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**Bacterial Pathogens and Factors Linked to Wound Sepsis at the Western Uganda Kampala International University Teaching Hospital**

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**ABSTRACT**

Wound sepsis is a common issue in patients undergoing caesarean sections, contributing to morbidity and mortality. A study was conducted at KIUTH to identify factors associated with wound sepsis and common bacterial pathogens. The study involved 303 participants, collecting socio-demographic, clinical, hospital, and obstetric factors. The wound sepsis rate was 16.8%, with factors such as education, multiple vaginal examination, hygiene, previous caesarean sections, and HIV sero-positivity significantly associated with the disease. Staphylococcus aureus was the most common pathogen found in wound swab specimens, with coliforms showing high susceptibility to imipenem and Staphylococcus aureus to ciprofloxacin.

**Keywords:** bacteria, pathogens, wound, sepsis

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**INTRODUCTION**

Sepsis is a life-threatening illness caused by the body's response to an infection and develops when mediators of inflammation are released in the general body circulation [1]. Modern understanding of sepsis is in reference to human response to infection and this is mediated by several inflammatory mediators [2]. This shows that sepsis is a complex physiological and metabolic response of the body and is currently a major reason for admission of patients to the intensive care unit [3, 4]. In medical practice, post-operative sepsis has been recognized as a major cause of mortality and morbidity in patients as a result of dysregulation of host immune response to infection. This leads to production of cytokines, prostanoids and nitric oxide, which suppress immunity of the body further [5]. In addition, the leading cause of severe sepsis has been shown to be related primarily to Gram-negative bacterial infections and the prognosis is grave in older people, black race and those with a pre-existing illness [6]. In addition, gram positive bacteria, in particular *Streptococci* species have also been isolated as major pathogens in sepsis [7].

Health believe theory will be used in this study were changing behaviour will be based on balance between barriers versus benefits to change. Post-cesarean wound sepsis is common among women following cesarean section and this can easily progress into septic shock if poorly managed [8, 9, 10]. Early diagnosis of post-cesarean wound sepsis using sepsis biomarkers [11] such as pro-calcitonin (PCT) is an important medical practice. These biomarkers are hardly available in several health care units in developing countries and this has led to the development of a global campaign on development of appropriate guidelines for successful

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management of sepsis [12, 13]. Successful management is crucial to ensure that unnecessary prolonged activation of the immune response is inhibited [1, 14, 15].

## METHODOLOGY

### Study design

This is a retrospective study because the data were collected from the records of the hospital

### Study site and setting

The study was conducted at KIUTH which is a public hospital in Ishaka-Bushenyi district. It is located along Mbarara-Kasese road, in western Uganda. KIUTH is the largest hospital in Bushenyi district and accommodate neighbouring communities and districts.

### Study population

The study population was participant with wound sepsis that cultured test was done to determine the bacterial and antibiotics susceptibility test.

### Inclusion Criteria

All records of patients with wound sepsis who were subjected to culture and sensitivity.

### Exclusion Criteria

Those with wound sepsis but did not do culture and sensitivity were excluded from the study.

### Sample size

The minimum sample size for this study was 271.

### Sample size determination

**Specific objective one:** The prevalence of post wound sepsis in Uganda was reported to be 22.2% [16].

Using formula [17];

$$n = \frac{(z_{\alpha})^2 \times p \times (1-p)}{e^2}$$

Where:

Z = Standard normal deviate at 95% level of confidence; z= 1.96

$Z_{\alpha}$  = z-statistic at  $\alpha=1.96$

p = prevalence of post-cesarean wound sepsis in Uganda, p=22.2%

e = level of precision (in proportion of one, if 5% e=0.05)

n = Desired sample size

$$n = \frac{(1.96)^2 \times 0.222 \times (1 - 0.222)}{0.05^2} = 266$$

**Objective two:** The associated factors of post-cesarean wound sepsis; the sample size was determined according to modified Daniel's formula [16];

$$n = \frac{(z_{\alpha} + z_{\beta})^2 \times \frac{1}{R} \times p \times (1 - p)}{e^2}$$

Where:

