#### **Original Research Article**

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# Characteristics of patients presenting with septic wounds in selected hospitals in Kajiado County, Kenya

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#### **ABSTRACT**

**Background:** Wound management is a serious global health problem. The objective of this study was to describe the characteristics of patients presenting with septic wounds in selected hospitals in Kajiado County, Kenya, and their association with selected factors.

**Methods:** We purposively sampled 182 patients with septic wounds and collected data using questionnaires whose statistical relationship between various patients' characteristics, including the data collected Likert-scale design was assessed.

**Results:** A majority (73.1%) of the patients presented with one wound. Most (54.4%) of the wounds were located on the lower limbs and mainly (23.1%) caused by road traffic accidents. The majority of the wounds had lasted for 1-2 weeks at the time of presentation, and the wound sizes were mainly >11 mm. We found a significant association (p<0.05) between number of wounds and age, marital status, and highest education level. The wound causes were significantly associated with gender, age, occupation, and sub-county of residence. Wound duration was significantly associated with understanding prescribed medication, adherence to dosage, water source, alcoholism, and cigarette smoking. Wound improvement was significantly associated with patients' understanding of the prescribed medication, adherence to dosage and water source, alcoholic status, and cigarette smoking.

**Conclusions:** Individual patient, social and cultural factors were associated with septic wounds characteristics, suggesting that addressing them at the individual level using proper hygiene and cleanliness at home and workplaces is key. Policies to reduce traffic accidents, increase literacy, and promote healthcare access need to be promoted to reduce the wound sepsis burden.

Keywords: Septic wound, Sociodemographic, Patients, Individual factors, Clinical factors

#### INTRODUCTION

Wounds occur following disruption of the skin, which can be intentional or accidental—the subsequent wound infections become a burden for both the patient and the health services. To the patient, it causes pain, discomfort, inconvenience, disability, financial drain, and even death due to complications such as septicemia. The human wounds burden is high, with approximately 8.2 million people having wound infections worldwide. In contrast,

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the healthcare burden ranged from USD 28.1 to 96.8 billion by the end of 2018.2 Globally, the rate of septic wound infections ranged between 2.5-17.4%, with the highest rate in the developing countries partly due to their higher exposure to bacterial infections.3 The most common bacterial pathogens associated with wounds Pseudomonas include S. aureus, aeruginosa, Streptococcus pyogenes and Enterococci, with the prevalence of S. aureus infected wounds ranging from 1.4% to >35% in Africa.<sup>4,5</sup> Studies have also reported a high prevalence of up to 24.4% of wounds in developing countries such as Nigeria, with Staphylococcus aureus (40.3%) being the most dominant bacterial infection in Africa.<sup>6</sup> Hospitalization of the patients with septic wounds varies between 2.5% and 14.8% of the general population in African countries such as Algeria, Burkina Faso, Senegal, Tanzania, and Nigeria.<sup>7</sup> A study conducted at Agha Khan University Hospital in Kenya showed that S. aureus is the most prevalent bacterial infection of wounds in Kenya. This bacterial species remains a crucial source of health burden in the country.<sup>8</sup> A study in Kenya shows that S. aureus infection of wounds is more prevalent in publicly funded healthcare facilities, with a prevalence of 21-30%. 9 A study conducted in Thika Level 5 Hospital demonstrated that a large proportion of S. aureus from septic wounds are resistant to commonly used antibiotics. This significant health burden could contribute to antimicrobial resistance in Kenya. 10

Wounds are highly susceptible to bacterial infections if immediately not managed. The wound infection triggers the patient's immune response causing inflammation and tissue damage and a slow healing process. While minor scratches on the skin could self-cure, unmitigated septic wounds could become severe. Pathogens access wounds through direct contact, airborne dispersal, and self-contamination. Despite the known wound burden in Kenya, studies on the characteristics of the affected patients presenting with septic wounds and associated factors are limited. We designed and implemented this study to fill this gap.

