# Magnitude of Surgical Site Infection and its Associated Factors among Patients who Underwent a Surgical Procedure at Debre Tabor General Hospital, Northwest Ethiopia

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**Keywords:** Surgical, Infection, Debre Tabor

**Posted Date:** December 30th, 2020

**DOI:** https://doi.org/10.21203/rs.3.rs-136000/v1

# Abstract

**Background:** Surgical site infections are commonest nosocomial infections and responsible for considerable morbidity and mortality as well as increased hospitalizations and treatment cost related to surgical operations.

**Objective:** The aim of this study was to determine the magnitude and factors associated with surgical site infections at surgical ward of Debre Tabor General Hospital, Northwest Ethiopia.

**Method:** Institution based cross sectional study was conducted on patients who underwent a surgical procedure at Debre Tabor General Hospital in 2020. The sample size was determined using single population proportion formula. Data were entered and analyzed using SPSS version 21 software. Bivariate and multivariate logistic regressions analysis were employed. Odds ratio and its 95% confidence interval were taken to test the association between the dependent and independent variables. P-value of less than 0.05 will be considered as statistically significant.

**Result:** In this study, a total of 191 patients have participated in the study yielding a response rate of 100%. The mean age of the respondents was 2.5 (SD ±0.68) years. The most age group 115(60.2%) resides at the age group greater than 40 years. More than one half(62.3) of the surgical clients were females. Most of the clients were farmers(32.5%) and un able to read and write(41.9) based on the occupation**.** The magnitude of surgical site infection in this study was found to be 11.5% (95% CI: 7.8%, 15.9%).The factors existance of comorbidity and antibiotic prophylaxis given were found to be significantly assoiated with magnitude of surgical site infection.

**Conclusion:** The magnitude of surgical site infection in this study was high. Proper management of patients with co-morbidity especially those with diabetes mellitus, proper administration of anesthesia and delivering intravenous antimicrobial prophylaxis before surgery as ordered would significantly reduce the incidence of surgical site infection.


# Background

Surgical site infection (SSI) refers to infections that took place within 30 days of an operative procedure and may extend to more than 30 days according to the surgical procedure [1]. Surgical site infection is one of the common problems in a hospital setting. Reports from the World Health Organization in 2009 showed that 23% of surgical patients worldwide developed SSIs [2]. It is the 3rd commonly reported nosocomial infection accounting for 10% to 40% of all nosocomial infections[3, 4]. It account for 3.7 million excess hospital stay days, more than it costs $1.6 billion excess costs annually and 3.57 extra drug usage [5].

Globally, SSI rates have been found to be from 2.5% to 41.9% [6]. Approximately 2–5% of surgical patients worldwide have developed SSIs [7]. The incidence of SSIs is higher in developing countries relative to developed nations [8]. SSIs are preventable complications following surgery and imposes

significant burden in terms of patient morbidity, mortality and increased cost of treatment. Patients who develop SSIs are up to 60% more likely to spend time in an intensive care unit, 5 times more likely to be readmitted to hospital, and 2 times more likely to die compared with patients without SSIs [9].

Surgical site infections are the most frequent type of HAI in low and middle income countries (LMICs) and affect up to one third of patients who have undergone a surgical procedure[10]. In LMICs, the pooled incidence of SSI was 11.8 per 100 surgical procedures [11]. In Africa, SSIs were the leading infections in hospitals and incidence ranged from 2.5%-30.9% [12]. A study conducted in southern part of Ethiopia showed that, SSI was found to be 13% [1]. The study done in Northern Tanzania showed that there were 20.0% of surgical site infection [5].

A prospective observational study done in India showed that, surgical site infection rate was 13.04% in patients receiving inappropriate chemoprophylaxis; this study revealed that there was no significant difference for SSI rate between gender, types of anesthesia and between open and laparoscopic surgery, while emergency surgery showed significantly higher SSI rate as compared to the elective surgery [13]. The study in Tanzania revealed that ,presence of pre-morbid, use of iodine alone in skin preparation, duration of operation ≥ 3 hours and cigarette smoking were factors for surgical site infection (SSI) [5]. The study done in Southern part of Ethiopia, Sodo hospital showed that, Patients younger than 40 years old, being illiterate, history of previous hospitalization prolonged preoperative hospital stay (> 7 days) and admitted on the wing side of the hospital were found to be significant factors for surgical site infection [1]

## Materials And Methods

# Study Area and period

The study was conducted in Debre Tabor General Hospital, Northwest Ethiopia to assess the magnitude and associated factor of postoperative surgical site infection among patients visiting Debre Tabor General Hospital from March 1-30/2020. Debre Tabor is the capital of South Gondar Zone which is 666kms far from Addis Ababa, the capital city of Ethiopia and 100kms away from Bahir Dar, the capital city of Amhara regional state.