Z = Standard normal deviate at 95% level of confidence; z= 1.96

$Z_{\alpha}$  = z-statistic at  $\alpha=1.96$ ,  $Z_{\beta}$  = z-statistic at  $\beta=0.84$

p = prevalence of post-cesarean wound sepsis in Uganda, p=22.2%

e = level of precision (in proportion of one, if 5% e=0.05)

n = Desired sample size

R = Odds ratio=2.0

$$n = \frac{(1.96 + 0.84)^2 \times \frac{1}{2} \times 0.222 \times (1 - 0.222)}{0.05^2} = 271$$

**Objective three & four:** The common bacterial cause of post-cesarean wound sepsis, *Pseudomonas aeruginosa*, 21% in KIUTH teaching hospital [6]; Using formula; [16]

$$n = \frac{z^2 pq}{d^2}$$

Where;

n = Desired sample size

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z = Standard normal deviate at 95% level of confidence; z= 1.96  
p = expected prevalence of post-cesarean wound sepsis, p=0.21  
d = level of precision (in proportion of one, if 5% d=0.05)

$$n = \frac{(Z_{\alpha})^2 \times p(1-p)}{(d)^2}$$

$$n = \frac{(1.96)^2 \times 0.21 \times (1 - 0.21)}{0.05^2} = 255$$

Therefore, the overall minimum sample size for this study was 303 participants.

#### Sampling technique

Consecutive enrollment of participants who consent to participate in the study. This was carry out on a daily basis until required sample size was reached.

#### Data collection instruments

Structured pre-tested questionnaire was used for each participant to collect information on socio-demographic, prevalence, common bacteria and factors that are related to the development of post-cesarean wound sepsis in each patient including obstetric factors, hospital factors and health factors.

#### Data analysis

Data on questionnaires was entered in Microsoft Excel version 2010, and then data from Excel was exported to IBM SPSS statistics version 23 as well as STATA 14.2 (Statacorp, USA Texas). Socio-demographic and clinical factors were summarized as means and medians, standard deviations and interquartile range (for continuous variables). Proportions, percentages and frequencies were used for categorical variables using STATA 14.2.

#### Ethical considerations

Permission to carry out the study was obtained from KIUTH administration to access the secondary data which records of patients that had wound sepsis and were cultured. Informed consent from participants were obtained during consultation with the doctor after fully explaining the details of the study to them in English [18] therefore, no direct consent was obtained prior to data collection from the records.

#### RESULTS

The median age was 23 years for both referred and non-referred study participants, with 92.2% married among the non-referred participants. Majority of the non-referred study participants had no formal education (56%) compared to 24% among referred participants (p=0.001). Farming was the major occupation (79%) among the referred participants with 41% Anglicans were the majority among the non-referred participants while believers of Bushenyi-ishaka faith were the minority (<5%) in both groups.

**Table 1. Socio-demographic characteristics of study participants attending KIUTH**

Variable	Patient type		p-value
	Non-referred (n=205)	Referred (n=98)	
Median age in years (IQR)	23(20-28)	23(19-28)	0.95
Marital status n (%)			
Married	189(92.2)	87(88.8)	0.56
Single	9(4.4)	8(8.2)	0.51
Divorced	5(2.4)	2(2.0)	0.95
Cohabiting	2(1.0)	1(1.0)	1.00
Education n (%)			
None	115(56.1)	23(23.5)	<b>0.001</b>
Primary	49(23.9)	52(53.1)	<b>0.004</b>
Secondary	26(12.7)	19(19.4)	0.51
Tertiary	15(7.3)	4(4.1)	0.075
Employment n (%)			
Farmer	119(58.1)	77(78.6)	0.25
Health worker	2(1.0)	2(2.0)	0.95
Saloon	28(13.7)	7(7.1)	0.51
Teacher	9(4.4)	3(3.1)	0.94
Others	47(22.9)	9(9.2)	0.44
Religion n (%)			
Catholic	68(33.2)	39(39.80)	0.75
Anglican	84(41.0)	32(32.7)	0.69

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Muslim	15(7.32)	4(4.1)	0.88
SDA	12(5.9)	4(4.1)	0.93
Bishaka	7(3.4)	4(4.1)	0.97
Others	19(9.3)	15(15.3)	0.78
Median no. of times bathe a day (sd)	1.94(0.64)	1.12(1.20)	<0.001

