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**Determinants of Health Outcomes of Patients Presenting with
Massive Traumatic Bleeding in the Emergency Department in
Selected Hospitals in Kiambu County, Kenya**



Determinants of Health Outcomes of Patients Presenting with Massive Traumatic Bleeding in the Emergency Department in Selected Hospitals in Kiambu County, Kenya

 ^{1*}Odaro Anne Edith, ²Dr. Alfred Owino Odongo, ³Dr. Josphat Njuguna

^{*1}College of Health Sciences, School of Clinical Medicine, Mount Kenya University, Thika, Kiambu County, Kenya.

<https://orcid.org/0000-0002-6482-2981>

²College of Health Sciences, School of Public Health, Mount Kenya University, Thika, Kiambu County, Kenya.

³College of Health Sciences, Medical School, Mount Kenya University, Thika, Kiambu County, Kenya.

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ABSTRACT

Purpose: The study sought to identify the determinants of the health outcomes of patients presenting with massive traumatic bleeding in the emergency department of selected hospitals in Kiambu County, Kenya.

Methods: The research employed an analytical cross-sectional study design, utilizing quantitative data. Data was collected using a questionnaire, an observation checklist, and extraction of secondary data from patient records. A census sampling was done. The collected data underwent analysis using IBM SPSS version 26. Simple linear regression and multiple logistic regression analysis was used to analyze the data.

Results: Regarding the health outcomes of patients presenting with massive traumatic bleeding, three outcomes were observed: 68.39% of the patients were discharged in fair general condition (FGC), 21.70% were referred and 9.90% were deceased. The experience of the healthcare workers, 11.6% of the variability of the health outcome of the patient is explained by experience of healthcare workers (p -value = 0.0138). Comparing the health outcomes in the two facilities, there was no difference in health outcome ($p < 0.001$). According to the multinomial logistic regression the results indicate that age is a significant predictor of the deceased outcome ($B = 0.064$, $p = 0.014$). Therefore, age is the most significant predictor of the health outcomes of patients presenting with massive traumatic bleeding.

Unique Contribution to Theory, Policy and Practice: To reduce poor health outcomes of pediatric and geriatric patients, it is recommended that a specific area in the emergency department should be set aside for the trauma patients in these age categories. Due to adding special areas in the emergency department, more staff and resources will need to be allocated to the emergency department.

Key words: *Emergency medicine, Hemorrhage, Trauma*

I. INTRODUCTION

According to JPAC (2020) massive bleeding is defined as bleeding the whole volume of blood in circulation in a 24-hour period, or more than 50% of the volume of blood in circulation in a 3-hour period, or more than 150 milliliters per minute, or more, to the point where transfusions of plasma and platelets are required.

In accordance with the guidelines provided by the ^[1]Centers for Disease Control and Prevention (CDC), August 2012, roughly 5,000,000 of the world population lose their lives every year because of trauma secondary to accidents or trauma that is not related to accidents. Trauma, therefore, accounts for most deaths in people who are forty-five years old and below. A 2013 review by the CDC estimates about 30 percent of patients who suffer from trauma die within 24 hours. Approximately one-third of these fatalities result from significant hemorrhaging. Hemorrhage is associated with both the danger of the patient dying instantaneously and increased morbidity and mortality due to disseminated intravascular coagulopathy (DIC), hypothermia and acidosis; as well as prolonged hospital stay. Immense bleeding continues to be a leading cause of possibly avoidable fatalities. If bleeding was managed adequately, about 10-20% of these patients could survive ^[2](Vymazal, 2015).

According to ^[3]Ojuka. et al (2018), majority (52.1%) of the patients who presented with traumatic bleeding at Kenyatta National Hospital (KNH) developed coagulopathy and this accounted for prolonged hospital stay and mortality. Furthermore, DRC strategies are not set in place or followed therefore there is increased mortality from massive bleeding. The result is prolonged hospital stay and increased mortality from traumatic bleeding. Nevertheless, there is an inadequate amount of information regarding the health results of individuals who arrive with extensive traumatic bleeding in Kiambu County, Kenya.

