIS) of the Centre for Disease Control (CDC) indicate that surgical site infections are the third most frequently reported nosocomial infection, accounting for 14-16% of all nosocomial infection in acutely hospitalized patients. Among surgical patients SSIs are the most frequent cause of such infections, accounting for 38% of the total.[2] In surgical practice, infection is a common problem worldwide. It enhances morbidity, long stay in hospital, mortality and reason for more expenditure of patient. Though this is the era of newer and effective antibiotics, still post-operative wound infection continue to be a common surgical complication. Despite tremendous advances in modern operative technology, developed countries are not exempted from this problem.[3] In USA Centre for Disease Control (CDC) estimated of 500000 surgical wound infections per year.[4] The most widely recognized definition of infection, which is used throughout the USA and Europe, is that devised by Horan and colleagues and adopted by the Centre for Disease Control (CDC). This splits surgical site injections into three groups- superficial and deep. SSIs and organ space SSIs-depending on the site and the extent of infection. The Centre for Disease Control (CDC) definition states that only infections occurring within 30 days of surgery (or with a year in the case of implants) should be classified as SSIs.[2] All surgical wounds are contaminated by bacteria, but only a minority actually demonstrates clinical infection. These infections are the biological summation of several factors, the inoculums of bacteria introduced into wounds during the procedure, the unique virulence of contaminants, the micro-environment of each wound, and the integrity of the patient's host defense mechanism. An appreciation of the sources of bacteria is important, and in abdominal surgery these may be summarized as endogenous from the patient's viscera (90%); endogenous from the patient's skin.[5] Establishing the burden of healthcare associated infections (HCAI) is a prerequisite before any institutional improvement programme can begin so that the success can be measured against the baseline rate.[6] Improper usage of antimicrobials complicates the problem of HCAI by encouraging multi-resistance in nosocomial pathogens, and treatment options are fast running out, particularly against gram-negative nosocomial pathogens.[7,8] SSI[9,10] and peripheral IV access device infections are two major HCAI avoidable by relatively simple means, avoiding the associated morbidity and extra cost and saving thousands of lives. Risk factor for acquiring infection would be of following categories as host factors, surgical factor, environmental factor and nature of the microbes. Host factors contributing to increased risk of infection are age, length of hospital stay and concurrent infection at the other site of the body. Among surgical factors the nature and extensibility of operation, site and depth of the wound, logistic used and continued during and after operation and surgeons' technical skills are remarkable. On the other-hand, virulent bacteria of drug resistant nature may be the single factor for an overt and fulminate infection.[11-13] Postoperative wound infection alarmed the surgeons in early 1950. Most of them were due to staphylococcus aureus. This was attributed mainly to emergence of antibiotic resistant strains.In bacterial analysis of postoperative wound infections in 8 medical college hospitals of Bangladesh, Zaman et al[14] found that the commonest microorganisms were Esch. Coli (60%) followed by Staph. Aureus (20%), Ashraf et al[15] reported that the predominant causative organisms for the postoperative wound infections in the surgery wards of Dhaka Medical College Hospital were Esch. Coli (37.5%), Staphylococcus aureus (21.7%), Pseudomonas spp. (15.1%), Streptococcus (8.4%), Proteus (2.7%). Surgical site infection is a great burden for local surgeon and reflects a massive economic loss for the country. But there is no infection control policy that runs effectively in this hospital. The judicious use of antibiotic prophylaxis and the use of an organized system of wound surveillance and reporting can help in reducing the wound infection rate to an attainable minimum.[16] The apex medical research body has finally realized there is no place for jingoism in matters of science, and that the latest findings on antibiotic resistance must be taken seriously and verified scientifically.[17] So purpose of the study is to see the bacteriological aetiology of surgical site infection and eventually an infection control policy too.

