

## ENDOGENOUS DETERMINANTS OF SURGICAL SITE INFECTIONS AMONG PATIENTS ATTENDING HOSPITALS IN EKITI STATE, NIGERIA

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### Abstract

*Surgical Site Infection (SSI) still remains substantial burden to patients attending hospitals in Ekiti State despite advancement in the field of surgery. This study investigated the endogenous determinants of surgical site infections in patients attending hospitals in Ekiti State, Nigeria. It adopted descriptive research survey to study a sample of 150 health workers consisting of surgical doctors, theatre nurses and surgical ward nurses of which 50 samples were used from each of the 3 groups of health workers. Stratified random sampling technique was used to divide the state into 3 strata following senatorial districts, simple random sampling to select one hospital per stratum and purposive sampling to select doctors, theatre nurses and surgical ward nurses. Determinants of Surgical Site Questionnaire (DSSIQ) was used for data collection after being validated by experts in medicine, test and measurement and health education, and was pre-tested for reliability yielding 0.89 index, while it was administered to the health workers, completed and collated with 100% returns. The data were analysed using descriptive statistics of percentage, mean and standard deviation and inferential statistics of linear and multiple regression. The results showed that patients' underlying medical condition was a significant determinant of SSI (f value of 7.845 with p value of  $0.000 < 0.05$ ) and patient's personal hygiene was also a significant determinant of SSI (f value of 30.319 with p value of  $0.000 < 0.05$ ). It was concluded that patients' underlying medical condition is the most commonly observed cause of surgical site infection according to the finding of this study. It was recommended that efforts should be put in place by government, health agencies, community, family and individuals towards prevention of diseases that can complicate surgeries and cause SSI with emphasis on health education for patients.*

**Keywords:** Endogenous determinants, Patients, Surgical site infection.

### Introduction

Surgery is the branch of medicine that employs operations in the treatment of disease or injury. Surgery can involve cutting, abrading, suturing or otherwise physically change body tissue or organs. Surgical Site Infections (SSIs) are the most common infections that occur during hospitalization globally and a major cause

of morbidity and mortality following surgical operations. It is believed to be a major source of worry to the patient, health professionals, and the community as a whole, and this is due to the fact that an infected wound can prolong hospitalization by 5 to 20 days and subsequently increase medical costs. These infections occur after operation within 30 days if no implant is

used and one year if implant is used (Mangram, Horan, Pearson, Silver & Jarvis, 1999).

Makkanen and Huhtala (2006) reported that the highest number of surgical infections is post-operative infections, and in cases where the hospital care is prolonged, the need for medical and special care increases with a possible re-operation, this will inconvenience the family, cause the patient more pains, discomfort, economic and social hardship to the family. According to them, the longer the patient stays on admission, the more he/she is prone to other infections. In most cases, infection develops during the healing process. It does not matter if it is an open or closed wound. When an infection occurs, it can be diagnosed from patient's weakened physical condition or from local symptoms from the wound. The wound starts to get red from its margins, and then gets swollen and painful. When the infection develops further, the wound starts to secrete and produce bad odour. At this point the wound bleeds more easily and the surface becomes wider and deeper.

In some hospitals in Ekiti State, surgical site infections commonly occur especially after abdominal operations like caesarean section, fibroid removal, appendix removal, hernia repair, and orthopaedic or bone operations. For health educator, the role of preventing surgical site infections is

comprehensive and span the continuum of care. They play a crucial role in providing counseling and education to patients during the initial pre-operative visits and clinics, especially in relation to smoking cessation; glucose control in patients with diabetics; instructing patients to report new rashes or skin infections and to bathe or shower with soap or an antiseptic before surgery.

The risk of surgical site infections in developing countries is higher than the equivalent surgical procedures carried out in high-income countries (Mukagendanez, Munyaneza & Muvunyi, 2019). This is so in sub-Saharan Africa countries like Tanzania, surgical site infections rate is 26%, while the incidence for Uganda is 58.5%. In children undergoing surgical operation in Ahmadu Bello University Teaching Hospital, Zaria, surgical site infection rate of 14.3% in clean incisions, 19.3% in clean contaminated incisions, 27.3% in contaminated incisions, and 60% in dirty incisions were observed (Ameh, Mshelbwala, Nasir, Lukong, Jabo & Anuma, 2009).

