

## RESEARCH ARTICLE

### PREVENTING SURGICAL SITE INFECTIONS IN EAST AND SUB-SAHARAN AFRICA

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#### ABSTRACT

This research project provides evidence-based scientific methods for preventing Surgical Site Infections (SSIs) following operative obstetric and gynecologic procedures in East and sub-Saharan Africa. Some examples of these gynecological and obstetric-related procedures are caesarian section, hysterectomies, myomectomies, oophorectomies, and tubal ligations. An initial meta-analysis of 120 articles ( $n=120$ ) was used for providing the best infection control protocols that have proven successful in some of the developing and developed countries. 15 best articles were selected for the final analysis. The authors provided proven evidence-based novel infection control essential steps for surgical patients that will be undergoing either obstetric and or gynecology surgical procedures in East Africa and sub-Saharan Africa.

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## INTRODUCTION

Surgical site infection (SSI) are infections that occur within thirty days after an operation involving skin, subcutaneous tissue and, or deep soft tissue of the incision (Center for Disease Control and Prevention, 2021). SSIs are some of the common complications among patients in East and sub-Saharan Africa. These complications could lead to mortality, morbidity, prolonged hospital stay, increased readmissions and high treatment costs (Berrios-Torres *et al.*, 2017). Other immediate and long-term complications associated with surgery include fistulae, sepsis, thromboembolism, hemorrhage, infertility, maternal and infant mortalities (Berrios-Torres *et al.*, 2017; Amulio *et al.*, 2019). Implementation of SSI prevention measures, especially multimodal strategies have been found to be effective in reducing the occurrence and burden of infections (World Health Organization, 2018).

Kenya, Tanzania, Uganda, Burundi, Ethiopia, Rwanda, and Somalia are countries located in East Africa. These countries belong to a larger group of countries in sub-Saharan Africa. The development of SSIs in East Africa is probably linked to non-adherence of infection prevention and control practices (IPC), high patient to healthcare worker ratio, inadequate IPC

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knowledge, poor attitudes towards IPC and lack of good antibiotic stewardship leading to antibiotic resistance. These reasons usually occur before and after elective or emergency surgical procedures. A study done in a Ugandan hospital that started in May 2016 and ended in January 2017 found that *Klebsiella pneumonia* (50%) was the most predominant bacteria followed by *Staphylococcus aureus* (27.8%). Both of these bacteria had shown a 100% antimicrobial resistance to ampicillin, tetracycline, septrin, and erythromycin (5). The overall SSI incidence rate in the Ugandan study was 16.4%. 5.9% was superficial, and 47.1% deep organ tissue cultures. Conversely, ciprofloxacin and ceftriaxone were found to be very potent antibiotics against all bacterial pathogens (5). Could it be that the choice of antibiotics prescribed, or incorrect bacterial cultures, quality of health care before and after surgical procedures, lack of proper health information management and policy be some of the main causes of SSIs in the rest of the East Africa countries? Cesarean Section (CS) is a popular type of surgical procedure that obstetricians and pregnant women opt for delivering a fetus. There are elective and emergency types of CS. Emergency CS account for approximately 76.7% of surgical procedures in East Africa (6). The popularity of a CS may be common among younger nulliparous women due to its painless process during the delivery period compared to the natural method of fetal delivery known as the vaginal type of delivery. However, multiple mortalities and development of SSIs during the postpartum period are associated with elective and emergency CS in sub-Saharan Africa (6).

The maternal mortality ratio (MMR) due to SSIs post-CS procedures in sub-Saharan Africa is 14 times higher compared to developing countries (7, 8). Essential Healthcare workers are physicians, nursing staff, clinical officers, respiratory therapists, laboratory staff, and et cetera (9). All healthcare workers must comprehend the correct protocols and procedures before and after any emergency or elective surgical operations. Working collaboratively in a healthcare setting among essential healthcare workers ensures that all the required SSI prevention protocols are strictly adhered to. Building a strong and efficient cream of leaders in healthcare settings in East Africa is one of the proposed solutions for preventing SSIs. Engaging internal and external stakeholders or health experts breeds new ideas. These ideas are envisioned to improve surgical outcomes after obstetrical and gynaecological procedures in East and sub-Saharan African. Sharing of clinical ideas among essential healthcare workers in developing and developed countries is one solution for mitigating future SSIs. This is achievable through educative oral presentations in workshops, seminars, and conferences (10). Obstetricians and gynaecologist-physicians in East and sub-Saharan Africa ought to begin creating exchange programs for medical, nursing, and other students in medical training during their clinical and surgical rotations.