Methods:

This observational cross-sectional study was conducted from January 2021 to December 2021 in the Department of Surgery at Rangpur Medical College Hospital, Rangpur and for the bacterial isolation, identification and sensitivity testing, the samples was sent to the Department of Microbiology at Rangpur Medical College, Rangpur. 100 patients operated in the surgery ward of Rangpur Medical College was enrolled as study population. Among them, 72 of patients who developed surgical site infection were included through purposive sampling for observation and clinical follow up and wound swab was microbiologically evaluated, patients of all ages, sex and those gave consent were also included. Patients with SSI undergone prior antibiotic therapy and severely ill patients (abscess, cellulites, gangrene) were excluded. All operated patients was checked on 3rd postoperative day to see their surgical site and if there is purulent drainage from the incision or symptoms or signs of inflammation like pain, tenderness, localized swelling, redness or heat and these patients was selected as the case. With all aseptic precaution the incision was deliberately opened and wound swab or pus was taken and immediately sent to Microbiology laboratory for culture. Swab was not taken from the proposed site of incision of skin preoperatively. Preoperative antibiotics was used as the unit protocol. Aerobic culture was done for every sample using appropriate media following standard method. No sample was discarded before 72 hours declaring as no growth. Bacterial isolates was identified according to morphological, colonial and biochemical characters. Anti-microbial susceptibility test was performed by disk diffusion methods according to procedures described in NCCLS. For grading of results breakpoint one of inhibition was considered and expressed as Sensitive (S), Intermediate (I) and Resistant (R).

Data was collected using a preformed data collection sheet (questionnaire). Base line information was collected from the patient after exploration of different complaints and sign and symptoms of the SSIs. All information regarding clinical features and microbiological results was recorded in a data collection sheet. All the relevant collected data was compiled on a master chart first and then statistical analysis of the results was obtained by using window-based computer software devised with Statistical Packages for Social Sciences (SPSS-13) (SPSS Inc, Chicago, IL, USA). The results were presented in tables.

Results:

The age and sex distribution of cases were shown in table-I. Out of 72 cases 46 were male and 26 were female giving a male to female ratio of 1.76:1. Majority cases (41) were in the age group of 21-40 years followed by the age group of 41-60 years (15). Least number of cases (7) was in the age group of below 20 years. Males were predominating in almost all the age groups.

Table-I: Age and sex distribution of cases (n=72)

Age group (Years)	Frequency (n)	Male n (%)	Female n (%)
Up to 20	07	5(71.42%)	2(28.57%)
21-40	41	25(60.97%)	16(39.02%)
41-60	15	10(66.66%)	5(33.33%)
Above 60	09	6(66.66%)	3(33.33%)
Total	72	46(63.89%)	26(36.11%)

The results of culture of surgical site infections were being shown in Figure-1. Of the total 72 wound 54 were positive culture and 18 were negative culture. Out of 54 positive culture 36 were male and 18 were female.

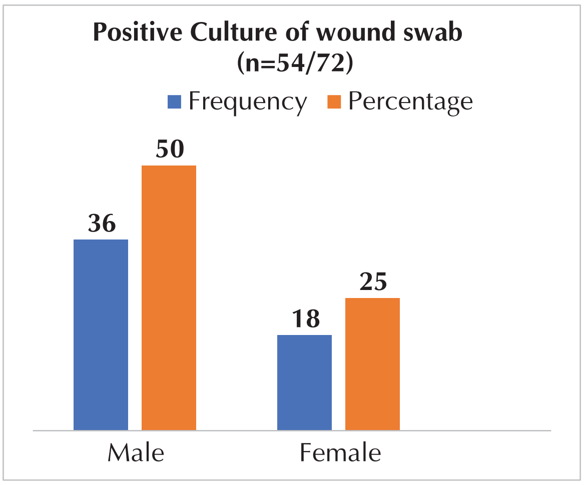

Figure-1: Positive Culture of wound swab (n=54)

Nature of surgery and percentage of surgical site infections were shown in Figure-2. Out of the 72 surgical site infections 22 (30.55%) were following elective surgery and 50(69.44%) were following emergency surgery.