Surgical site infections are associated with considerable morbidity and mortality and may double the length of post-operative hospital stays with attributable increased cost of treatment. In some cases, patients may require re-admission after initial discharge leading to additional cost of treatment, repeated

operations and other treatments. Infections increase the discomfort and disability experienced by patients following surgical procedures and still causes considerable morbidity and high cost to the health care system. Surgical site infections accounted for 14% to 16% of all nosocomial infections and was the most common health associated infections among surgical patients in the United States of America despite the improvement in surgical technique and advances in infection control practices (Mangram, Horan, Pearson, Silver & Jarvis, 2009). It is also becoming increasingly important in medico-legal aspects or simply put medical litigation in which a case of injury or ailment occurs during treatment of a patient, requiring investigation by the law enforcing agents; essentially to fix the responsibility regarding the causation of the injury, severe SSI may quadruple the cost of care and decrease patients' quality of life.

The most frequently cited determinants of SSIs have been broadly defined under endogenous factors and exogenous factors (Lobley, 2013). Endogenous factors are patient related determinants which include: nutritional status of patients, underlying medical conditions like HIV and diabetes, cigarette smoking, skin bleaching habits, poor personal hygiene and obesity/overweight. Age of patient refers to the length of time

that a patient has lived or existed and could be a considerable factor that increases the chance of surgical site infections. Aged people and young children are generally more prone to infections. This is because immunity is relatively low among the two extremes of age. Study has shown that advanced age is one of the important determinants of Surgical Site Infections (Stotts & Wipe-Tevis, 2001). Immunity, which allows man to fight invading microorganisms deteriorate with the aging process and it is not very active in young children.

Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of nutrients. Patients who are malnourished have been found to possess reduced immune response to infection. Obesity which is a product of abnormal nutrition is considered as a determinant of poor outcomes from different kinds of surgical procedures. Malnourishment negatively affects normal immune function and often results in poor wound healing causing surgical site infections and poor post-operative outcomes (Alfargieny, Bodalal, Bendardaf, Fadil & Langis, 2015).

Smoking refers to the inhalation of smoke of burning tobacco encased in cigarettes, pipes and cigars and could be associated with inhibited wound healing and decreased blood circulation to the skin due to obstruction of blood vessels from

aggregated blood components (<https://medical-dictionary.thefreedictionary>).

Cigarette smoking can restrict blood flow to the skin and prevent essential nutrients from reaching a wound. This is why cigarette smoking is considered a determinant of surgical site infection.

Underlying medical condition refers to disease or health condition that serves as a basis or cause for another secondary disease. Some diseases and underlying medical conditions have been identified as determinants of surgical site infections; they include, diabetes mellitus, HIV and cancer. Diabetes could cause lower immunity due to white blood cell malfunction when the blood sugar is high, SSIs occur in diabetic patient due to poor supply of glucose, oxygen and protein to the surgical site tissue. Patients with HIV and cancer have depressed immune system leading to delay in wound healing and surgical site infections (Stotts & Wipe-Tevis 2001).

Skin bleaching agents reduce skin quality by removing the protective epidermis (outer covering of the skin), while its chemical ingredients suppress the immune system thereby making the body susceptible to diseases and surgical site infections (Darko, Aduful & Edwin, 2013). Poor personal hygiene of patient has been observed to be an important determinant of SSIs, as dirty body surfaces may harbour

harmful microorganisms that may easily enter surgical cuts made during surgery leading to SSIs.

This study through its findings looked critically into patient related factors or endogenous factors in the cause of surgical site infections among patients attending hospitals in Ekiti State. Essentially, it successfully identified which one/ones among the factors of age; skin bleaching, nutrition, underlying medical conditions, personal hygiene and smoking could be identified as the endogenous determinant of SSIs in Ekiti State, as well as strategies for its prevention.