This could result in a transfer and exchange of novel ideas among the medical or nursing students on best clinical practices for preventing SSIs. For example, medical students at Kenyatta University in Kenya may attend clinical and surgical rotations either at Makerere University or The University of Dar es Salaam or The University of Texas Rio Grande Valley or The University of Cape Town or Cairo University. Educating students about following the best clinical practices and strictly adhering to SSI prevention protocols at the beginning of their learning years in medical school is highly imperative. A well-mentored student usually follows the correct clinical practices compared to a student that lacks appropriate training. This is where the main gap for preventing SSIs exists i.e., during training of healthcare personnel and actively practicing healthcare providers (11).

## RESEARCH METHODS

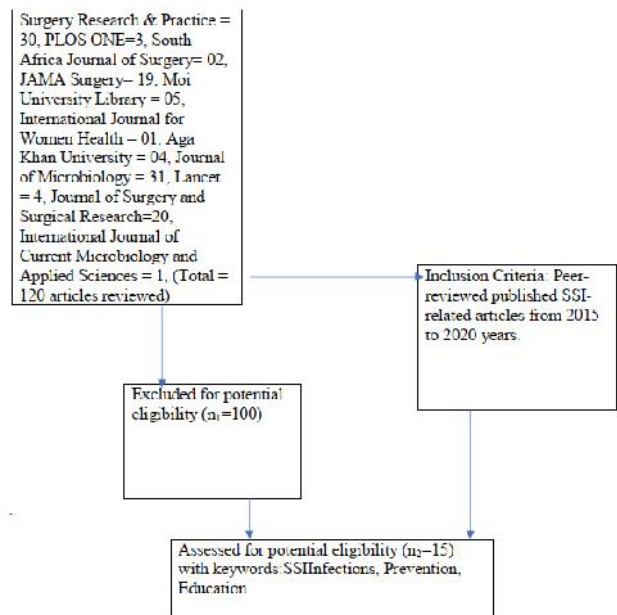
A retrospective meta-analysis of 120 evidence-based articles provided different types of interventions and risk factors for preventing SSI. The inclusion criteria were articles from 2015 to 2021 years. The exclusion criteria were articles published before 2014. 15 best articles were selected for providing more insight for infection control in the East and sub-Saharan African countries.

A scoring algorithm of 1-10 was used for determining the strengths and weaknesses of the best 15 articles for infection prevention in East and sub-Saharan Africa. Library were searched using the terms, "Surgical Site Infections (SSI) OR Surgical Site Infections in East Africa OR Surgical Site Infections in obstetrical and gynecological procedures OR Surgical Site Infections in developed and developing countries OR SSI mortality and morbidity rates in developing and developed countries." A score of 1-3 referred to the least effective interventions for preventing SSIs whereas scores of 4-6 medium interventions and 7-10 the most effective interventions.

## RESULTS

15 articles of the best articles provided evidence-based solutions for preventing SSIs in East Africa.

Table (I)



## DISCUSSION

There is a need for more health education at the college or university level for medical and nursing students about best clinical practices before and after surgical operations is the beginning step for preventing SSIs in East and Sub-Saharan Africa hospitals (12). Prescribing the correct choice of antibiotics after obstetrics and gynaecological surgical procedures is one of the main steps for preventing SSIs. Testing of bacterial cultures from blood and tissue samples after completing surgical operations prevents antibiotic resistance among recuperating patients and SSIs. Administration of the correct prophylactic and empiric antibiotics before and after surgical procedures ought to be done without fail. A case-control study at Moi Teaching and Referral Hospital in Eldoret, Kenya in 2018 found that the most common pathogens in order of incidence and commonality were *Staphylococcus aureus*, *Escherichia coli* (*E. coli*), *Actinobacteria baumannii*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, and *Streptococcus pyogenes* (12). Methicillin-Resistant *Staphylococcus aureus* (MRSA) is a common pathogen to all isolated *Staphylococcus aureus* bacterial cultures. Most gram-positive bacteria are resistant to ceftriaxone, cotrimoxazole, ciprofloxacin, azithromycin, erythromycin, cefuroxime, and levofloxacin. Conversely, 50% of gram-negative bacteria were resistant to ceftriaxone, cefotaxime, ceftazidime, cefepime, and levofloxacin (12). Following strict hygiene and disinfectant protocols of surgical theatres is essential for preventing SSIs (13). SSI prevention protocols approved by all Ministries of Health in Kenya, Uganda, Tanzania, Rwanda, Burundi, and South Africa should be harmonized and similar.