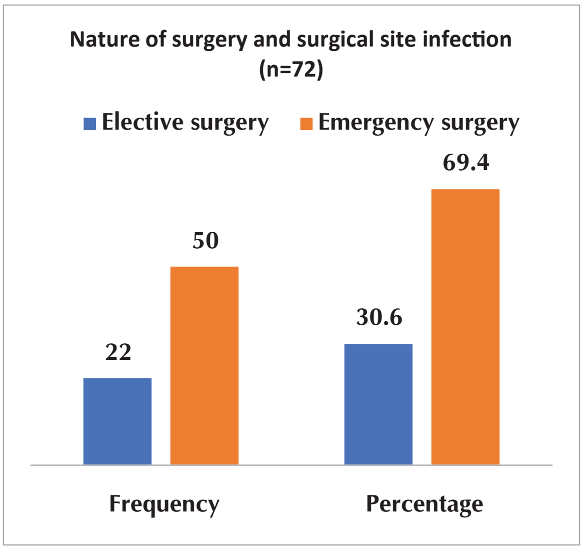

Figure-2: Nature of surgery and surgical site infection (n=72)

Figure-3 showed the recorded co-morbid status of the patients. Out of 72 surgical site infections 7 (9.72%) patients had associated co-morbid conditions. The following figure shows the details.

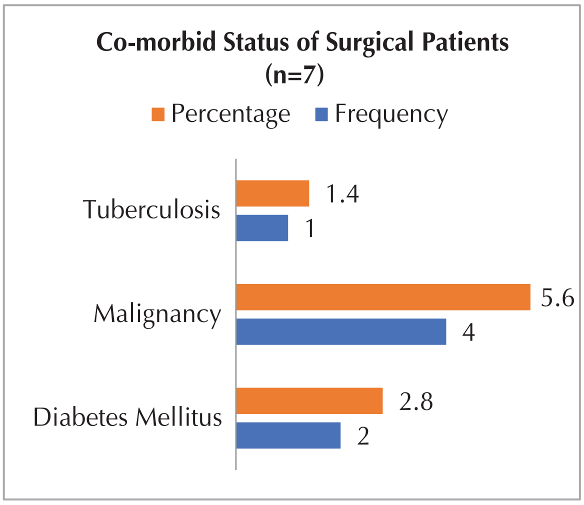

Figure-3: Co-morbid Status of Surgical Patients (n=7)

Distributions of organisms isolated from surgical site infections were shown in Figure-4 Escherichia coli (30) were highest isolates followed by Staphylococcus aureus (14). Other included Pseudomonas spp. Was 7 and Klebsiella spp. was 3.

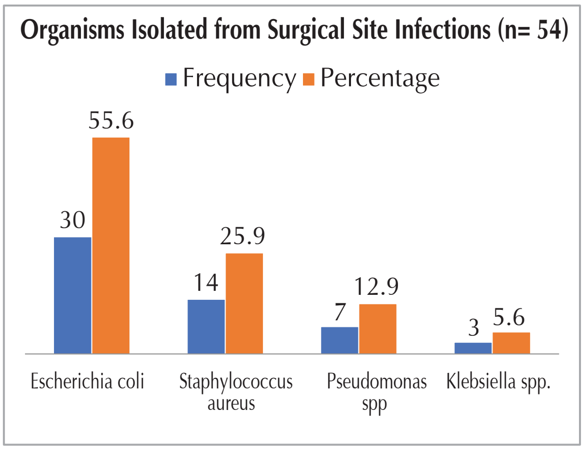

Figure-4: Organisms Isolated from Surgical Site Infections (n= 54)

Antimicrobial susceptibility of Escherichia coli isoltated from patient were being given in table-II, where 98% of strains were resistant to Amoxycillin and > 70% were resistant to Doxicycline and Cotrimoxazole and > 50% were resistant to Gentamicin, Cephalexin and Nalidexic acid. But all of the strains are sensitive to Imipenem and 73.4% of strains were sensitive to Ciprofloxacin and 62.5% were sensitive to Coftrixone.