#### **METHODS**

#### Description of study area

The study was conducted in Kajiado County Referral Hospital, Ongata Rongai Sub-County hospital, and Ngong Sub-County Hospital which serves Kajiado County with a human population of about 687,312 and an area of 21,292.7 km². KCRH is a Kajiado County Ministry of Health facility located in Kajiado Town, 76.4 km from Nairobi City. The facility has a bed capacity of 200 and serves an average of 400 patients, with a total number of 150 inpatients and 250 outpatients daily. NSCH is located in Ngong Town, 26.2 km from Nairobi City, and has a bed capacity of 80, serving an average of 300 patients per day, with a total number of approximately 50 inpatients and 200 outpatients on daily

basis. NSCH is the main healthcare facility in Kajiado North Sub-County. On the other hand, ORSCH is a health facility located in Ongata Rongai Town in Kajiado North sub-county, Kajiado County, about 22 km from Nairobi City. The hospital serves inpatients with a bed capacity of 40 and approximately 250 outpatients daily.

#### Study design and sample size determination

A cross-sectional study hospital-based design was adopted with the aid of a questionnaire as the data collection instrument. The sample size was calculated using Fishers et al. (1998) 's formula expressed as n=Z<sup>2</sup> pq/d<sup>2</sup> whereby n is the desired sample, Z is the standard normal deviation of 1.96 corresponding to 95% confidence level, p is the proportion of the target population taken to be 47% (Gitau et al. 2018), d is the degree of accuracy of  $\pm 0.05$ , and q (1-p) is 0.53. Thus, n=383. Since the target population was less than 10,000 (Fishers et al. 1998), the second formula was introduced to get the sample size (nf) as follows: nf=n/(1+n/N)where n is the desired when the population is above 10,000, and N is the estimated average monthly population of patients with wounds visiting KCRH, NSCH, and ORSCH, which was 268. Using the Fishers formula, the minimum desired sample size was 158 but the study collected 182 samples.

#### Recruitment of patients and inclusion criteria

Systematic random sampling technique was used to recruit the sample from the target population by dividing the sample population (268) by the desired sample (158), giving 1.7, which shows that the random starting point of 112, and applying a skipping interval method to select the next subject. From unpublished records from Kajiado (KCRH), Ngong (NSCH), and Rongai hospital (ORSCH) registry departments show an average of 268 registered inpatients per month with wounds. From these figures, the study selected a total of 75 patients from KCRH and 46 from NCRH, and 61 from ORSCH.

We recruited patients with septic wounds visiting Kajiado Level 5 and Ngong level 4 hospitals consenting to participate in the study. Wounds were likely to be sustained from active surgical site infections (SSI), infected skin ulcers or burns, skin abscesses, diabetic foot ulcers, decubitus ulcers, and other wound infections. These patients covered both inpatients and outpatients.

The exact study period from data collection to completion of analyses covered January 2020 to February 2021.

#### Administration of questionnaires

The questionnaires were administered physically using face-to-face and paper-to-pencil strategy to the study subjects. The questionnaire forms were distributed to the respondents who could read and speak both English and Kiswahili. Those who had a limited literacy level were assisted to read and understand the questions to aid accuracy of their response without any form of influence. The parents or guardians of minors (under 18 years) responded on their behalf to the questions after providing informed consent.

#### Statistical analysis

The data collected using the questionnaire forms was entered into MS Excel (Microsoft, United States), cleaned, and then exported to Statistical package of social science (SPSS 25.0 IBM, United States) for further statistical analysis. Descriptive statistics were used to analyse the characteristics of wounds. Pearson's Chi-Square test with Phi and Cramer's V was used to assess the association between various demographic information and patients' characteristics.

#### Ethical clearance

Jomo Kenyatta University of Agriculture Technology-Ethical Review Committee approved the study. Kajiado County Ministry of Health administrative offices and hospital ethical committees provided permission to research the three hospital settings. The researchers sought the consent of the patients who presented with wounds in Kajiado County Referral Hospital (KCRH), Ngong Sub-County Hospital (NSCH), and Ongata Rongai Sub-County Hospital (ORSCH) to participate in the study and only those who agreed out of their own will were included in the study. The study subjects' rights to privacy and confidentiality were protected by giving them unique numbers e.g. KCRH001, KCRH002, KCRH003, etc., and the same was applied for NSCH and ORSCH, respectively.

