

Prevalence and Risk Factors of Surgical Site Infections among Patients in Tertiary Hospital: A 5 Years Review of NAUTH, Nnewi

Ita Sampson Ekong¹; Okechukwu Chibuike Collins²; Nnaife David Munachukwuso²; Chinelo Cynthia Nduka¹; Chika Ofiaeli³; Chiejine Gibson Ifechukwude ¹; Darlington Chukwudimma Obi¹; Collins Chimezie Onyechocha Alutu¹; Ezidiegwu Onyinye Diana¹; and Chigozie Ifeadike¹

¹Department of Community Medicine, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.

²Faculty of Medicine, Nnamdi Azikiwe University, Nigeria. ³Department of Family Medicine, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.

Corresponding author: dr gib2002@gmail.com

DOI: <https://doi.org/10.62154/ajastr.2025.019.01018>

Abstract

Surgical site infections (SSIs) are a significant cause of postoperative morbidity and mortality worldwide. Despite advances in surgical techniques and infection prevention protocols, SSIs remain a major healthcare challenge, particularly in resource-limited settings. This study determined the prevalence and risk factors of surgical site infections among patients in a tertiary hospital in Nigeria. A descriptive retrospective study was conducted among surgical patients admitted to Nnamdi Azikiwe University Teaching Hospital, Nnewi (NAUTH) over a five-year period (2019–2023). Ethical approval was obtained from the Ethics Committee of NAUTH. Data were collected using a checklist from the medical records of 174 surgical patients during the study period. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. The mean patient age was 32.05 years, ranging from 1 to 84 years. The study revealed an SSI prevalence of 15.5%. Exploratory laparotomy was the most common procedure associated with SSIs, accounting for 18.52% of cases, with abdominal surgeries having the highest complication rate at 24.0%. Significant factors influencing SSI risk included gender, department of surgery, patient occupation, pre-existing infection, postoperative nasogastric tube passage, and type of surgical procedure. *Staphylococcus aureus* was the most commonly identified pathogen, present in 37.04% of cultures. The study highlights the need for ongoing surveillance, targeted prevention, and stringent infection control measures to reduce SSIs. Strengthening infection control protocols, conducting preoperative risk assessments, establishing real-time surveillance systems, monitoring prophylactic antibiotic use, providing continuous staff training on infection prevention, and educating patients on postoperative care and early detection of SSIs are recommended.

Keywords: Surgical Site Infections, *Staphylococcus Aureus*, Exploratory Laparotomy, Abdominal Surgery, Tertiary Hospital, NAUTH.

Introduction

Nosocomial infections are hospital-acquired infections that develop or are acquired within a hospital setting. The most common type of nosocomial infection is urinary tract infection, followed by pneumonia, surgical site infections, and *Clostridium difficile*–associated diarrhoea. Surgical site infection is a type of healthcare-associated infection characterized by wound infection occurring after an invasive (surgical) procedure (Amoran et.al., 2013). According to the World Health Organization, surgical site infections (SSIs) are caused by bacteria that enter through incisions made during surgery. They threaten the lives of millions of patients each year and contribute to the spread of antibiotic resistance. In low- and middle-income countries, 11% of patients who undergo surgery develop an infection. In Africa, up to 20% of women who undergo a caesarean section contract a wound infection, compromising their health and their ability to care for their babies. SSIs are infections that occur at or near a surgical incision within 30 days of surgery or up to one year if an implant is placed (Smith et. al.,2013).

Approximately 0.5% to 3% of patients undergoing surgery experience an infection at or adjacent to the surgical incision site (Jessica et.al.,2023). Surgical site infection (SSI) is recognized as one of the most prevalent healthcare-associated infections. Each year, up to 355,500 surgical patients develop SSIs following orthopedic surgery (Smith et. al.,2013).

Postoperative infections are among the most frequent surgical complications and the leading cause of prolonged hospital stays (Jurt et.al.,2021)

Globally, SSI rates range from 2.5% to 41.9% (Lubega et.al.,2017; Singh et.al.,2014) . In Western countries, 2% to 5% of patients undergoing clean surgery and up to 11 to 34.4% of intra-abdominal surgery develop SSIs (Getaneh et.al.,2020). In Africa, surgical site infections are the most common hospital-acquired infections, with a pooled cumulative incidence of 5.6 per 100 surgical procedures—significantly higher than rates recorded in developed countries (Abubakar et.al.,2022; Ling et. al.,2015).