Table-II: Antibiotic susceptibility (in percentage) of Eschericia coli

Antibiotic	Escherichia Coli		
	(S)	(I)	(R)
Amoxicillin	2	0	98
Doxycycline	14.3	14.3	71.4
Cotrimoxazole	8.5	0	91.5
Ciprofloxacin	73.4	5.6	21
Gentamicin	32.3	14.3	53.5
Cephalexin	28.6	14.3	57.1
Ceftriaxone	62.5	15.3	22.2
Nalidexic acid	29.1	10.4	60.5
Imipenem	100	0	0
Chlorumphenico	60.5	10.5	29
Nitrofurantoin	62.4	4	33.6

Table-III, showed the susceptibility of Staphylococcus aureus isolated from patients surgical wound. Only 12.5% strains were sensitive to Penicillin and Cotrimoxazole whereas 100% strains were sensitive to Cloxacillin and Imipenem and > 87% to Ciprofloxacin and Erythromycin. Sensitive results of >75% were found against Cephradine, Doxycycline and Gentamycin.

Table-III: Antibiotic susceptibility (in percentage) of Staphylococcus aureus

Antibiotic	Staphylococcus aureus		
	(S)	(I)	(R)
Penicillin	12.5	12.5	75
Cloxacillin	100	0	0
Erythromycin	87.5	12.5	12.5
Cephreadine	75.5	12.5	12.5
Ciprofloxacin	88.5	0	11.5
Doxycycline	75.0	12.5	12.5
Cotrimoxazole	12.5	0	87.5
Gentamicin	75.0	0	0

Table-IV, showed the susceptibility of Pseudomonas spp. isolated from patients surgical wound. Only 42.7% strains were sensitive and 50% strains were resistant to Gentamicin respectively. But 100% strains were sensitive to Imipenem and 93.7% strains to Ceftazidime followed by Pefloxacin (57.7%), Ciprofloxacin (56.3%) and Ceftrixone (55%). Ceftrixone appeared intermediate sensitive to 32.5% strains and resistant to 12.5% strains.

Table-IV: Antibiotic susceptibility (in percentage) of Pseudomonas spp

Antibiotic	Pseudomonas spp		
	(S)	(I)	(R)
Gentamycin	42.7	06.3	50.0
Ciprofloxacin	56.3	12.5	31.2
Pefloxacin	57.1	14.3	28.6
Ceftazidime	93.7	0	06.3
Ceftrioxone	55.0	32.5	12.5
Imipenem	100	0	0

Table-V, showed the susceptibility of Klebsiella spp. isolated from patients surgical wounds, where 100% of strains were resistant to Amoxycillin and 90% to Cotrimoxazole and >66.7% strains were resistant to both Doxicycline and Cephalexin. All of the strains of Klebsiella were sensitive to Ceftriaxon, Ciprofloxacin and Imipenem. 66.7% of strains were sensitive to Gentamicin.

Table-V: Antibiotic susceptibility (in percentage) of Klebsiella spp.

Antibiotic	Klebsiella spp		
	(S)	(I)	(R)
Amoxycillin	0	0	100
Doxycyclline	0	33.3	66.7
Cotrimoxazole	10.0	0	90.0
Gentamicin	66.7	0	33.3
Cephalexin	33.3	0	66.7
Ceftriaxone	100	0	0
Ciprofloxacin	95.4	0	04.6
Imipenem	100	0	0

Discussion:

The incidence of infection varies from surgeon to surgeon, from hospital to hospital, from one surgical procedure to another, and most importantly from one patient to another. Surgical site infection is a major problem in both developed and developing countries.[18] In developed countries many interventions were made to control surgical site infection. But in developing countries like Bangladesh no emphasis has yet been given in this field, infection in surgical patients has been appearing as a serious risk due to insurgence of drug resistance.[18] Sometimes it appears as a life-threatening challenge. Age and sex distribution of the cases in the present study showed highest number of both male and female in the age group of 21-40 years (56%). Also male was predominating as per sex was concerned. The finding indicated highest number of surgical diseases in the active age of the life especially in male. Generally, infection is prevalent in extremes of ages. The age-sex distribution in our study should not reflect the actual one rather than it may be an overestimation. Because, our male ward had more beds in comparison to female ward and below 12 years of aged patient was not admitted in our ward. In this study, out of 72 samples, 54 yield growth in culture. No growth in rest of 18 samples might be due to the reason of having anaerobic bacteria or prior administration of antibiotics might have inhibited growth in culture. Of the 72 cases, 22 (30.55%) cases infection developed following elective surgery and 50 (69.44%) cases infection developed following emergency surgery. Different studies had shown that surgical site infection rates following emergency surgery are always more than that after elective surgery. But in this study, it was not really the rates of surgical site infection rather it was due to more cases were undergone emergency surgery. Out of 72 cases 7 cases associated with co-morbid conditions like Diabetes mellitus (2 cases), Malignancy (4 cases) and Tuberculosis (1 cases). It was observed that the most common organisms were Esch. coli (30/54) followed by Staph. aureus (14/54), Pseudomonas (07/54) and Klebsiella (03/54). In an earlier study in Bangladesh Ashraf et al[15] found that in wound infection Esch. coli (37.5%) was the predominating organism followed by Staph. aureus (21.7%). and Pseudomonas spp. (15.1%). In another study in Bangladesh, Zaman et al[14] showed that Esch. coli the major pathogen in post operative wound infection (60%) followed by Staph. aureus (20%). Another study[19] found the bacterial pattern of wound infection as follows: Staph. aure (50.7%). Pseudomonas (27.6%), and Esch. coli (15,4%). In present study showed that Esch. coli 30 cases (55.55%) followed by Staph. aureus 14 cases (25,92%), Pseudomonas spp 07 cases (12.96%) and Klebsiella spp. 03 cases (05.55%) were similar with former two studies but it is dissimilar with the latter one because that study was included preoperative infected cases but in our study there were predominating abdominal cases. Aman[17] in Lahore found that the predominating causative organism of surgical site infection was Staph. aureus (28.6%), followed by Esch. coli (24.7) and Pseudomonas spp. (23.7). This dissimilarity might be due to sample selection and development of antibiotics resistance by the organism.The antibiogram pattern of the organism isolated from wound swab of SSIs were analysed with commonly used antibiotics. Resistance of Esch. coli to Amoxycillin, Cotrimoxazole, Doxycyclin and Nalidexic acid were 100%, 91.5%, 71.4% and 60.5% respectively. Mohiuddin[20] also found 100% resistance against Ampicillin but other values were showing same differences. Resistance to Ceftriaxone was 22.2% and Ciprofloxacin 21%.This difference should have to be caused due to low number of organism in this study, but still we are not exempted from