#### **RESULTS**

#### Nature septic wounds and treatment approaches

The nature of the sustained wounds was defined by the number of wounds, location on the body, and cause of the wound, and size of the wound. In descending order, the majority of the respondents had one wound (73.1%), followed by two wounds (17.0%), three wounds (2.7%), and the least affected had four wounds and above (3.3%). Based on the location of the wound, majority of the wounds were located on the lower (54.4%) and upper limbs (25.8%). In other cases, wounds were located on genitalia (6.0%), trunk (4.9%), and head (4.9%). The main causes of the wounds were road traffic accidents (23.1%), burns (14.8%), and household trauma (10.4%). Other causes of wounds were those sustained from cellulitis (14.8%), abscesses (12.6%), farm trauma (8.8%), post-surgical wound (3.3%), and other causes (4.4%). Based on the duration of the wound, majority of the patients had the wound (s) for 1-2 weeks (39%) and less than a week (35.7%) while others had sustained their wounds for 3-4 weeks (11.0%) and a substantial proportion (9.9%) had wounds for more than 4 weeks. The results showed that majority of the patients (30.2%) had the size of the wounds ranged from 11 mm to 20 mm and those with wound size ranged from 41mm to 50mm (19.8%). More than 50 mm (23.6%) and 41-50 mm (19.8%). More than half of the patients (57.1%) had large-sized wounds of more than 30 mm.

# Relationship between cause of the wound and age, gender, occupation, and sub-county of residence

The study also investigated the association between the cause of wound and specific sociodemographic factors such as age, gender, occupation, and sub-county of residence.

Table 1: Association between demographics and number of wounds sustained in the body.

Independent variables (IVs)	χ² value	df	Phi value	Cramer's V	P value
Gender	4.479	3	0.161	0.161	0.214
Age bracket	31.335	12	0.427	0.246	0.002
Marital status	22.685	9	0.361	0.208	0.007
Sub-county of residence	20.843	15	0.345	0.199	0.142
Highest education level	23.804	12	0.369	0.213	0.022
Occupation	26.769	18	0.392	0.226	0.083
Contact with animals	8.690	6	0.229	0.162	0.192
Monthly household income	19.081	18	0.332	0.192	0.389

Dependent variable: number of wounds sustained in the body.

Table 2: Relationship between cause of the wound and age, gender, occupation and sub-county of residence.

Independent variables (IVs)	χ² value	df	Phi value	Cramer's V	P value
Gender	33.301	9	0.440	0.440	0.000
Age bracket	104.392	36	0.779	0.390	0.000
Occupation	75.699	54	0.660	0.269	0.027
Sub-county of residence	74.494	45	0.652	0.292	0.004

Dependent variable: cause of the wound.

Table 3: Relationship between wound duration and demographic characteristics of patients.

Independent variables (IVs)	χ² value	df	Phi value	Cramer's V	P value
Gender	11.988	3	0.265	0.265	0.007
Age bracket	25.914	12	0.389	0.225	0.011
Marital status	24.072	9	0.373	0.216	0.004
Sub-county of residence	22.058	15	0.356	0.206	0.106
Highest education level	18.579	12	0.327	0.189	0.099
Occupation	38.119	18	0.469	0.271	0.004
Contact with animals	7.900	6	0.219	0.155	0.246
Consumption of raw milk	12.160	3	0.281	0.281	0.007
Monthly household income	32.682	18	0.436	0.252	0.018
Type of house	32.162	6	0.430	0.304	0.000

Dependent variable: wound duration.

Table 4: Relationship between wound improvement after first treatment and patients' medical factors.

Independent variables (IVs)	χ² value	df	Phi value	Cramer's V	P value
Tetanus vaccination status	4.743	2	0.169	0.169	0.093
Understanding prescribed medication	46.520	4	0.529	0.374	0.000
Adherence to dosage	63.444	4	0.618	0.437	0.000
Presence of chronic diseases in family	2.657	2	0.129	0.129	0.265
Water source	23.770	8	0.380	0.268	0.003
Alcoholic status	10.652	2	0.253	0.253	0.005
Cigarette smoking status	6.615	2	0.200	0.200	0.037

Dependent variable: wound improvement after treatment.