Important patient-related factors for SSI include existing infection, low serum albumin concentration, older age, obesity, smoking, diabetes mellitus, and ischemia secondary to vascular disease or irradiation. Surgical risk factors include prolonged procedures and inadequacies in either the surgical scrub or the antiseptic preparation of the skin. Physiological states that increase the risk of SSI include trauma, shock, blood transfusion, hypothermia, hypoxia, and hyperglycemia. Parameters that may be independently associated with an increased risk of SSI, and that may predict infection, include abdominal surgery, a contaminated or dirty operation, and more than three diagnoses at the time of discharge. The major sources of infection are microorganisms on the patient's skin and, less often, the alimentary tract or female genital tract. The organism most frequently isolated is *Staphylococcus aureus*, which is often resistant to methicillin. Antibiotic-resistant bacteria remain a continuing and increasing problem (Sullivan et.al.,2017).

Most surgical site infections can be prevented if appropriate strategies are implemented. Although numerous strategies are recommended by international organizations to reduce surgical site infections, only six general strategies are supported by randomized trials.

Interventions associated with lower infection rates include avoiding razors for hair removal (4.4% infection rate with razors vs. 2.5% with clippers); decolonization with intranasal anti-Staphylococcal agents and anti-Staphylococcal skin antiseptics for high-risk procedures (0.8% infection rate with decolonization vs. 2% without); use of chlorhexidine gluconate and alcohol-based skin preparation (4.0% infection rate with chlorhexidine gluconate plus alcohol vs. 6.5% with povidone-iodine plus alcohol); maintaining normothermia with active warming methods such as warmed intravenous fluids, skin warming, and warm forced air to keep body temperature above 36°C (4.7% infection rate with active warming vs. 13% without); perioperative glycemic control (9.4% infection rate with glucose ≤ 150 mg/dL); and use of negative pressure wound therapy (9.7% infection rate with vs. 15% without) (Jessica et.al.,2023). Periodic studies to assess SSI risk should be conducted regularly. Identifying risk factors for surgical site infections should encourage the development of national prevention guidelines (Ban et.al.,2017).

Surgical site infections (SSIs) are a significant complication following surgery, leading to increased morbidity, mortality, healthcare costs, and length of hospital stay (Ahmed et.al.,2018). Studies have shown that SSIs are a major global concern, and limited data suggest similar problems in developing countries (Maria et.al.,2019; Ahmed et.al.,2018). SSIs are serious operative complications that occur in approximately 2% of surgical procedures and account for 20% of healthcare-associated infections. Many studies have reported that SSIs rank third among common nosocomial infections, following urinary tract and respiratory tract infections (Seidelman,et. al.,2023). Recent studies indicate that the SSI rate ranges from 19.4% to 36.5% globally, whereas in India, it ranges from 3% to 12% (Mukagendaneza et.al.,2019; Kumar & Rai.,2017) .

In sub-Saharan Africa, economic and social factors are major barriers to the prevention of SSIs due to their high incidence. The prevalence of SSIs in hospitals across sub-Saharan Africa ranges from 6.8% to 26%. Significant heterogeneity has been observed across specialties, with an incidence of 19.1% in general and visceral surgery, 14.8% in orthopedics, and 8.6% in obstetric gynecology (Cyriaque et.al.,2021). In Nigeria, the incidence of SSIs is 14.5%, with the highest incidence reported in the northeastern region (27.3%, 95%). SSIs are more commonly observed following colorectal and abdominal surgeries, among elderly patients, and in those with comorbid conditions. The most frequently reported type is superficial incisional SSI, occurring in 62.5% of cases. A higher preponderance is also observed among patients with dirty wounds (52.7%, 95%) (Ahmed et.al.,2019) .

In Anambra State, Nigeria, anecdotal evidence from healthcare workers suggests a high prevalence of SSIs in hospitals. However, the true burden of SSIs and the associated risk factors remain unknown due to a lack of comprehensive data. This knowledge gap hinders the implementation of effective preventive measures to reduce SSIs in hospitals across the state. Therefore, this study aims to assess the prevalence and risk factors of SSIs among patients undergoing surgery in an Anambra State hospital over a five-year period (2019–2024). By understanding the scope and contributing factors of SSIs, targeted interventions

can be developed to improve surgical outcomes and enhance patient safety in Anambra State.

Methodology

Study area

The study was conducted at Nnamdi Azikiwe University Teaching Hospital (NAUTH) in Nnewi, Anambra State, Nigeria. Anambra is a state in southeastern Nigeria, named after the Omambala River, the Igbo name for the Anambra River, which flows through the area and is a tributary of the River Niger. The capital and seat of government of Anambra State is Awka.

The study site, NAUTH, was established by the Anambra State Government under Edict No. 10 of 1988 as the Anambra State University of Technology Teaching Hospital, Nnewi. Initially, it shared premises with the then General Hospital, Nnewi, before becoming a fully-fledged teaching hospital.