### Research Questions

This study found answers to the following research questions:

1. What are the common endogenous determinants of surgical site among patients attending hospitals in Ekiti State?
2. What are the health education strategies in the prevention of surgical site infections among patients attending hospitals in Ekiti State?

### Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance

1. Patient's personal hygiene will not be a significant determinant of SSIs among surgical patients attending hospitals in Ekiti State.
2. Patient's underlying medical conditions will not be a significant determinant of SSIs among surgical patients attending hospitals in Ekiti State.

### Methodology

This study employed descriptive research design. The design allows for the investigation of many variables and their interrelationships at the same time with a view to discover the common endogenous determinants of SSI in patients attending hospitals in Ekiti State. The population for this study comprised surgical doctors, theatre nurses and surgical ward nurses, using simple random sampling technique to select one hospital from each of the 3 tertiary hospitals in Ekiti State. Stratified random sampling technique was used in tandem with the 3 senatorial districts as follows: Federal Teaching Hospital (FETHI), Ido-Ekiti in Ekiti North, Ekiti State University Teaching Hospital (EKSUTH), Ado-Ekiti in Ekiti central and General Hospital (GHI), Ikere-Ekiti in the southern senatorial district. 150 health workers were sampled using purposive sampling technique, 50 surgical doctors, 50 theatre nurses and 50 surgical ward nurses

were purposively sampled from the selected hospital from each of the 3 senatorial districts of Ekiti State in the ratio 20: 20: 10 (FETHI, EKSUTH, GHI respectively). A self-designed structured questionnaire tagged Determinants of Surgical Site Infections Questionnaire (DSSIQ) was used for the study. The questionnaire was divided into five sections, A to E. Section A contained demographic characteristics of the respondents such as sex, religion, marital status and educational background; Section B considered the common endogenous causes of SSI; Section C sought information on SSI preventive health education strategies; while Section D provided information on the endogenous determinants of SSI among patients attending hospitals in Ekiti State. To ensure the validity of the instrument, a draft of the questionnaire was vetted by three experts in Health education, Test and Measurements and Guidance and Counselling, Ekiti State University, Ado-Ekiti. The pilot study involved the administration of the instrument to 30 respondents (all of the General Hospital, Ikole-Ekiti, Ekiti State) that were not included in this study but have similar characteristics as respondents in the actual study. The instrument was administered on them twice within interval of two weeks. The scores from the two sets of responses were correlated using

Pearson's Product Moment Correlation (PPMC) to determine the reliability coefficient. The instrument yielded a reliability coefficient of 0.89 which was considered high enough for the study. The copies of questionnaire were administered to the health workers with the help of five trained research assistants, after seeking permission from the authorities of the health institutions that were selected as well as the respondents. All the copies of the questionnaire administered were collated

on the spot with 100% returns after proper completion for analysis. The data were analysed using descriptive statistics of frequency counts, percentages, mean and standard deviation, while hypotheses were tested using linear and multiple regression analysis.

### **What are the common endogenous determinants of surgical site among patients attending hospitals in Ekiti State?**

## **Results**

**Table 1: Common Endogenous Determinants of SSIs**

<b>Variable</b>	<b>Very common (%) on monthly basis</b>	<b>Common (%) once every 3 months</b>	<b>Not common (%) once every 6 months</b>	<b>Mean</b>	<b>Standard Deviation</b>
Skin bleaching	2(1.3)	112(74.4)	36(24.0)	1.77	.45090
Cigarette Smoking	3(2.0)	113(75.3)	34(22.7)	1.79	.45313
Aged patient	4(2.7)	146(97.3)	0(0.0)	1.97	.16165
Young patient	5(3.3)	145(96.7)	0(0.0)	1.97	.18011
Nutritional status	68(45.3)	80(53.3)	2(1.3)	2.44	.52431
Underlying Medical status	87(58.0)	43(28.7)	20(13.3)	2.45	.71922
Personal hygiene	22(14.7)	75(50.0)	53(35.3)	1.79	.67850

Table 1 showed that surgical site infections are very common among patients with underlying medical conditions as represented by 87 respondents (58.0%) and patients with poor nutrition 68(45.3%). Most of the variables stated above are all common endogenous determinants, because 50 to 97.3% of the respondents

indicated that all the endogenous determinants of SSIs are common among patients attending hospitals in Ekiti State. Also, 53 respondents representing 35.3% indicated that poor personal hygiene of patients was not a common determinant.