As reported by the ^[4]Indian Journal of Forensic Medicine and Toxicology in 2020 regarding Nurses' Knowledge on Bleeding Management, there exists a positive correlation between a nurse's knowledge of hemorrhage management and the accumulation of years of experience. A cross-sectional investigation carried out in Iran in 2020 to assess the knowledge, attitude, and practices of emergency department personnel in managing bleeding among trauma patients indicated that EMS staff had only a moderate level of knowledge in the field of bleeding management. The study emphasized the crucial importance of continuous education for EMS staff, given the life-threatening nature of bleeding and the critical role of their skills (Yasser et al, 2020). In a 2019 Tanzanian study conducted by ^[5]Al-beity et al on "Predictors of changes in the knowledge and skills of health workers following the Helping Mothers Survive Bleeding after Birth" intervention, health workers were randomly chosen.

^[6]Kalkwarf (2020) studied all trauma-related deaths in Harris County, Texas, in 2014. He noted that 56.2% of all the trauma patients who died in the well-developed trauma system died either

during pre-hospital care (35.8%) or within an hour of reporting to the trauma center (20.4%). He also noted that 34.5% of the deaths were potentially preventable deaths. In research conducted by [7]Adzemovic et al 2019, 5.2% of patients were admitted to level III and IV trauma centers, while 94.8% were transferred to a tertiary trauma center. The study observed that individuals referred to a tertiary trauma center for the management of traumatic bleeding had a lower mortality rate, with a hazard ratio of 0.69.

In a study done by [8]Takayama et al, (2020), on the impact of coagulopathy across different age groups, it was noted that people older than 65 were more likely to develop coagulopathy post intracranial bleeds as compared to people who were in the age bracket of 16 to 64. This indicates that the morbidity of traumatic bleeding in elderly patients is likely to be worse than that of younger patients. According to [9]Victorino et al (2003), an established risk factor for poor outcomes in trauma patients is advanced age. The close monitoring and strong treatment methods used by trauma teams can be beneficial for older individuals.

[10]Leeper et al (2018), studied 64,344 subjects under the age of 18 from the Pennsylvania Trauma Outcome Study registry. The median age of the children was 9 years with most children ranging from 4 – 15 years of age. 51% had been transferred from another facility. 2.0% died, 4.4% developed hypotension and were admitted and 1.6% were transfused at the trauma bay. It was reported that 46% of the children who developed hypotension died, 42% of the children who received transfusion died and 63% of children who both developed hypotension and received blood transfusion died.

STUDY OBJECTIVES

Broad Objective:

To assess the determinants of the health outcomes of patients presenting with massive traumatic bleeding in the emergency department in Thika Level 5 Hospital and Kiambu Level 5 Hospital in Kiambu County, Kenya.

Specific Objectives:

1. To determine the health outcomes of patients presenting with massive traumatic bleeding in Thika Level 5 Hospital and Kiambu Level 5 Hospital in Kiambu County, Kenya.
2. To assess how the experience of the healthcare workers impacts the health outcome of patients presenting with massive traumatic bleeding in Thika Level 5 Hospital and Kiambu Level 5 Hospital in Kiambu County, Kenya.
3. To determine the health facility factors in Thika Level 5 Hospital and Kiambu Level 5 Hospital that influence the health outcomes of patients presenting with massive traumatic bleeding in Kiambu County, Kenya.

4. To analyze how patient factors affect the health outcomes of patients presenting with massive traumatic bleeding in Thika Level 5 Hospital and Kiambu Level 5 Hospital in Kiambu County, Kenya.

II. METHODS

Study design: An analytical cross-sectional study design was employed the study. The data was quantitative in nature.

Setting: The location of the study was the two Tier 5 hospitals in Kiambu county; Thika level 5 Hospital and Kiambu Level 5 Hospital. The average bed capacity of the two hospitals is 250 beds. With approximately 357 clinicians on average. The study was done from March 2022 to June 2022.

Participants: Out of these two facilities a total population comprising of clinicians, theatre staff and laboratory technologists involved in emergency care of patients were selected to answer the questionnaires. Patient files were assessed to determine patient factors. The facilities were also observed to evaluate its ability to manage patients with massive traumatic bleeding.

Variables: The dependent variable was the health outcome (FGC, Referred or Deceased) of patients presenting with massive traumatic bleeding. The independent variables were experience of the healthcare workers, the health facility and patient factors (age and co-morbid conditions).

Data sources: To assess the knowledge and practices of the healthcare workers and their relationship to the outcomes of the patients presenting with massive traumatic bleeding, structured questionnaires were given to clinicians. The questionnaires included both open-ended and close-ended questions in order to achieve a balanced opinion from all participants. The researcher used observation to assess the facility factors and therefore employed an observation checklist. Secondary data from patient files was abstracted to assess the patient factors.