# Study Design

Institution based cross-sectional study design was employed.

# Population

# Source Population

All patients who were undergone surgery from Debre Tabor General Hospital.

# Study Population

Selected patients who were undergone surgery from Debre Tabor General Hospital.

# Study Variables

# Dependent Variable

- Magnitude of post-surgery surgical site infection

# Independent Variables

- Age group (in a years) of care givers
- Sex of child
- Educational level
- Religion

# Sample size Determination

The sample size is determined by using single population proportion calculation formula. In a study done in Wolaita Sodo University Teaching and Referral Hospital, South Ethiopia, 13% developed surgical site infection (p) (27).By considering 95% confidence interval (CI) and 5% marginal error the, sample size is calculated as follows;

$$\text{Where } n = \frac{(Z\alpha/2)2\ p\ (1\text{-}p)}{d2}$$

Therefore, total sample size = 174 + non-respondent rate (10%)

= 174+17 = 191

# Sampling Technique

Systematic random sampling technique and proportional allocation was applied.

# Data collection Instruments

Data were collected by using structured self-administered questionnaire observational checklist by three trained nurses

# Data Quality Control

Training was given for data collectors and supervisors.  Pre- testing was done to keep data quality. Daily cleaning of the questionnaire and strict follow up by the supervisor was done.

# Ethical Consideration

Ethical clearance was obtained from the Amhara Public Health Institute. All the study participants were informed about the objective of the study and their verbal informed consent was obtained. Additionally confidentiality and privacy of the information were be kept anonymously.

# Data Processing and Analysis

The collected data were checked for completeness and cleanness and then entered into SPSS version 21 software for analysis. Descriptive statistics was done to describe the study variables. Bivariate analysis was performed to select candidate variables for multi variable logistic regression analysis. All independent variables with p-value less than 0.2 was taken as candidates for multivariable logistic regression analysis. Finally, p-value of less than 0.05 at 95% CI were used to declare statistical significance. The AOR from multi variable logistic regression was used to measure the strength of association.

## Results

# socio-demographic characteristics of clients undergoing surgery

In this study, a total of 191 patients have participated in the study yielding a response rate of 100%. The mean age of the respondents was 2.5 (SD ± 0.68) years. The most age group 115(60.2%) resides at the age group greater than 40 years. More than one half(62.3) of the surgical clients were females. Most of the clients were farmers(32.5%) and un able to read and write(41.9) based on the occupation (Table 1).

Table 1
SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PATIENTS WHO UNDERGONE SURGICAL PROCEDURES AT DEBRE TABOR GENERAL HOSPITAL, NORTHWEST ETHIOPIA (N = 191)

| Variables | | Frequency(n = 191) | Percent (%) |
|---|---|---|---|
| Age in years | 1–18 | 20 | 10.5 |
| | 19–40 | 56 | 29.3 |
| | > 40 | 115 | 60.2 |
| Sex | Male | 72 | 37.7 |
| | female | 119 | 62.3 |
| Educational status | Unable to write and read | 80 | 41.9 |
| | Able to write and read | 44 | 23.0 |
| | Primary school | 18 | 9.4 |
| | Secondary school | 26 | 13.6 |
| | Certificate of and above | 23 | 12.0 |
| Occupation | House wife | 29 | 15.2 |
| | Merchant | 20 | 10.5 |
| | Student | 19 | 9.9 |
| | Daily laborer | 47 | 24.6 |
| | Employed | 7 | 3.7 |
| | Unemployed | 7 | 3.7 |
| | Farmer | 62 | 32.5 |
| Residence | Rural | 51 | 26.7 |
| | Urban | 140 | 73.3 |

# SURGICAL PROCEDURE RELATED FACTORS ON PATIENTS WHO UNDERGONE SURGERY

Majority of the clients176(92.1%) had no previus history of hospitalization and preoperative hospital stay.Nearly three quarter(70.7%) of the clients had undergone elective surgery.Most of them(95.3%) had no co-morbidity and were given prophylaxis antibiotics(88%). (Table:2)