Table 4. In the study comprising 303 participants, 16.8% were diagnosed with post-caesarean wound sepsis with non-referred and referred participants having the condition of 11.7% and 27.6% respectively

**Table 2 Prevalence of wound sepsis at KIUTH**

Overall prevalence (n=303) Frequency % (95%CI)	Patient type		p-value
	Non-referred (n=205) Frequency % (95%CI)	Referred (n=98) Frequency % (95%CI)	
51 16.8(13.0-21.5)	24 11.7(7.9-16.9)	27 27.6(19.4-37.4)	<b>0.002<sup>a</sup></b>

<sup>a</sup>P-value between prevalence of post caesarian wound sepsis among referred and non-referred patients

In our study, intern doctors mainly handled cesarean sections for both referred and non-referred mothers attending KIUTH. Emergency cesarean section were the majority in this setting with the most preferred type of incision being midline. Among 61% of non-referred patients, there were no antibiotics given before surgery compared to 42% among referred patients. Premature rupture of membranes was more among referred patients (13%) compared to Premature rupture of membranes among non-referred patients (p=0.03). Participants with more than one previous cesarean section were more in non-referred 29% compared to 25% in referred patient (p = 0.42)

**Table 3: Hospital and obstetric factors of women attending KIUTH**

Variable	Patient type		p-value
	Non-referred (n=205)	Referred (n=98)	
<b>Cadre that performed the surgery n (%)</b>			
Intern	204(99.5)	96(98.0)	0.32
Medical officer	1(0.49)	2(2.0)	0.06
<b>Antibiotics given prior surgery</b>			
No	124(60.5)	41(41.8)	<b>0.02</b>
Yes	81(39.5)	57(58.2)	<b>0.02</b>
<b>Median length of labor in hours (IQR)</b>	9(6-13)	10(6-18)	0.07
<b>Median parity (IQR)</b>	2(1-3)	2(1-4)	0.30
<b>Type of incision</b>			
Transverse	86(42.0)	34(34.7)	0.16
Midline	119(58.1)	64(65.3)	0.23
<b>Median no. of vaginal examination (IQR)</b>	3(2-4)	2(1-5)	0.057
<b>Type of c/section n (%)</b>			
Emergency	190(92.7)	94(95.9)	0.24
Elective	15(7.3)	4(4.1)	0.24
<b>Techniques of CS n (%)</b>			
Classical	5(2.44)	6(6.12)	0.17
LTCS	200(97.56)	92(93.9)	0.17
<b>Premature rapture of membrane</b>			
No	193(95.1)	85(86.7)	<b>0.03</b>
Yes	10(4.9)	13(13.3)	<b>0.03</b>
<b>Previous CS</b>			
1	146(71.22)	74(75.5)	0.42
>1	59(28.8)	24(24.5)	0.42

The most common bacterial isolates were *Staphylococcus aureus* 28.8%, followed by *E. coli*, 21%. The least was *Proteus mirabilis*.

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**Table 4: Common bacterial isolates from septic wounds in KIUTH**

Pathogen	Frequency	Percent	95%CI
<i>Pseudomonas aeruginosa</i>	43	15.3	11.5-20.0
<i>Staphylococcus aureus</i>	81	28.8	23.8-34.4
<i>E. coli</i>	59	21.0	16.6-26.2
<i>Proteus mirabilis</i>	24	8.5	5.8-12.5
<i>Staphylococcus spp</i>	35	12.5	9.1-16.9
<i>Klebsiella pneumoniae</i>	39	13.9	10.3-18.5

## DISCUSSION

High level of education (primary and post primary) was a significant predictor of post- cesarean wound sepsis among non-referred patients. This contrary to findings by Paschal *et al* from Northern Ghana where mothers with higher level education were less likely to experience post caesarian sepsis compared to those with primary and lower education [19]. Our findings could be explained by non-compliance of educated mothers towards health education offered by health workers; in our setting there is the “we know it all” among the educated mothers (especially secondary school education) as compared to mothers with no formal education. Also it may be due to increased maternal requests for cesarean sections which is a risk factor for post-cesarean wound sepsis among educated mothers [20]. However, our findings are consistent with those obtained by Rajab *et al* in South Western Iran where mothers that had attained high school education were 1.4 times likely to have post-cesarean section than those with lower school [21], and this suggests higher risk of post-cesarean wound sepsis among this group.