# What are the health education strategies in the prevention of surgical site infections among patients attending hospitals in Ekiti State?

**Table 2: Health Education Strategies in Prevention of SSIs**

S/N	Item	Never (%)	Sometimes (%)	Often (%)	Mean	Standard Deviation
1	Continuous health education of health workers on SSI prevention practice	0 (0.0)	60 (40.0)	90 (60.0)	1.40	.49154
2	Organized health talks for patients on prevention of patient related causes of SSIs	0 (0.0)	71 (47.3)	79 (52.7)	1.47	.50096
3	Health education for patients and families on effective method to reduce SSI	1 (0.7)	68 (45.3)	81 (54.0)	1.47	.51379
4	Health education information in leaflets and translated into local languages	0 (0.0)	61 (40.7)	89 (59.3)	1.41	.49286
5	Quality health information on SSI that prevents patients from seeking information from untrusted sources	0 (0.0)	71 (47.3)	79 (52.7)	1.47	.50096
6	Health information on SSI before surgery	6 (4.0)	64 (42.7)	80 (53.3)	1.51	.57634
7	Health information on SSI after surgery	6 (4.0)	66 (44.0)	78 (52.0)	1.52	.57603
8	Health information on SSI using social media	0 (0.0)	60 (40.0)	90 (60.0)	1.40	.49154
9	Health education for health workers on SSI prevention	0 (0.0)	57 (38.0)	93 (62.0)	1.63	.48531
10	Hospital management sponsored training of health workers on latest technological advancement in SSI prevention	0 (0.00)	94 (62.7)	56 (37.3)	1.38	.48701

Table 2 showed that the health education strategies often adopted in hospitals in Ekiti State are health education for health workers on SSIs prevention (62.0%) and continuous health education of health workers on SSIs prevention practice (60%). These were closely followed by health education information on leaflets translated to local languages (59.3%). Also,

about 38% to 62.7% of respondents indicated that all the education strategies are sometimes carried out in hospitals in Ekiti State, with 62.7% of the respondents indicating that hospital sponsored training for health workers was done sometimes in Ekiti hospitals. About 4% of the respondents indicated that all the health education strategies are never conducted



for patients attending hospitals in Ekiti State.

The results of the analysis of the research questions showed that endogenous SSIs are very common in patients with underlying medical conditions, and all the endogenous determinants are common among patients attending hospitals in Ekiti State. Exogenous SSIs are also very commonly experienced from bacteria flora

on the hands of health workers as well as the use of unsterile surgical instruments. Health education for health workers on SSIs prevention and continuous health education of workers are the strategies often adopted in hospitals in Ekiti State.

**Ho 1: Patients' personal hygiene will not be a significant determinant of surgical site infections**

**Table 3: Linear regression analysis of personal hygiene**

Model	Unstandardized coefficient		Standardised Coefficient	T	P value
	B	Std Error	Beta		
(Constant)	21.075	.979		21.542	.000
Personal hygiene	.468	.085	.412	5.506	.000

R=.412

R<sup>2</sup>=.170

Adjusted R<sup>2</sup>=.164

F=30.319

P value=.000

Table 3 showed that an F value of 30.319 with P value of 0.000 table value is less than 0.05, when the sum of data on personal hygiene was statistically regressed against the sum of all the endogenous determinants of SSI at 0.05 level of significance. Hence the hypothesis which states that patients' personal hygiene will not be a significant determinant of SSIs was

rejected. This is an indication that patients' personal hygiene is a significant determinant of SSIs. Table 3 further showed that 17% of the total variance in SSIs was attributable to patients' personal hygiene.