Study Design

This was a descriptive retrospective study that assessed the prevalence and risk factors of surgical site infections among patients at Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, over a five-year period (2019–2023).

Study Population

The study population comprised individuals who had undergone surgery within the Male Surgical, Female Surgical, Paediatrics Surgical, and Obstetrics and Gynaecology units at NAUTH, Nnewi, during the period of investigation. Medical records with incomplete data and those lacking the required parameters outlined in the study checklist were excluded.

Sample Size Determination

This was an all-sample study, and a total of 174 complete patient folders were reviewed.

Ethical Consideration

Ethical approval was obtained from the Ethics Committee of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, through the Head of the Department of Community Medicine. The ethical approval reference number is NAUTH/CS/66/VOL.3/141/2024/102.

Results

Out of 200 patient records collected from the Nurses' Register, 174 folders had complete information, yielding an 87% retrieval rate. The study comprised 38.5% males and 61.5% females. The mean age of the patients was 32.05 ± 21.23 years, with an age range of 1 to 84 years. The mean age for males was 32.25 ± 26.60 years (range: 2–84 years), while for females, it was 31.93 ± 17.17 years (range: 1–74 years). The majority of the patients (71.3%)

were married. Additionally, 96.6% of the patients were Christians, and 94.9% were of Igbo ethnicity.

The overall prevalence of surgical site infections (SSIs) at NAUTH was 15.5% (27 patients). The highest prevalence (24.2%) was recorded in 2020, while 2023 had the lowest prevalence at 11.1%. SSI prevalence was higher in males (22.4%) compared to females (11.2%). Among patients under 19 years, females had a higher infection rate (25%) than males (14.3%), whereas among patients 19 years and older, males had a significantly higher prevalence (28.2%) compared to females (8%).

Among the surgical wards, the male surgical ward had the highest SSI prevalence (28.2%), while the female surgical ward reported no SSIs, likely due to less complex procedures such as mastectomies and excisional biopsies for breast cancer.

In the study, General Surgery accounted for the highest number of surgical cases (26.4%), followed by Obstetrics (23.0%) and Paediatric Surgery (12.1%). Other specialties included Plastic Surgery (9.8%), Urology (8.0%), Neurosurgery (6.9%), Orthopaedics (5.2%), Cardiothoracic Surgery (4.0%), ENT (3.4%), and Gynaecology (1.1%).

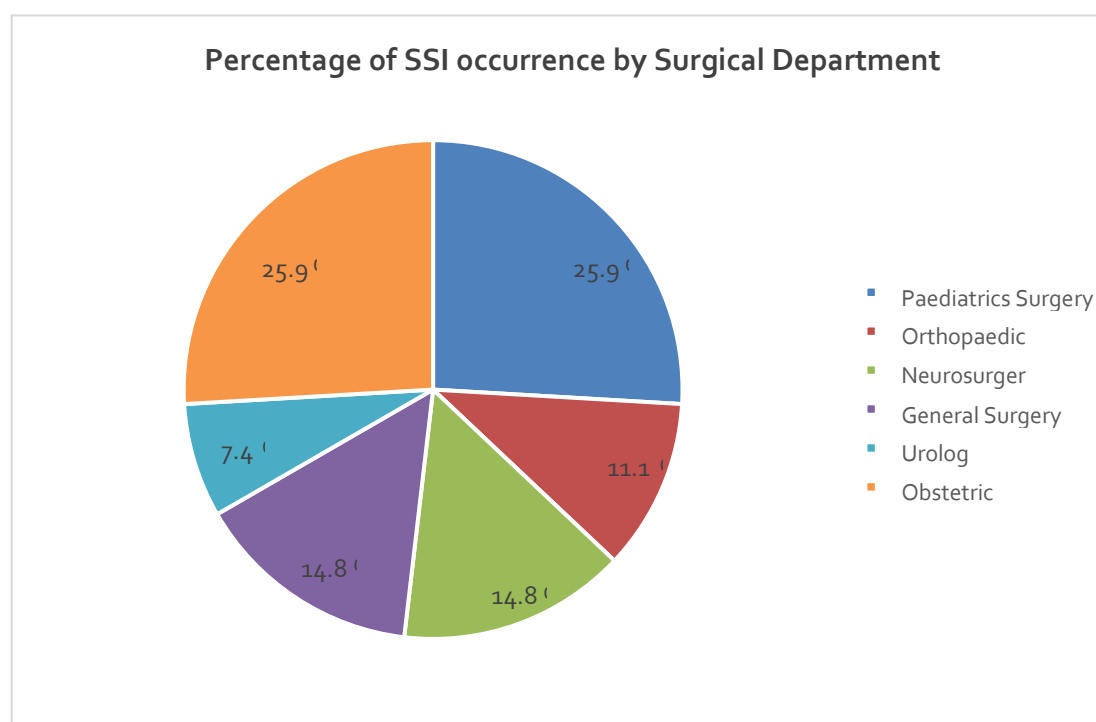


Figure 1: Percentage of SSI occurrence by Surgical Department

The above figure shows that in the surgical departments, most of the of SSI occurred in the Paediatrics surgery and the obstetrics departments (25.90% each).