resistance in relation to the use of these two antibiotics, which warranted future rise because, Chamberland S, Blais J, Hoang M et al[21] observed significant increase in resistance of Esch. coli in 2nd samples of same patients to Ceftriaxone (from 43.9% to 73.9%; p<0.01), Ceftazidime (from 28.1% to 65.2%; p<0.002), Ciprofloxacin (from 70.2 to 100.0%; p<0.005) and Gentamicin (from 61.4% to 91.3%; p<0.008). In case of, Staphylococcus aureus 87.5% were resistant to penicillin and Cotrimoxazole whereas Shamsuzzaman[19] showed 100% of IPD strains were resistant to Penicillin/Ampicillin. None of strains showed resistance to Cloxacillin but corresponding value was 15%.[19] Similar trend of increasing resistance to Penicillin and Oxacillin in MV-Staph. aureus was also found by Kresken and Hofner.[22] This type of resistance might bedue to acquisition of plasmid and chromosome mediated resistance genes evident by-other study.[21] Only 12% strains of our study were resistant to Erythromycin, Ciprofloxacin and Doxycyclin. These values also not well correlated with those of Shamsuzzaman et al[19] and Mohiuddin.[20] The probable reason behind this may be due to the less use of oral Erythromycin in IPD patients, since injectablc antibiotics are commonly chosen for them. Resistance of Pseudomonas spp. to Ciprofloxacin, Ceftazidime and Gentamicin were 31.2%. 6.3% and 50% respectively. In Spain, Bouza[23] found that resistance rate of Pseudomonas spp. to Ciprofloxacin was (23.0%), Ceftazime (15.0%) and Gentamicin (30.0%). Though those values were not same but indication of resistance was clear. Higher rate of Ciprofloxacin resistance (58.9%) was reported by Mohiuddin.[20] The phemenon of resistance of Pseudomonas in our study might be due to widespread and improper use of those antibiotics in our hospitals. On the other hand none of strains in the present study were showed resistance to Imipenem. No resistance against Imipenem indicates their low use in our hospital. In case of Klebsiellaspp, it showed that 100% strains were resistant to Amoxycillin like Esch. coli but all strains were sensitive to both Ceftriaxon and Imipenem. The antibiogram of only 03(5.55%) strains of Klebsiella spp. from our patients could not be well compared with others due to low number of isolates. In the present study, evidence of increasing resistance against Ceftriaxon was noticed as having considerable number of intermediate sensitive strains of Esch. coli (15.3%) in patient's strains as well as Pseudomonas (32.5%). These findings well correlated with another study in the Mymensingh Medical College Hospital by Shamsuzzaman et al.[19] Here also inappropriate use and overuse should be the reason behind, because random exposure of antimicrobial agents to a bacterial population induces development of resistance factors. In our study, considerable number of bacterial strains of different genus showed resistance towards Ciprofloxacin. This should be considered as an alarming outcome because of its highest selling presently. Our findings were supported by other studies in home and abroad.[24] This increasing trend of resistance was again due to improper and injudicious use. All investigators were in agreement that high exposure of these anti-microbial agents had been the cause behind the magnitude of this resistance. In favor of this view Sahm et al.[24] worked out the mutation of the resistance gene in Esch. coli against fluoroquinolone. Interestingly Gentamicin appeared as one of the highly sensitive antibiotic against different strains. We could not compare this finding with other study, but the view as low exposure to an agent reduces the risk of developing resistance in bacterial population well correlate with the observed finding. Because, Gentamicin is less used for community patients due to availability of its injectable preparation only.