Bias: To evaluate the internal consistency of the questionnaire, the researcher utilized the Cronbach's alpha test, especially given the utilization of a Likert scale in numerous questions. The Cronbach's Alpha was $\alpha = 0.77344$, meaning that the internal consistency was acceptable. Data validation was done to find out whether the data collection was done as per the pre-set standards and without any bias. They were checked to determine if the respondents were interviewed or not (fraud), if the respondents were selected according to the set criteria, to check whether the data collection procedure was duly followed and to ensure that the interviewer asked the respondent all the questions.

Study size: 112 respondents involved in emergency patient care were located given that some staff were on leave and others were unavailable for various other reasons. A total of 212 patient files were reviewed ranging from June 2021 to March 2022.

Quantitative variables: These included years of experience of health care workers, number of beds in critical care of patients per facility and age of patients. Years of experience of healthcare

workers was extrapolated using a questionnaire. Number of beds for critical care was gotten by observation and age of patients was extracted from patient files.

Statistical methods: The gathered data was input into Microsoft Excel spreadsheets to streamline the data analysis procedure. Incomplete questionnaires were excluded from both the data entry and analysis stages. Subsequently, the data was imported into IBM SPSS version 26. Descriptive statistics were calculated for each data set and results presented in tables and charts. For the independent variables (experience of healthcare workers and facility factors), linear regression was done to determine if these variables fully or partially mediate the health outcome of the patient who presents with massive traumatic bleeding. For the independent variables (age and co-morbid conditions), multiple regression analysis was done for the quantitative variable (age) testing the relationship of the health outcomes across different age cohorts. For the categorical variable (co-morbid conditions), the researcher compared the statistical significance of the model in the patients with co-morbid conditions versus those with no co-morbid conditions to determine if co-morbidity moderates the relationship of the independent variable (patient factors) with the dependent variable (health outcome). The researcher employed logistic regression analysis to investigate the correlation between the patient's health outcome and factors such as age and the presence of co-morbid conditions. Data presentation involved the arrangement of data into concise, logical and tabulated formats.

Ethical approval was sought from the Mount Kenya University Institutional Ethical Research Committee (MKU ERC). This was followed by obtaining a permit from the National Commission for Science and Technology (NACOSTI) and approval to conduct the research was obtained from the medical superintendents of the respective hospitals.

III. RESULTS

Participants: The intended sample size was 148 respondents, however, only 112 respondents were located given that some staff were on leave and others were unavailable for various other reasons. A total of 212 patient files were reviewed ranging from June 2021 to March 2022.

Descriptive data: The participants involved in emergency care who returned the questionnaires included clinical officers (25), consultants (6), laboratory technicians (8), medical officers (16), nurses (40) and radiographers (3).

From the patient files, the majority of patients fell within the 21-30 years age range, accounting for 48.58% of the sample. Patients aged 20 years and below accounted for the next largest group, representing 20.75% of the sample. The remaining age categories each represented a smaller proportion of the sample, with the 31-40 years age group accounting for 16.04%, 51 and above years accounting for 10.85%, and the 41-50 years age group representing the smallest group at 3.77% of the sample. Out of 212 patients, 134 (63.21%) were male, and 78 (36.79%) were female.

Outcome data: Health Outcomes of Patients Presenting with Massive Traumatic Bleeding in the Emergency Department

The patient files were also assessed to find out the condition of the patient at discharge. 9.9% of the patients were deceased, 16.5% were referred and 73.6% were discharged in fair general condition.

MAIN RESULTS

Experience of Healthcare Workers

The respondents were asked to compare how clinicians who have varying years of experience in emergency care of patients were efficient in managing massive traumatic bleeding.

It was evident that efficiency of clinicians increased with increase in years of experience, with 32.65% stating that continuous medical education (CME) on management of bleeding was done annually, 31.63% stating that CMEs were done biannually, 18.37% stated quarterly and 17.35% stated monthly.

A linear regression analysis was done to test the relationship between the years of experience of the health worker to the health outcome of the patient presenting to the ED with massive traumatic bleeding.

The correlation (R) is 0.341, indicating a mild positive association between the experience of healthcare workers and the health outcome of the patient. The R-Squared (R²) is 0.1161, signifying that 11.6% of the variance in the health outcome of the patient can be attributed to the experience of healthcare workers [Table 1].