**Ho2: Patients' underlying medical condition will not be a significant determinants of surgical site infections.**

**Table 4: Linear regression analysis of underlying medical conditions**



Model	Unstandardized Coefficient		Standardized coefficient	T	P value
	B	Std. Error	Beta		
(constant)					
Underlying medical conditions	22.436 .311	1.416 .111	.224	15.842 2.801	.000 .006

R=.224

R<sup>2</sup>=.050

Adjusted R<sup>2</sup>=.044

F=7.845

P value=0.00

Table 4 showed that an F value of 7.845 with P value of 0.000 table value is less than 0.05, when the sum of data on underlying medical condition was statistically regressed against the sum of all the endogenous determinants of SSI at 0.05 level of significance. Hence the hypothesis which states that patients' underlying medical condition will not be a significant determinant of SSIs was rejected. This is an indication that patients' underlying medical condition is a significant determinant of SSIs. Table 4 further showed that 5% of the total variance in SSIs was attributable to patients' underlying medical conditions.

## Discussion

The study examined the determinants of surgical site infections among patients attending hospitals in Ekiti State. The findings of the study were consistent with many findings of previous

studies, though findings in some studies contradict the findings. The finding of this study showed that in Ekiti State, the most common endogenous or patient related determinant of SSIs is patients with underlying medical conditions 87(58.0%). Underlying medical conditions such as skin infections, diabetes, obesity, cancer, HIV/AIDS have been reported to be among endogenous determinants of surgical site infection.

The finding of this study supported the finding of Scotts and Wipe-Tevis (2001), which opined that medical underlying or diseases are risk factors for developing SSIs, also; Faraday, Elaina, Trish, Perl and Karen (2012) in their research finding submitted that people with a past history of just a single skin infection may be three times more likely to develop a painful, costly and potentially deadly surgical site infection after surgery. The

same type of bacteria that cause skin infections such as abscesses, impetigo or cellulitis, are the same types of bacteria known to cause wound infections in the operations that were studied. Although, the research does not establish a cause-and-effect relationship between a past skin infection and SSI but believes that the association between the two is strong and should not be ignored.

The findings revealed that poor nutritional status of patients is among the highest common determinants of SSI in patients attending hospitals in Ekiti State 65(45.3). Characteristics of abnormal nutrition include: obesity, underweight, malnutrition. The finding of this study is in agreement with earlier finding by Gunningberg et al (2008), that malnutrition has long been an increased risk for nosocomial infections including SSI as patients who are malnourished have been found to possess less competent immunity response to infection. The finding also supported the works of Alfargieny et al (2015), that malnourishment negatively affects normal immune function and often results in poor wound healing, placing the patient at risk for SSIs and poor post-operative outcomes.

The findings of the study revealed that patients' underlying medical condition is a significant determinant of SSIs. Underlying medical conditions that may be

risk factors in surgery include: diabetes, skin infections, obesity, cancer, HIV/AIDS. The study supported the earlier finding by Everhart, Alteau and Calhoun (2013) that multiple patient comorbidities have been identified as SSIs risk factors including obesity, tobacco use, diabetes, immunosuppression, malnutrition and coagulopathy. Also supported by this study is the finding of Martin, Kaye, Knott, Nguyen, Santarossa, Evans, Betran and Jaber (2015) that diabetic patients are at a considerable risk for developing SSIs while undergoing most types of surgeries compared to non-diabetic patients.

### **Conclusion and Recommendations**

The study investigated the endogenous determinants of SSI among patients attending hospitals in Ekiti State. Based on the data collected and analysed, it is necessary to conclude that patients' underlying medical condition is the most commonly experienced endogenous determinant of SSI in Ekiti State. The study further showed that poor personal hygiene practices among patients attending hospitals in Ekiti State is also very significantly high compared with other endogenous or patient related factors, this may not be unconnected with the prevailing socio-economic factors, ignorance, tradition, superstitious beliefs, and poor attitude towards early utilization of medico-

surgical care. In addition, the findings of the study showed that the health education strategies often adopted in hospitals in Ekiti State are health education for health workers on SSI prevention practices. These findings are strong indications of the need for management of hospitals to give priority to the prevention of patient related causes of SSI, by ensuring treatment of underlying medical disease and putting emphasis on the need for healthful living habits. It is therefore recommended that more efforts should be put in place by governments, health agencies, community, family and individuals towards the prevention of diseases that can complicate surgeries and cause SSI, also, preventive health education should not be limited to the training of health workers, rather, consideration must be given to health education for patients and their family.