Table 1: Prevalence of Surgical Site infections (Surgical procedure)

Presence of Surgical Site Infections	Frequency (27)	Percentage (%)
Surgical Procedure		
Colostomy (n = 4)		
No	2	50.0
Yes	2	50.0
Colotomy (n = 2)		
No	0	0.0
Yes	2	100.0
Gardner Well Traction (n = 2)		
No	0	0.0
Yes	2	100.0
Exploratory Laparotomy (n = 13)		
No	8	61.5
Yes	5	38.5
Internal Fixation (n = 3)		
No	2	66.7
Yes	1	33.3
Craniotomy (n = 9)		
No	5	55.6
Yes	4	44.4
Caesarean Section (n = 37)		
No	33	89.2
Yes	4	10.8
Appendectomy (n = 4)		
No	2	50.0
Yes	2	50.0
Pull Through Surgery (n = 2)		
No	0	0.0
Yes	2	100.0
Tumour Excision (n = 2)		
No	0	0.0
Yes	2	100.0
Colostomy Reversal (n = 1)		
No	0	0.0
Yes	1	100.0

In table 1, a total of 27 patients developed SSIs postoperatively, with Obstetrics and Paediatrics Surgery each accounting for 25.9% of cases. Among the 36 surgical procedures performed during the study period, Colotomy, Gardner-Wells Traction, Pull-Through Surgery, and Tumor Excision each had a 100% SSI prevalence. In contrast, Caesarean Section had the lowest prevalence (10.8%), with 33 out of 37 cases free of infection.

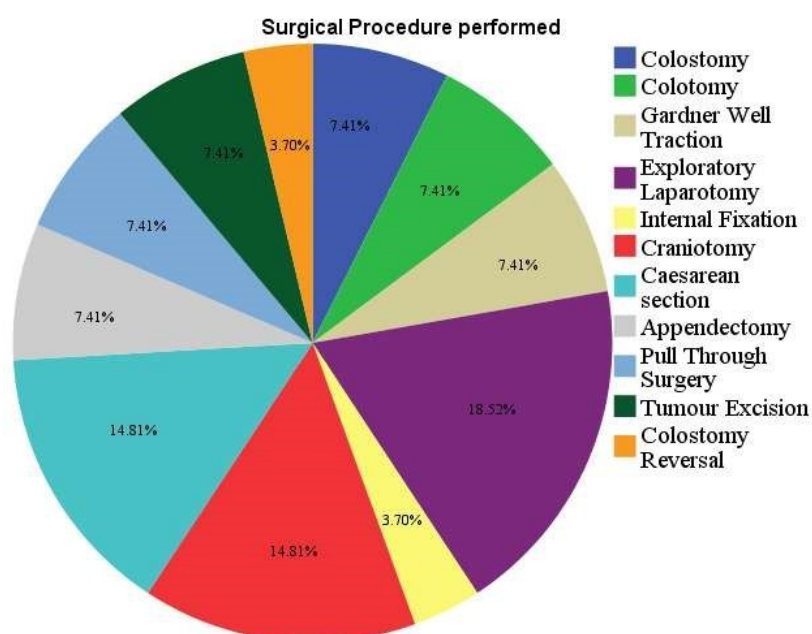


Figure 2: Pie chart illustrating the surgical operations with the highest rates of SSIs in NAUTH.

The figure shows that exploratory laparotomy (18.52%), craniotomy (14.81%), and caesarean section (14.81%) were the top three procedures.

For surgical procedures, the highest SSI rates were observed in patients who underwent exploratory laparotomy, craniotomy, and caesarean section.

Table 2: Prevalence of Surgical Site infections (surgical site)

Site of Operation		
Head (n = 18)		
No	12	66.7
Yes	6	33.3
Abdomen (n = 75)		
No	57	76.0
Yes	18	24.0
Thigh (n = 4)		
No	3	75.0
Yes	1	25.0
Sacrum (n = 3)		
No	1	33.3
Yes	2	66.7

In table 2 above, the abdomen was the most common site of SSIs, with 66.7% (18 cases) among the 27 patients who developed infections, followed by the head (22.2%; 6 cases), the sacrum (7.4%; 2 cases), and the thigh (3.7%; 1 case).