Behaviourally, mothers (non-referred) who reported having over 2 baths per day were more likely to experience post-cesarean wound sepsis compared to their counterparts who reported to have two or less number baths per day. This is against biological plausibility and it is possible that baths taken may be unhygienic as our participants were culturally oriented who incorporate herbs in their baths and this increases chances of microbial contamination of the wound post caesarian section [22]. Additionally, the study participants were from low-income background and possibility of having no recommended bathing soap is likely. There is need to sensitise such mothers against use of herbal concoctions in their baths.

Mothers who experienced more than four vaginal examinations had increased risk of post caesarian sepsis compared to mothers who experienced less than 4 vaginal examinations. Our findings are consistent with findings by Hassan *et al* obtained among mothers attending Port Harcourt Teaching Hospital, Southern Nigeria [16]. The similarity is the highest delivery rate between the two hospitals; KIUTH and Port Harcourt teaching Hospital. Frequent vaginal examinations are likely to introduce microbial pathogens during examination into uterus through the vagina.

In our study, mothers who were HIV positive were more likely of developing post-cesarean wound sepsis compared to HIV sero-negative mothers. Our findings are similar to those obtained by Marsel in Tygerberg Hospital, South Africa where HIV ART naïve patients were about 6 times more likely to experience post-cesarean sepsis [23]. This is can be explained by immunosuppression associated with HIV positivity that facilitate bacterial infection in such mothers.

In our study, mothers who had a prior caesarian section were more likely to have post-cesarean wound sepsis compared to those with no prior caesarian section. The explanation could be explained by several reasons: There are high chances of prolonged caesarian section for mothers with prior Caesarian section due to fibrosis and adhesion. Also, prolonged CS is likely to result into severe bleeding leading to anemia, delayed or no ambulation that have a significant role on risk of Post Caesarian sepsis.

We found out that antiseptic use (Savlon) was protective against post caesarian wound sepsis among referred mothers and this is so because most of these mothers are from refugee camp (Kyangwali refugee resettlement) where they are supported with supplies like antiseptics. Our findings are consistent with those found by Kawakita and Landy in their review paper where use of Chlorhexidine (similar ingredient for savlon) as antiseptic was protective against post-cesarean wound sepsis [24].

We found that single mothers were more likely to have post caesarian wound sepsis compared to the married mothers. This is possible because such mothers have got reduced care and support as compared to married ones.

Mothers of Anglican Faith were 64% less likely to have post caesarian sepsis compared Catholics. In Anglican settings, there are formed groups such as Mother’s Union which hold regular discussions /guidance about maternal health and hygiene among other activities. This has a bearing on reducing post caesarian sepsis. Conversely catholic faith is liberal about alcohol consumption and this may have an implication on the risk of post caesarian wound sepsis among the catholic mothers.

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In our study, coliforms showed high susceptibility to Imipenem followed by *Staphylococcus aureus* to Ciprofloxacin and this is comparable to a study done in Mbale Regional Referral Hospital [25]. Furthermore, the study also showed that *Staphylococcus aureus* and other coliforms were resistant to Ciprofloxacin, Ceftriaxone, gentamycin and Cotrimoxazole. This may be attributed to the fact that these drugs were the most erroneously prescribed medications in KIUTH. The study also showed that *Staphylococcus aureus* was also resistant to Tetracycline and Penicillin which was in agreement with a study conducted by [26]. That showed over 80% antibacterial resistance to Penicillins and its derivatives in postpartum mothers of Uganda. In addition, a study done in Mulago National Referral Hospital revealed a development of *Staphylococcus aureus* methicillin resistance in post-caesarean wound sepsis [27]. However, a study conducted in Tanzania reported a high resistance of *E.coli* to Gentamycin [28].

## CONCLUSION

The prevalence of wound sepsis at KIUTH is 16.8%. The major significant risk factors of post-caesarean wound were being educated, history of previous cesarean section, hygiene, obstructed labor, HIV seropositivity and multiple vaginal examinations prior to surgery. The most common bacterial pathogens were *Staphylococcus aureus* and the least was *Proteus mirabilis*. Resistance was highest for coliforms and *Staphylococcus aureus* against, ciprofloxacin, gentamycin, ceftriaxone and cotrimoxazole.

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