Table 2. Showing the Top 15 Articles Identified out of 120 Articles for Providing Effective Preventative Methods and Interventions for Surgical Site Infections (SSIs) in East Africa

Article Title	Author(s)	Strong Intervention	Medium Intervention	Least Intervention
Antibiotic susceptibility patterns of bacteria isolate from post-operative wound infections among patients attending Mama Lucy Kibaki Hospital, Kenya	Amulioto, J., Muturi, M.W., Mathenge, S., & Mutua, G.M. (2019).		Discusses the effect of antibiotic resistance during the treatment of SSIs with regard to specific surgical sites in the body. Score (7)	
Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital, Southwestern Uganda.	Abubaker L., Bazira J., & Najjuka, J.L., (2017).	Discusses incidence rates (overall IR=16.4%, 5.9% superficial, and 47.1% deep and organic space tissue cultures), risk factors, and etiology of SSIs in a regional hospital in Uganda. Identifies Klebsiella pneumonia was most common isolated bacteria for causing SSI in the Mbarara Regional Referral Hospital. (MRRH) Ciprofloxacin was found to be effective against all SSI causing bacteria at the MRRH. Score 10		
Burden of Surgical Site Infection following cesarean section in sub-Saharan: a narrative review. International Journal of Women's Health, 11, 309-318.	Sway, A., Nthumba, P., Solomkin, J., Tarchini, G., Gibbs, R., <i>et al.</i> (2019).	Describes the difference of MMR ratio of developing and developed countries. Gives evidence insight of Cesarean Section as one of the main obstetrical surgical procedures and possible cause of SSIs in the post-partum period. Analyzes the incidence and epidemiology of SSIs in developing countries specifically in East Africa. A detailed meta-analysis based on a quality-scoring system for 15 operative variables and outcomes that are associated with the development of SSIs. Precisely suggests evidence-based interventions for preventions SSIs beginning with improvement and availability of healthcare. Score 10.		
Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN maternal mortality estimation inter-agency group	Alkema L., Chou D., Hogan D., <i>et al.</i> , (2016)	Analyzes and discusses SSIs from a global, regional, and national perspective. Gives different MMRs of SSIs in different geographic zones. Score 9.		
Knowledge, practice, and Associated factors towards prevention of surgical site infections among Nurses working in Amhara regional state referral hospitals, Northwest Ethiopia	Teshager, F.A., Engenda, E.H., & Workie, W.Z. (2015).	Identifies a knowledge gap among healthcare workers in one Ethiopian healthcare facility. Remedies the gap by offering more education for healthcare providers in preventing SSIs in Ethiopia. Score 10.		
Effect of corona virus disease 2019 (COVID 19) on maternal, perinatal and neonatal outcome: systematic review	Juan, J., Gil, M. M., Rong, Z., Zhang, Y., Yang, H., & Poon, L. C. (2020).			Does not propose definitive prevention mechanisms against COVID-19 or SSI. Score 3

Continue ...