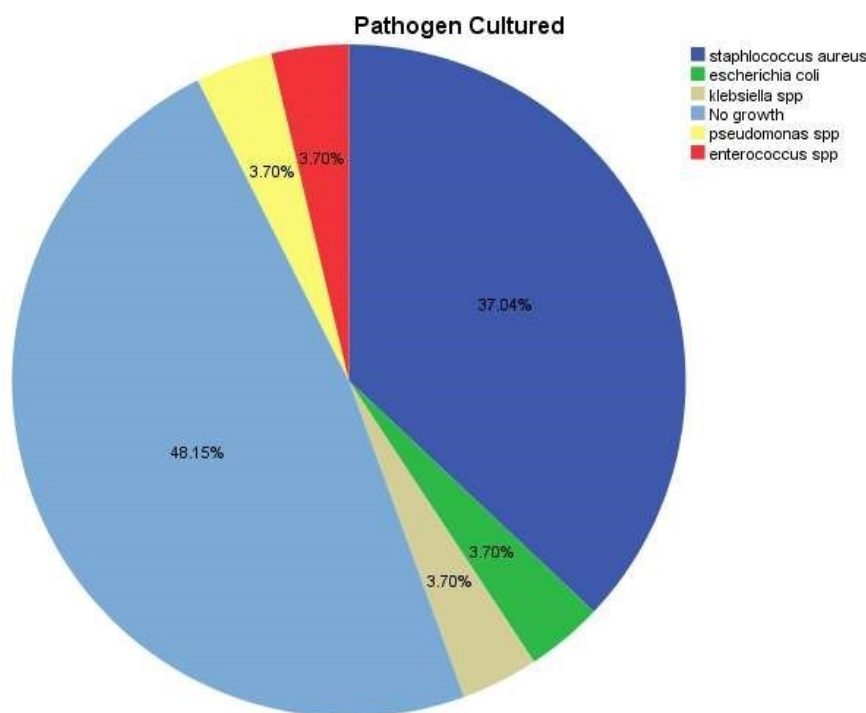


Figure 3: Identified microbial pathogens responsible for SSIs

The figure shows the percentages of cultured pathogens in SSIs. It was found that *Staphylococcus aureus* was the most frequently identified microorganism, present in 37.04% of positive cultures. However, 48.15% of cultures showed no bacterial growth. Other identified pathogens included *Klebsiella* spp., *Escherichia coli*, *Pseudomonas* spp., and *Enterococcus* spp., each accounting for 3.70% of cases.

The factors that were significantly associated with SSIs included gender, department of surgery, patient's occupation, pre-existing infection before surgery, postoperative passage of a nasogastric tube, and type of surgical procedure performed.

Discussion

To the best of our knowledge, this descriptive retrospective survey is the first study of its kind conducted in a tertiary institution in Anambra, Nigeria. The study found that the prevalence of surgical site infections (SSIs) at Nnamdi Azikiwe University Teaching Hospital was 15.5% (27 patients) over the five-year study period. This prevalence was slightly higher than the rates reported by Kumar et al. in Ranchi, India (12.5%), and Annette et al. in Ho Chi Minh City, Vietnam (14.3%) (Kumar, A., & Rai 2017; Annette et.al 2015). Similarly, a study by Kidanie et al. in Ethiopia, which compared SSI prevalence in public and private hospitals,

reported an overall prevalence of 9.9%, with 13.4% in public hospitals—both lower than our findings (Kidanie et. al.,2019). These results contrast mildly with studies conducted in Nigeria by Brisibe et al. in Port Harcourt and Olowo-Okere et al. in Abuja, which reported SSI prevalence rates of 10.34–13.33% and 13.58%, respectively (Olowo-Okere et.al.,2017; Brisibe et.al.,2015). Conversely, higher prevalence rates were reported by Brown et al. in Tbilisi, Republic of Georgia (16.7%) (Rahel et.al.2019).

Exploratory laparotomy was identified as the most common procedure among patients who developed SSIs at NAUTH, with an infection rate of 18.52% and a prevalence of 38.5%. This finding aligns with a study by Kidanie et al. in Ethiopia, where abdominal laparotomy accounted for 33.3% and 55.7% of procedures associated with SSIs in public and private hospitals, respectively (Kidanie et.al.,2019). Similarly, a retrospective study by Kumar et al. in India also identified exploratory laparotomy as the procedure most frequently linked to SSIs (Kumar et.al.,2017). Craniotomy, with an infection rate of 14.81%, was the second most common procedure associated with SSIs in this study, which is consistent with findings by Chiang et al., who reported that neurosurgical procedures, including craniotomy and spinal fusion, carry a significant SSI risk (Chiang et.al.,2015). Caesarean sections, also with an SSI rate of 14.81%, were associated with a high risk of infection, in line with studies by Tamrat et al. and Vjosa et al., which reported that caesarean sections contribute to high infection rates and mortality (Vjosa et. al.,2019; Chiang et.al.,2015).