## References

- Alfonso-Sanchez, J. L., Martinez, I. M., Martin-Moreno, J. M., Gonzalez, R.S. & Botia, F. (2017). *Analysing the risk factors influencing surgical site infection: The site of environmental factors. Canadian journal of surgery*, 60 (3), 155-161.
- Ameh, E.A., Mshelbwala, P.M., Nasir, A.A., Lukong, C.S., Jabo, B.A. & Anumah, M.A. (2009). *Surgical site infection in children. Prospective analysis of the burden and risk factors in sub-Saharan African setting. surgical infection journal*, 10(3), 105-109.
- 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 west, Nigeria. International Journal of Tropical Diseases & Health*, 3(1), 25-36.
- Alfargieny, R., Bodalal, Z., Bendardarf, R., El Fadil, M. & Langis, S. (2015). *Nutritional status as a predictive marker for surgical site infection. Avicenna journal of medicine*, 5(4), 117-121.
- Darko, R., Aduful, H. & Edwin, F. (2013). *Post-Operative surgical site infections from skin bleaching: A case report. West African journal of medicine*, 32(4), 307-310.
- Everhart, J.S., Altneu, E. & Calhoun, J.H. (2013). *Medical comorbidities are independent preoperative risk factors for surgical site infection after total hip arthroplasty. Clinical orthopedic related research*, 471(10), 3112-3119.
- Faraday, N., Trish, M.P., Carroll, K. & Stierer, S. (2012). *Surgical site infections more likely in patients with history of skin infections. Johns Hopkins medicine. Retrieved from [http://www.hopkinsmedicine.org/anesthesiology\\_critical\\_care\\_medicine/research\\_faculty/bios/faraday.html](http://www.hopkinsmedicine.org/anesthesiology_critical_care_medicine/research_faculty/bios/faraday.html)*.
- Gunningberg, L., Persson, C., Akerfeldt, T., Stridsberg, M. & Swenne, C. (2008). *Pre and post-operative nutritional status and predictors thoracic patients. The European*

- journal of clinical nutrition and metabolism*, 3(3), 93-101.
- Lobley, S.N. (2013). *Factors affecting the risk of surgical site infection and methods of reducing it*. *Journal of Perioperative Practice*, 23(4), 77-81.
- Mangram, A.J., Horan, T.C., Pearson, M.L., Silver, L.C. & Jarvis, W. (1999). *Guideline for Prevention of surgical site infection, hospital infection control practices advisory committee*. *American journal of infectious disease control*. 27(2), 97-132.
- Markkanen, A. & Huhtala, A. (2006). *Aseptic techniques in surgical wound care executed by Nurses*. Unpublished bachelor's thesis, Jyväskylä University of applied sciences, school of health and social care.
- Martin, E.T., Kaye, K.S., Knott, C., Nguyen, K., Santarossa, M., Evans, R., Betran, E. & Jaber, L. (2016). *Diabetes and risk of surgical site infections: A systematic review and meta-analysis*. *Infection Control Hospital Epidemiology*, 37(1), 88-99.
- Medical Definition of Surgery. (2016). Retrieved from [www.medicinet.com](http://www.medicinet.com).
- Mukagendaneza, M.J., Munyaneza, E., % 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*, retrieved from <https://doi.org/10.1186/s13037-019-0190-8>.
- Stotts, N. & Wipke-Tevis, D. (1996). *Co-Factors in impaired wound healing*. *ostomy wound manage*, 42(2), 44-46.