Incidence and risk factors for surgical site infections following emergency laparotomy at Kenyatta National Hospital (KNH)	Miima, S.E., Oliech, J.S., Ndaguatha, P.L.W., & Opot, E.N. (2016).	Discusses incidence rates of SSIs following emergency laparotomies at KNH. Identifies endogenous, exogenous, and independent predictors of developing SSIs. Provides public health education against cigarette and alcohol use among young males for preventing SSIs. Reviews a t-test for comparing which groups of patients and the relationship of developing SSIs in conjunction with smoking and alcohol use. Cites periodic surveillance and a reduction of preoperative and postoperative waiting times and recuperation times as a solution for preventing SSI. Score 9.		
Antibacterial susceptibility patterns and risk factors for surgical site infections at Moi Teaching and Referral Hospital, Eldoret-Kenya.	Okello, S.O. (2018)	Comprehensively discusses risk factors (smoking, diabetes [DM] mellitus, and long-time operation) for developing SSIs. Smoking tobacco products was found to be one of the largest risk factors for developing SSIs with an Odds Ratio of 5.8 ( $P<0.01$ ). DM ( $OR=3.5$ , $p=0.025$ ) and long-term operation ( $OR=1.5$ , $p=1.5$ ). Provides an intervention that more active surveillance for SSI causing microorganisms and their pathogenesis for developing SSI should be placed on high alert at all times. Patients with SSIs and prolonged operation times should be closely monitored. Score 10.		
Prevalence and predictors of surgical-site infection after caesarean section at a rural district hospital in Rwanda	Nkurunziza, T., Kateera, F., Sonderman, K., Gruendl, M., Nihwacu, E. <i>et al.</i> , (2018).	Discusses the prevalence and indicators (travel time from home to the healthcare center, cost of travel, total spent time spent to get to hospital) of SSIs in Rwanda. Found that combining antiseptic solutions on the skin pre-operatively could reduce the risk ( $OR=4.42$ ; $p=0.043$ ) of SSIs. Score 8		
Admissions for post-discharge surgical site infection at a quaternary South African public sector hospital.	Naidoo, N., Madiba, T.E., Moodley, Y. (2019).	Explains reasons for lack of reporting SSI after patient admissions and suggesting interventions for preventing future SSIs in a South African (SA) hospital. Finds that patients residing in urban areas are more affected than those in rural areas in SA. Suggest providing a prevention package to surgical patients after discharge from hospital. This is more aligns to educating patients about risk factors for preventing SSIs before leaving hospital. Score 9		
Surgical site infection in elective clean and clean-contaminated surgeries in developing countries	Curcio D., Carne, A., Fernandez, F., & Correa, J. (2019)			Compares the global incidence rates, cost of hospitalizations for SSIs in developing and developed countries. Limitations for this study are inherent higher data (clean or clean-contaminated) or developed countries compared to developing countries. Score 4
A multimodal infection control and patient safety intervention to reduce surgical site infections in Africa: a multicenter, before-after, cohort study.	Allegranzi, B., Aike, A.M., Kubilay, N.Z., Nthumba, P. Baraza, J. <i>et al.</i> , (2018).		Discusses about multimodal interventions for preventing SSIs in five different hospitals in Africa. General intervention and requires a large-scale experimental study to justify the findings in this study. Score 5	
Surgical Site Infection Rates in Breast Cancer Surgery at a University Hospital in Nairobi, Kenya	Nyaoncha, A., Wasike, R., Ahmed, M. & Njihia, B. (2016).	Discusses SSI rates and the efficacy of perioperative and post-operative antibiotics after breast cancer surgery. The introduction of a new surveillance protocol for assessing the risk of SSI following breast cancer surgery at the Aga Khan Hospital Nairobi, Kenya was found to be lower (6%) than other related research studies. Score 10		

This ensures that all essential healthcare workers caring for surgical patients are up to date with new and best practices for preventing SSIs (14).

## CONCLUSION

The incidence and quality of medical care of patients after emergency caesarian sections in sub-Saharan and East Africa could result in high mortality outcomes among nulliparous and multiparous women. Continuous education of essential healthcare staff responsible for taking care of surgical patients is imperative for preventing SSIs. All healthcare centres in urban and rural locations in East Africa and sub-Saharan Africa must have an abundant supply of antibiotics and medical equipment. Medical personnel ought to correctly care for surgical patients (13,14). Investing in drone technology for transporting blood-borne products, medicines, and portable equipment is vital for ensuring that rural and urban healthcare centres have sufficient resources for surgical patients. The use of drones and cell phone technology is currently being utilized in Rwanda and proving very effective in improving patient outcomes (15,16).

These technologies ought to be replicated in all East and sub-Saharan Africa countries. Smoking, diabetes mellitus (DM), and prolonged hospitalization time are some of the high-risk factors known for developing SSIs in East Africa. It is important to closely monitor SSI patients with known histories of smoking tobacco products and diabetes mellitus (17). MRSA and *Actinobacter baumannii* have shown overwhelmingly multidrug resistance. More vigilance is mandatory for MRSA, *Pseudomonas aeruginosa*, and *Actinobacter baumannii* blood (17, 18,19,20). Replacement of old health management policies with new ones is imperative for preventing SSIs and improving healthier outcomes among surgical patients in East and sub-Saharan Africa (20).

Developed countries follow the principle of replacing old health management policies with new ones regularly. These new policies are evidence-based and have led to an improvement in the delivery of health care services (20, 21, 22). Developing countries in East and sub-Saharan Africa could benefit from a massive overhaul of existing health management policies as incorporating all SSI prevention measures discussed in this article. Investing in a harmonized Health Information Management Systems (HIMS) and Electronic Medical Records (EMS) in rural and urban hospitals East and sub-Saharan is essential for tracking any SSIs in real-time (23). Tracking of surgical patients using mobile phones is an inexpensive surveillance method for preventing SSIs during and after hospitalization.

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