The abdomen was the most common site of operations complicated by SSIs, with a prevalence of 24.0%. This is comparable to findings by Aroub et al. and Azoury et al., who reported abdominal surgery as the site most frequently associated with SSIs, with prevalence rates of 15–25% and 19.5%, respectively (Aroub et. al.,2019; Emmanuel et.al.,2012).

The study population had a mean age of 32.25 ± 26.59 years for males (38.5%) and 31.93 ± 17.17 years for females (61.5%). These demographics are comparable to the findings of Emmanuel et al. in Kano, Nigeria, who reported mean ages of 38.3 ± 16.3 years for males (35.3%) and 30.6 ± 12.3 years for females (64.9%) (Emmanuel et.al.,2012).

Several factors were significantly associated with an increased risk of SSIs, including gender, surgical unit, patient occupation, pre-existing infections before surgery, post-operative passage of a nasogastric tube, and the type of surgical procedure performed. Similarly, Amoran et al. in Sagamu, Nigeria, found that pre-existing medical conditions, department of care, and age were linked to SSIs.³² However, unlike Amoran et al., our study did not find age to be a significant factor, though pre-existing medical conditions and department of care remained significant ($p < 0.05$). Additionally, Margaret et al. reported that procedures involving tumor resection and morbid obesity were associated with higher SSI risk.³³ In this study, all cases of tumor excision (100%) were associated with SSIs, but due to sample size limitations, obesity could not be assessed as a risk factor.

In the obstetric population, no significant difference in SSI risk was found between patients who attended antenatal care and those who did not, nor between those who experienced premature rupture of membranes and those who did not. This contrasts with a prospective

cohort study by Carol et al. in New York, which associated antenatal care and premature rupture of membranes with an increased risk of SSIs among obstetric patients (Carolet.al.,2015). These differences may be due to sample size variation and regional factors.

Regarding microbial pathogens, laboratory microbiology results showed that *Staphylococcus aureus* was the most frequently cultured microorganism, present in 37.04% of cases, making it the most common pathogen identified. However, 48.15% of cultures showed no bacterial growth after 24 hours of incubation. Other identified pathogens, including *Klebsiella* spp., *Escherichia coli*, *Pseudomonas* spp., and *Enterococcus* spp., were each found in 3.70% of cases. The predominance of *Staphylococcus aureus* aligns with studies by Vikrant et al. in India, Yeneabat et al. in Ethiopia, Sebel et al. in Debre Tabor, and Akinkunmi et al. in Nigeria. However, this study showed a higher prevalence compared to Akinkunmi et al., who reported an 18.35% prevalence in a prospective study at Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria. *Escherichia coli* and *Enterococcus* spp. were also identified in all these studies.

Bacterial growth was observed in 51.75% of cultures, which is significantly lower than the 96.4% bacterial growth reported in a cross-sectional study by Vikrant et al. in Uttarakhand State, India. This discrepancy may be attributed to the retrospective nature of this study, as culture methods and storage conditions may have affected bacterial detection rates (Seble et.al.,2023; Yeneabat et.al.,2020; Vikrant et.al.,2015; Akinkunmi et.al.,2014).

Conclusion

The findings revealed that SSIs were present in 15.5% of the patient population, accounting for a total of 27 cases. This prevalence underscores the significant burden of SSIs within the hospital setting, highlighting the critical need for ongoing surveillance, targeted preventive measures, and stringent infection control practices to mitigate this risk. The study provides valuable insights into the epidemiology of SSIs in the region, emphasizing the importance of continuous monitoring and intervention strategies to improve patient outcomes and reduce the incidence of infections in surgical patients.

Recommendations

The following recommendations were made:

1. The State Government, through the Ministry of Health, should establish a hospital-wide surveillance system to track SSI rates in real-time. This will enable the timely identification of infection outbreaks and prompt corrective measures. Additionally, regular training sessions should be conducted for healthcare staff, including surgeons, nurses, and ancillary personnel, to reinforce best practices in infection prevention.
2. The hospital management should implement and consistently reinforce standardized infection control measures in operating rooms and postoperative care units. This includes strict adherence to hand hygiene, proper sterilization of surgical

instruments, and compliance with antiseptic protocols. Patients should be educated on wound care, the importance of post-surgical hygiene, and early signs of infection. Furthermore, structured follow-up programs should be incorporated post-discharge to facilitate early detection and timely intervention for SSIs.