Gender was significantly ( $\chi^2(9)=33.301$ , p<0.001) associated with the cause of the wound among the patients, and the strength of association according to both phi and Cramer's V was significant (0.440, 44.0%). Age bracket of respondents the is significantly  $(\chi^2(36)=104.392, p<0.001)$  associated with the cause of the wound(s), and the strength of association was high (phi=0.779 (77.9%). The results also showed a statistically  $(\chi^2(54)=75.699, p=0.027)$ significant relationship between occupation and the cause of the wounds, and phi's strength of relationship was above average (0.660 (66.6%), The cause of the patients' wounds was significantly ( $\chi^2(45)=74.494$ , p=0.004) associated with their sub-counties of residence, and the strength of relationship was high (phi=0.652, (65.2%) (Table 2).

## Relationship between wound duration and patients' demographics

Duration of the wound is the period from the time the wound was sustain to the time of the sample collection. The study was interested to know the association between the wound duration and sociodemographic characteristics of patients such as gender, age bracket, marital status, sub-county of residence and highest education level; as well as socioeconomic characteristics such as occupation, contact with animals, consumption of raw milk and household income (Table 3). The duration of the wound was significantly ( $\chi^2(3)$ =11.988, p=0.007) associated with the patients' gender although the strength of relationship

was low (phi=0.265 (26.5%). Age bracket of the respondents significantly ( $\chi^2(12)=25.914$ , p=0.011) related to wound duration with relationship strength of 0.389 (38.9%). Marital status of the patients significantly  $(\chi^2(9)=24.072, p=0.004)$  associated with the wound duration. Other demographic factors that had statistically significant association with the wound duration were occupation of the respondents ( $\chi^2(18)=38.119$ , p=0.004, r=0.469), consumption of raw milk ( $\chi^2(3)=12.160$ , p=0.007) r=0.281, monthly household income  $(\chi^2(18)=32.682, p=0.018, 0.436)$  and type of house  $(\chi^2(6)=32.162, p<0.001, r=0.430)$ . However, demographic characteristics such as sub-county of residence, highest education level, and contact with animals did not have a significant (p>0.05) association with the duration of sustaining septic wounds in the body.

# Association between wound improvement and medical characteristics of patients

The study also investigated the association between wound improvement after treatment and various medical characteristics of the patients with septic wounds. The medical characteristics included tetanus vaccination status, understanding prescribed medication, adherence to dosage, presence of chronic disease in the family, source of water for domestic, alcoholic status, and cigarette smoking status (Table 4). The results provided a statistically significant association between wound improvement after treatment and patients' medical factors such as patients' understanding of the prescribed

medication ( $\chi^2(4)$ =46.520, p<0.001, r=0.529), adherence to dosage ( $\chi^2(4)$ =63.444, p<0.001, r=0.618 and water source for domestic use ( $\chi^2(8)$ =23.770, p=0.003, r=0.380). Furthermore, wound improvement after treatment was significant associated with the patient's alcoholic status ( $\chi^2(2)$ =10.652), p=0.005) and cigarette smoking status ( $\chi^2(2)$ =6.615), p=0.037). However, other medical factors such as tetanus vaccination status and the presence of chronic diseases in the family did not have a significant association (p>0.05) with wound improvement after treatment.

#### DISCUSSION

Sociodemographic characteristics such as age, marital status, and highest education were significantly associated with the number of wounds in the body. Duration of the wound was also associated with age, marital status, occupation, type of residence, and consumption of raw milk. There was a significant association between cause of the wound and sociodemographic and socioeconomic characteristics such as gender, age occupation, and subcounty of residence. Wound improvement significantly associated with the health-seeking behaviour such as patient's understanding of the dosage, source of water for domestic use, alcohol consumption and cigarette smoking. The results imply that public health policies for controlling prevalence of septic wounds in Kajiado County have given limited consideration to sociodemographic and socioeconomic characteristics. It also shows that the health-seeking behaviour of patients with septic wounds are poor leading to prevalence of wounds, especially among the low-income people in the county. Lack of consideration to patients' characteristics in developing public health policies may lead to more prevalence of septic wounds in the future.<sup>13</sup>