Conclusion:

Escherichia coli (55.55%), Staphylococcus aureus (25.92%) and Pseudomonas (12.96%) are main pathogens of surgical site infection. Maximum numbers of the bacteria of surgical site infections are as yet highly sensitive to third generation cephalosporin namely Ceftriaxon and Ceftazidime and all strains are sensitive to Imipenem. Caution should be taken against random use of Ceftriaxon injection. Because of appearing considerable number of intermediate sensitive strains, which run back towards the side of resistance. For patients with low economic status, Gentamicin would be an effective antibiotic and Cloxacillin in suspected cases of Staphylococcus aureus. Regular bacteriological studies on surgical site infection in collaboration with microbiology department and changing antibiotic policy according to sensitivity pattern of the microorganisms should be practiced and this would help to reduce the surgical site infection rates. So, proper antibiotic policy should be practiced to ameliorate future devastation of drug resistance as well as good administrative control is necessary to control overcrowding and environment of operation theatre and wards.

References:

1. Perren CI, Robert S, Hunt TK, Mundy EM. Inflammation, infection, & Antibiotics. In: Doherty GM, Way LW, MD, eds. Current Surgical Diagnosis & Treatment.12th ed. New York: McGraw-Hill Medical;2006:97
2. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol. 1992 Oct;13(10):606-608.
3. Nasher AA. Towards minimizing postoperative wound infection. Trop Doct. 1990 Oct; 20(4):166-8. doi: 10.1177/00494755900 2000408.
4. Haley RW, Culver DH, White JW, Morgan WM, Emori TG, Munn VP, et al. The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. Am J Epidemiol. 1985 Feb;121(2):182-205. doi: 10.1093/oxfordjournals.aje.a113990.
5. Anthony LG Peel. Sterile precautions and theatre safety. In: Williams NS, Bulstrode CJK, O'Connell PR; eds. Baily & Love's Short Practice of Surgery. 25 th ed. London: Hodder Arnold;2008:34-39.
6. Sarma JB, Ahmed GU. Infection control with limited resources: why and how to make it possible? Indian J Med Microbiol. 2010 Jan-Mar; 28(1):11-16. doi: 10.4103/ 0255-085 7.58721
7. Livermore DM. Has the era of untreatable infections arrived? J Antimicrob Chemother. 2009 Sep;64 Suppl 1:i29-36. doi: 10.1093/jac/dkp255.
8. Kumarasamy KK, Toleman MA, Walsh TR, Bagaria J, Butt F, Balakrishnan R,et al.Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study. Lancet Infect Dis. 2010 Sep;10(9):597-602. doi: 10.1016/S1473-3099(10) 70143-2.
9. National Institute for Health and Clinical Excellence (NICE).Surgical Site Infection, NICE Guideline[NG 74]. 2008. http://www.nice.ors.uk/nicemedia/pdf/ CG74NICEGuideline.pdf. [Acessed 12th June 2022]
10. Sarma JB, Ahmed GU. Characterisation of methicillin resistant S. aureus strains and risk factors for acquisition in a teaching hospital in northeast India. Indian J Med Microbiol. 2010 Apr-Jun; 28(2):127-129. doi: 10.4103/ 0255- 0857.62489.
11. Perl TM, Roy MC. Postoperative wound infections: risk factors and role of Staphylococcus aureus nasal carriage. J Chemother. 1995 Jul;7 Suppl 3:29-35.
12. Hansis M. Pathophysiology of infection--a theoretical approach. Injury. 1996;27 Suppl 3:SC5-8. doi: 10.1016/ 0020-1383(96)890 25-5.
13. Andenaes K, Amland PF, Lingaas E, Abyholm F, Samdal F, Giercksky KE. A prospective, randomized surveillance study of postoperative wound infections after plastic surgery: a study of incidence and surveillance methods. Plast Reconstr Surg. 1995 Sep;96(4):948-956. doi: 10.1097/00006534-199509001-00028.
14. Zaman MA, Ahmed ANN, Chowdhury MZU et al. Surveillance study of hospital acquired infection. Journal of Bangladesh College of Physicians and Surgeons.1992; 10(1): 9-13.
15. Ashraf SA, Prodhan A. Study of Pattern of Infections in the surgical wounds of DMCH. Bangladesh med J 1973; 1: 105-10.
16. Adams R, Fahlman B. Sterility in operating rooms. Surg Gynecol Obstet. 1960 Mar; 110:367-376.
17. Aman S. Bacteriological Analysis of Wound Infection in Mayo Hospital, Lahore. JPMA 1982; 66-68.
18. Meer PD, Ayliffe GAJ, Emerson AM et al. Report of the national survey on infection in hospitals. J Hosp infection.1981; 12 (Supplement).
19. Shamsuzzaman AKM, Hussain MA, Tariquzzaman M, Alam BB, Farooq M. Drug Resistance pattern of Aerobic Bacteria Isolates from Wound Infection at Mymensigh Medical College Hospital 2002.

20. Mohiuddin A. A study on bacterial pattern, their antibiogram and plasmid profiles from hospital acquired infection.M. Phil thesis(Micro) 1998.
21. Chamberland S, Blais J, Hoang M, Dinh C, Cotter D, Bond E, et al. In vitro activities of RWJ-54428 (MC-02,479) against multiresistant gram-positive bacteria. Antimicrob Agents Chemother. 2001 May;45(5):1422-30. doi: 10.1128/AAC.45.5.1422-1430.2001.
22. Kresken M, Hafner D. Drug resistance among clinical isolates of frequently encountered bacterial species in central Europe during 1975-1995. Study Group Bacterial Resistance of the Paul-Ehrlich-Society for Chemotherapy. Infection. 1999;27 Suppl 2:S2-8. doi: 10.10 07/BF02561661.
23. Bouza E, Garcia-Garrote F, Cercenado E, Marin M, Diaz MS. Pseudomonas aeruginosa: a survey of resistance in 136 hospitals in Spain. The Spanish Pseudomonas aeruginosa Study Group. Antimicrob Agents Chemother. 1999 Apr;43(4):981-982. doi: 10.1128/AAC. 43.4.981.
24. Sahm DF, Thornsberry C, Mayfield DC, Jones ME, Karlowsky JA. Multidrug-resistant urinary tract isolates of Escherichia coli: prevalence and patient demographics in the United States in 2000. Antimicrob Agents Chemother. 2001 May;45(5):1402-6. doi: 10.1128/ AAC. 45.5.1402-1406.2001.