3. The hospital's management and surgical departments should introduce comprehensive preoperative assessments to identify high-risk patients, such as those with existing comorbidities or prior infections. Targeted interventions should be implemented to mitigate their risk of developing SSIs.

Limitation

The limitations of this study included incomplete or inaccurate documentation in medical records, as well as the unavailability of some medical records, which may have affected data completeness and accuracy.

References

- Abubakar, U., Amir, O., & Rodríguez-Baño, J. (2022). Healthcare-associated infections in Africa: a systematic review and meta-analysis of point prevalence studies. *Journal of pharmaceutical policy and practice*, 15(1), 99.
- Akinkunmi E.O., Adesunkanmi A.R., Lamikanra A. (2014). Pattern of Pathogens from Surgical Site Infections in a Nigerian Hospital and Their Antimicrobial Susceptibility Profiles. *Afr Health Sci*, 14(4), 802-809.
- Ahmed O., Yakubu K.E., Ali S.S., Busayo O.O. (2018) Occurrence of Surgical Site Infections at a Tertiary Healthcare Facility in Abuja, Nigeria: A Prospective Observational Study. *Med Sci (Basel)*, 6(3),60.
- Ahmed O., Yakubu K.E., Busayo O.O., Joseph O.E. (2019). Epidemiology of Surgical Site Infections in Nigeria: A Systematic Review and Meta-Analysis. *Niger Postgrad Med J*, 26(3),143-151.
- Amoran O.E., Sogebi A.O., Fatugase O.M. (2013) Rates and Risk Factors Associated with Surgical Site Infections in a Tertiary Care Centre in South-Western Nigeria. *ResearchGate*,3(1),25-36.
- Annette H.S., Farah M.P., Tien V., Hoang H.H., et al. (2015) Prevalence of Surgical-Site Infections and Patterns of Antimicrobial Use in a Large Tertiary-Care Hospital in Ho Chi Minh City, Vietnam. *Cambridge Core*, 23(7),382-387.
- Ban, K. A., Minei, J. P., Laronga, C., Harbrecht, B. G., Jensen, E. H., ... & Duane, T. M. (2017). American College of Surgeons and Surgical Infection Society: surgical site infection guidelines, 2016 update. *Journal of the American College of Surgeons*, 224(1), 59-74.
- Aroub A., Osman O.A., Ahmad K., Anfal A., et al. (2019) Surgical Site Infection Following Abdominal Surgery: A Prospective Cohort Study. *Can J Surg*, 62(2), 111-117.
- Azoury S., Farrow N., Hu Q., Soares K., et al. (2015). Postoperative Abdominal Wound Infection – Epidemiology, Risk Factors, Identification, and Management. *ResearchGate*, 2(1),137-148.
- Brisibe S.F., Ordinioha B., Gbeneolol P.K. (2015) The Effect of Hospital Infection Control Policy on the Prevalence of Surgical Site Infection in a Tertiary Hospital in South-South Nigeria. *Niger Med J*, 56(3),194-198.
- Carol A.K., Eileen M.G., Timothy V., Richard A.V. (2015) Risk Factors for Surgical-Site Infections Following Cesarean Section. *Infect Control Hosp Epidemiol*, 22(10), 613-617.