Table 2
SURGICAL PROCEDURE RELATED FACTORS ON PATIENTS WHO UNDERGONE SURGERY AT DEBRE TABOR GENERAL HOSPITAL, NORTHWEST ETHIOPIA (N = 191)

| Variables | Response | Frequency (n = 191) | Percent |
|---|---|---|---|
| History of previous hospitalization | Yes | 15 | 7.9 |
| | No | 176 | 92.1 |
| Pre-operative hospital stay | No admission | 176 | 92.1 |
| | < 7 days | 8 | 4.2 |
| | 7 days | 7 | 3.7 |
| Type of surgical procedure done | Emergency | 56 | 29.3 |
| | Elective | 135 | 70.7 |
| Site of surgery | Abdominal | 109 | 57.1 |
| | Extremity | 24 | 12.6 |
| | Thorax | 12 | 6.3 |
| | Neck | 27 | 14.1 |
| | Others | 19 | 9.9 |
| Duration of surgery | < 1 hour | 55 | 28.8 |
| | 1–2 hours | 120 | 62.8 |
| | 3–4 hours | 10 | 5.2 |
| | > 4 hours | 6 | 3.1 |
| Presence of co-morbidity | Yes | 9 | 4.7 |
| | No | 182 | 95.3 |
| Type of co-morbidity | Diabetes mellitus | 5 | 2.6 |
| | Hypertension | 2 | 1.0 |
| | HIV/AIDS | 2 | 1.0 |
| | None | 182 | 95.3 |
| Wound care given as ordered | Yes | 189 | 99.0 |
| | No | 2 | 1.0 |
| Frequency of wound care given | Once daily | 39 | 20.4 |
| | 2 times daily | 128 | 67.0 |

| Variables | Response | Frequency (n = 191) | Percent |
|---|---|---|---|
| | 3 and more times a day | 22 | 11.5 |
| | No care given | 2 | 1.0 |
| Type of anesthesia given | General | 155 | 81.2 |
| | Regional | 36 | 18.8 |
| Duration of anesthesia given | < 30 minute | 41 | 21.5 |
| | 30–60 minutes | 114 | 59.7 |
| | 60–90 minutes | 20 | 10.5 |
| | > 90 minutes | 16 | 8.4 |
| Antibiotic prophylaxis given | Yes | 168 | 88.0 |
| | No | 23 | 12.0 |
| Medication given as ordered | Yes | 186 | 97.4 |
| | No | 5 | 2.6 |

# Magnitude of surgical site infection

Despite improvements in operating room practices, instrument sterilization methods, better surgical technique, and the best efforts of infection prevention strategies, surgical site infections remain a major cause of hospital acquired infections in the study area. Of the clients who undergone surgery 11.5% (95% CI: 7.8%, 15.9%) had surgical site infection.

# Factors for surgical site infection

The multi variate analysis showed that, presence of comorbidity and antibiotics prophylaxis given were the major predictors of magnitude of surgical site infection. On the other hand age, sex, type of comorbidity, medication given after surgery, duration of operation procedure and type anesthesia given were found to be insignificant factors for surgical site infection (Table : 3).

Table 3
BIVARAIBLE AND MULTIVARIABLE ANALYSIS ON SURGICAL SITE INFECTION AMONG CLIENTS UNDERGOING SURGICAL INTERVENTION AT DEBRE TABOR GENERAL HOSPITAL NORTHWEST ETHIOPIA, 2020 (N = 191)

| **Variables** | **Surgical site infection (SSI)** | | **COR** | **AOR** |
|---|---|---|---|---|
| | **Yes (%)** | **No (%)** | **(95% CI)** | **(95% CI)** |
| sex | | | | |
| Female | 5(22.7%) | 67(39.6%) | 2.23 [0 .79, 6.34] | 2.00[0 .58, 6.94] |
| Male | 17(77.3%) | 102(60.4%) | 1 | 1 |
| Presence of comorbidity | | | | |
| Yes | 4(18.2%) | 5(3%) | 0.14 [0 .03, 0.56]* | .09[0 .01, 0.61]** |
| No | 18(81.8%) | 164(97%) | 1 | 1 |
| Type of anesthesia | | | | |
| General | 12(54.5%) | 143(84.6%) | 4.58 [1 .80, 11.70]** | 1.42[0 .34, 6.04] |
| Regional | 10(45.5%) | 26(15.4%) | 1 | 1 |
| Duration of anesthesia | | | | |
| <30 minutes | 12(54.5%) | 29(17.2%) | 0.56 [0 .13, 2.32] | 4.167[0 .50, 35.10] |
| 30–60 minutes | 6(27.3%) | 108(63.9%) | 4.425[0 .93, 18.63] | 3.267[0 .52, 20.65] |
| 60–90 minutes | 1(4.5%) | 19(11.2%) | 4.39 [0 .41, 46.93] | 2.052[0 .16, 26.67] |
| >90 minutes | 3(13.6%) | 13(7.7%) | 1 | 1 |
| Antibiotics prophylaxis given | | | | |
| Yes | 10(45.5%) | 158(93.5%) | 17.24 [6 .10, 48.68]** | 25.16[4 .83, 131.04]** |
| No | 12(54.5%) | 11(6.5%) | 1 | 1 |
| medication given after surgery | | | | |
| yes | 20(90.9%) | 166(98.2%) | 5.53 [0 .87, 35.13] | 5.31[0 .50, 56.78] |
| No | 2(9.1%) | 3(1.8%) | 1 | 1 |
| NB:1 = Reference, * =P value-<0.05, **=p-value < 0.01, Hosmier and Lemesho Goodness of fit test = 0.931 | | | | |