Wound infections are common across all age groups leading to disease burden on both the patient and the health sector. 13 This study also showed that the number of wounds on patients increased with their age. A similar study of wound infection in Ethiopia revealed that wound infections were more prevalent among those aged 40 years and above.<sup>14</sup> Aging induces dysregulation of the body's immune system thereby increasing susceptibility of wounds to bacterial infections. 15 Further, as revealed in previous studies, the immune system tends to be compromised in the elderly, increasing wound duration which is similar to what was reported in this study. 16 The study also revealed the location and cause of wound were significantly associated with age bracket. These findings are similar to previous studied showing age, gender, occupation and marital status significantly influenced wound location and cause.<sup>17</sup>

The present study also showed that wound cause and infection is associated with the gender of the patients. The distribution of the participants in this study based on gender revealed that males had more wounds than female respondents. A study of wound infection in the Ethiopian

context revealed that 61% of males sustained wounds against 39% females 14, suggesting that males are more susceptible to sustaining wounds than females in the Sub-Sahara region. Majority of the males are doing laborintensive works in Kajiado County such as cattle herding, building and construction works, motorbike riding, farming, and agribusinesses. These kinds of jobs are not only labour intensive but they increase exposure of men to hazardous materials leading to sustenance of wounds. The number of married men with septic wounds was considerably higher than respondents with other marital status and gender. As shown by other studies, married men could have increased responsibilities and activities which predispose them to wounds. 14,18

Labour intensive jobs not only lead to wound acquisition but also escalate the potential for wound infection and protracting wound healing as well.<sup>15</sup> Labour intensive jobs are likely performed by persons with low education levels. In this study, persons attaining low education levels reported a higher number of wounds relative to those attaining higher education levels. Labour intensive jobs constitute unskilled manual works that expose workers to hazards and injuries, leading to the acquisition of wounds. These jobs correspond with low incomes that are reported to influence delayed medical seeking behaviour and accelerating wound sepsis.<sup>19</sup> Indeed, the number of patients with septic wounds was high among households earning between USD 50 and USD100 a month. According to, households earning low-incomes from labour intensive jobs were at a higher risk of acquiring injuries that generated wounds.<sup>20</sup> Besides, the low hygiene and sanitation in low skilled workplaces exposes the wounds to infection due to their permissive environments of bacterial proliferation.

Majority of the patients took up to two weeks' post acquiring the wounds before seeking medication. This protracted period without treatment increases bacterial load on the wounds causing them to be septic, delaying favourable wound healing outcomes and raising healthcare burden to hospitals. 14,21 Patient's understanding of the medication and adherence to dosage were associated with wound healing. Low literacy level among patients impairs their understanding of the importance of seeking medication without delay and adherence to the prescribed medication. Previous findings show health literacy influences medication adherence and hence quality of life.<sup>22</sup> In this study, most of the patients visited a hospital 3-5 times in one year suggesting the possibility of wound reinfections after treatment. Previous studies have reported that poor medication adherence could lead to reinfection, worsening of the wound condition, and increased cost of healthcare among patients whose wounds are infected by staphylococcus aureus infections of wound.<sup>23</sup> Besides, source of water for domestic use was associated with wound healing. Kajiado County is among arid and semi-arid areas in Kenya where accessing clean water is a problem. Using contaminated water at home may slow the wound healing process through infection.<sup>24</sup> Alcoholism and smoking known to be among

the factors slowing wound healing, especially among alcoholic users who tend to have poor eating and health habits that compromise immunity which is critical in the wound healing process.<sup>25</sup>

#### Study limitations

This study was a cross-sectional study, therefore we could not make inferences since the data was collected at a particular time point and the occurrence of wounds could not be established. In addition, we purposively sampled patients from hospitals, hence our findings are not population representative.

#### **CONCLUSION**

This study concluded the existence of a burden of body wounds, mainly caused by road traffic accidents, with most of the wounds located on the lower limbs. The wounds lasted for one or two weeks, presenting in different wound sizes. The number of wounds were significantly associated with age, marital status and education level. Additionally, the wound cause were significantly associated with gender, age, occupation and sub-county of residence. Moreover, while the wound duration was significantly associated the understanding of prescribed medication, adherence to dosage, water source, alcoholism and cigarette smoking, wound improvement associated with patients' understanding of the prescribed medication, adherence to dosage and water source, alcoholic status, and cigarette smoking. Further, this study advances the knowledge and understanding in the field by advocating for better policies to influence wound sustenance including increased access to proper wound management, education, universal healthcare plan, in combating wound sepsis.

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