- Chiang H.Y., Steelman V.M., Pottinger J.M. (2015). Postoperative Spinal Wound Infections and Postdischarge Surveillance: A Case for a New Medicare Reimbursement Model. *Infect Control Hosp Epidemiol*, 26(7), 23.
- Cyriaque D., Alphonse K., Drissa C., Pascal C., et al. (2021) Prevalence and Factors Associated With Surgical Site Infections in the University Clinics of Traumatology and Urology of the National University Hospital Centre Hubert Koutoukou Maga in Cotonou. *Front Public Health*, 9, 629351.
- Getaneh, T., Negesse, A., & Dessie, G. (2020). Prevalence of surgical site infection and its associated factors after cesarean section in Ethiopia: systematic review and meta-analysis. *BMC pregnancy and childbirth*, 20, 1-11.
- Jessica L.S., Christopher R.M., Deverick J.A. (2023). Surgical Site Infection Prevention: A Review. *JAMA*, 329(3), 244-252.
- Kidanie F., Muluken A., Getasew M., Koku S.T. (2019) The Prevalence and Root Causes of Surgical Site Infections in Public Versus Private Hospitals in Ethiopia: A Retrospective Observational Cohort Study. *Patient Saf Surg*, 13:26. [Accessed 15 May 2024]. Available from: <https://pubmed.ncbi.nlm.nih.gov/31333761/>.
- Kumar, A., & Rai, A. (2017). Prevalence of surgical site infection in general surgery in a tertiary care centre in India. *Int Surg J*, 4(9), 3101.
- Jurt, J., Hübner, M., Clerc, D., Curchod, P., Abd El Aziz, M. A., Hahnloser, D., ... & Grass, F. (2021). Challenges related to surgical site infection prevention—results after standardized bundle implementation. *Journal of clinical medicine*, 10(19), 4524.
- Ling, M. L., Apisarnthanarak, A., & Madriaga, G. (2015). The burden of healthcare-associated infections in Southeast Asia: a systematic literature review and meta-analysis. *Clinical Infectious Diseases*, 60(11), 1690-1699.
- Lubega, A., Joel, B., & Justina Lucy, N. (2017). Incidence and aetiology of surgical site infections among emergency postoperative patients in mbarara regional referral hospital, South Western Uganda. *Surgery research and practice*, 2017(1), 6365172.
- Margaret A.O., Jennie M. (2003). Risk Factors for Surgical Site Infection in Spinal Surgery. *J Neurosurg*, 98(2 Suppl), 149-155.
- Marie J.M., Emmanuel M., Esperance M., et al. (2019) Incidence, Root Causes, and Outcomes of Surgical Site Infections in a Tertiary Care Hospital in Rwanda: A Prospective Observational Cohort Study. *Patient Saf Surg*, 13(10). [Accessed 15 May 2024]. Available from: <https://pubmed.ncbi.nlm.nih.gov/30820247/>.
- Mukagendaneza, M. J., Munyaneza, E., Muhawenayo, E., Nyirasebura, D., Abahuje, E., Nyirigira, J., ... & Muvunyi, C. M. (2019). Incidence, root causes, and outcomes of surgical site infections in a tertiary care hospital in Rwanda: a prospective observational cohort study. *Patient Safety in Surgery*, 13, 1-8.
- Olowo-Okere A., Ibrahim Y.K.E., Sani A.S., Atata R.F., Olayinka B.O. (2017). Prevalence of Surgical Site Infection in a Nigerian University Teaching Hospital. *JOPHAS*, 14(1), 2430-2438.
- Rahel M., Awole S., Teshome G., et al. (2019) Prevalence and Root Causes of Surgical Site Infections at an Academic Trauma and Burn Center in Ethiopia: A Cross-Sectional Study. *Patient Saf Surg*, 14(3). [Accessed 15 May 2024]. Available from: <https://pubmed.ncbi.nlm.nih.gov/31921353/>.
- Seble W., Tamrat A., Ashenafi A., Berhanu S. (2023). Bacterial Profile of Surgical Site Infection and Antimicrobial Resistance Patterns in Ethiopia: A Multicentre Prospective Cross-Sectional Study. *Ann Clin Microbiol Antimicrob*, 22(1), 96.
- Seidelman, J. L., Mantyh, C. R., & Anderson, D. J. (2023). Surgical site infection prevention: a review. *Jama*, 329(3), 244-252.

- Singh R., Singla P., Chaudhary U.(2014). Surgical Site Infections: Classification, Risk Factors, Pathogenesis, and Preventive Management—A Review Article. *Int J Pharma Res Health Sci*,2(3),203-214.
- Smith M.A., Dahlen N.R., Bruemmer A., Davis S., Heishman C.(2013) Clinical Practice Guideline: Surgical Site Infection Prevention. *Orthop Nurs*. 32(5),242-248.
- Sullivan, E., Gupta, A., & Cook, C. H. (2017). Cost and consequences of surgical site infections: a call to arms. *Surgical infections*, 18(4), 451-454.
- Tamrat L.L., Desta H.G., Sadikalmahdi H.A. (2017) Incidence and Predictors of Surgical Site Infection in Ethiopia: A Prospective Cohort Study. *BMC Infect Dis*,17(1),119.
- Vikrant N., Shekhar P., Deepak J., Munesh K.S., et al. (2015). Bacteriological Profile of Surgical Site Infections and Their Antibigram: A Study From Resource-Constrained Rural Setting of Uttarakhand State, India. *J Clin Diagn Res*,9(10): DC17-20
- Vjosa A.Z., Rozalinda I., Zana S., Valon A.Z. (2019) Surgical Site Infections After Cesarean Sections at the University Clinical Center of Kosovo: Rates, Microbiological Profile, and Risk Factors. *BMC Infect Dis*, 19(1),752.
- Yeneabat B., Aklilu E. Surgical Site Infection and Pathogens in Ethiopia:(2020) A Systematic Review and Meta-Analysis. *Patient Saf Surg*, 14,7. [Accessed 15 May 2024]. Available from: <https://pubmed.ncbi.nlm.nih.gov/32110246/>.