# Discussion

This study result showed that the magnitude of surgical site infection was high; we found that 11.5% (95% CI: 7.8%, 15.9%) of the clients who undergone surgery had surgical site infection ,which is in line with the report of the systematic review and meta-analysis in Ethiopia [12], the study done in Ethiopia like Jima University Hospital 11.4% [14], Wolita Sodo Teaching and referral hospital 13%[1] ,a systematic review and meta-analysis study 12.3% [6], in Ethiopia 9.9% [15], the study done in referral hospitals of Ethiopia [16], Suhul hospital Tigray of Ethiopia 11.1%[17], Southern hospitals of Ethiopia 11% [18]study in India 13.04% [13] in Mwanza Tanzania 10.9% [19] and in Pakistan 11% [20].

The study result was lower than the studies done in Ethiopia like Ayder hospital 75% [11], the study done in primary hospital 20.6% [21] a prospective cohort study 19.1% [22] ,the study done in Tanzania Bugando medical center 20% [5] and in a university hospital in Germany 22% [10]. The possible reason for this difference might be time difference, care of the patients and even antibiotic prophylaxis given.

However, our study was higher than, the studies conducted in developing countries 6% [7], the study done in Italy 5.2% [23] and in university Missori Kansas city 0.6%[4] .The possible explanation for this might be care of the patient and time difference of the study.

A statistically significant association was obtained between presence of comorbidity, prophylaxis given and surgical site infection. The absence of comorbidity and antibiotics prophylaxis given were the major predictors for magnitude of surgical site infection.

Participants with no comorbidity (AOR = **0. 09**, 95% CI: **0 .01, 0.61**) were by 91% less likely to have surgical site infection as compared to participants with comorbidity. The result is in consistent with the study done in Woliyta Zone hospital Ethiopia [1], in Tanzania[5], in Pakistan [20], in Buenos Aires Hospital [7] and in the university hospital of Germany[10].

The probable reason for this could be primary prevention by both the clients and the health personnel with health care and nutritional care.

Another statistical significant association was also obtained between antibiotics prophylaxis given and surgical site infection. Respondents who were not used prophylaxis (AOR = **25.16**,, 95% CI: **4 .83, 131.04]**) were twenty- five times more likely to have surgical site infection as compared to those patients who ever used antibiotic prophylaxis. The result is consistent with the study done in university hospitals of Ethiopia like Jimma [14],Woliyta Sodo [1], the systematic and meta-analysis study done in Ethiopia [6], in tertiary hospital of Ethiopia [21], the prospective cohort study done in Ethiopia [22]. The probable reason for this could be that antibiotics could bring resistance and immunity compromising that could decrease the resistance for infection.

Finally, other factors like sex of respondents, age occupation, type of anesthesia given, duration of anesthesia, type of comorbidity, duration of surgery and type of surgery were found to have no association with surgical site infection.

## Conclusion

The magnitude of surgical site infection in this study was high. Proper management of patients with co-morbidity especially those with diabetes mellitus, and cautious delivering antimicrobial prophylaxis before surgery before surgery would significantly reduce the incidence of surgical site infection.

## Recommendations

Health care providers should care for surgical site. Antibiotic prophylaxis should be given selectively. This study will alarm health professionals with in the operation team for proper handling of surgical site and its prevention not being infected.

## Limitations

As the study was cross-sectional egg- chicken dilemma is considered. As it is interviewed based and observation, observer bias was considered during data collection

## Abbreviations

**AOR** -Adjusted odds ratio

**CI-** Confidence interval

**COR**-Crude odds ratio

**P-** Proportion

**P V value** - Probability value

**SPSS** - Statistical package

**SSI-** Surgical site infection

## Declarations

# Ethics approval and consent to participate

Ethical clearance was obtained from the Amhara Public Health Institute. The study participants were also informed about the objectives of the study, privacy, and data protection and gave informed consent before being enrolled in the study.

# Consent for publication

Not applicable.

# Competing Interests

The authors declare that we have no competing interests.

# Funding

Self-funding

# Authors' contributions

Mequanint Bezie (MB) designed the study, participated in the data quality control, analyzed the data, and drafted the paper, Tadesse Wuletaw (TW) assisted with the design, approved the proposal, and revised drafts of the paper. All authors read and approved the manuscript.

# Acknowledgment

We sincerely acknowledge the Amhara Public Health Institute for giving permission letters to conduct this research. Our next appreciation goes to study participants, coordinators, data collection facilitators, and the staffs of the respective colleges.

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# Availability of data

The original data are available at hand and maybe delivered upon request via the corresponding author.

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