Table 1

Correlation between Experience of Healthcare Worker and Health Outcome

Correlations	Health Outcome of Patient	Years of Experience
Pearson Correlation	Health Outcome of Patient	.341
Sig. (1-tailed)	Years of experience	1.000
	Health Outcome of Patient	.000
N	Years of experience	.000
	Health Outcome of Patient	212
	Years of experience	212

Health Facility Factors Influence on the Health Outcome of Patients Presenting with Massive Traumatic Bleeding in the Emergency Department

In the WHO Guidelines for Essential Trauma Care (2004), the second most common reason for poor patient management in the emergency department was lack of organized trauma care. There is a notable link between absence of a management protocol including an efficient referral procedure of management of massive traumatic bleeding to poor patient outcome. Both hospitals met the WHO standards.

When a patient is admitted to Hospital B: the odds of being referred in comparison to discharge in FGC is: 0.3077. The odds of being deceased in comparison to being discharged in FGC is: 0.1692

Admission to Hospital A: will decrease the odds of being referred in comparison to being discharged in FGC by 46.4% (a.k.a. the odds will be multiplied by 0.5357). It will decrease the odds of being deceased in comparison to by 35.1% (a.k.a. the odds will be multiplied by 0.6494) [Table 2].

Table 2

Odds of Being Referred compared to Being Discharged in FGC

	Coeff	SE	z- stat	lower z0.025	upper z0.975	exp(b)	p-value
b ₀	-1.1787	0.2557	-4.6094	-1.6798	-0.6775	0.3077	0.000004037
Health facility	-0.6242	0.3782	-1.6503	-1.3654	0.1171	0.5357	0.09888

Odds of Being Deceased compared to Being Discharged in FGC

b ₀	-1.7765	0.3260	-5.4489	-2.4155	-1.1375	0.1692	5.068e-8
Health facility	-0.4318	0.4661	-0.9263	-1.3454	0.4818	0.6494	0.3543

A chi square analysis of health outcomes of patients in Hospital A and Hospital B was done.

The chi-square statistic is 3.2373. The p-value is .19817. The result is not significant at $p < .05$. We do not have sufficient evidence to reject H_0 . Thus, there was no difference in health outcome in hospital B as compared to hospital A since both were Level 5 hospitals [Table 3]. Additional observation needs recording.

Table 3*Chi Square Analysis Of Health Outcomes Of Patients In Hospital A And Hospital B*

	Value	df	Asymptotic (2-sided)	Significance
Pearson Chi-Square	3.237 ^a	2	.198	
Likelihood Ratio	3.228	2	.199	
Linear-by-Linear Association	2.245	1	.134	
N of Valid Cases	212			

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.51.
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Influence of Patient Factors on Health Outcomes of Patients when they Present to the Emergency Department with Massive Traumatic Bleeding

For the final model, the likelihood ratio tests show that both Age and Co-morbid conditions are significant predictors ($p < .05$) of Health Outcome. The significant chi-square statistics for these predictors suggest that their inclusion in the model significantly improves model fit compared to a model without these predictors.

For the Deceased outcome, the results indicate that age is a significant predictor of the outcome (deceased) ($B=0.064$, $p=0.014$), after controlling for comorbidities, indicating that for each one-unit increase in age, the log-odds of the outcome increase by 0.064, holding the other variables constant.

For the FGC outcome, age and comorbidities are significant predictors of the health outcome (FGC). The parameter estimates indicate that age has a positive effect on the odds of being discharged in FGC ($B=0.074$, $p<0.001$), after controlling for comorbidities, for each one-unit increase in age, the log-odds of the health outcome increase by 0.074 [Table 4]. The patients that were between the ages of 13-40 years of age had the highest likelihood of being discharged in FGC.

Table 4*Multinomial Logistic Regression Between Age and Co-morbidities and Health Outcome of Patient*

Condition of patient at discharge		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Deceased	Intercept	-2.980	1.305	5.216	1	.022			
	Age	.064	.026	6.028	1	.014	1.066	1.013	1.121
	[COMORBIDITIES =No]	.592	.885	.448	1	.503	1.808	.319	10.247
	[COMORBIDITIES =Yes]	0 ^b	.	.	0
FGC	Intercept	-3.483	1.099	10.046	1	.002			
	Age	.074	.021	12.306	1	.000	1.077	1.033	1.123
	[COMORBIDITIES =No]	3.714	.758	23.984	1	.000	41.012	9.277	181.306
	[COMORBIDITIES =Yes]	0 ^b	.	.	0

a. The reference category is: Referred.

b. This parameter is set to zero because it is redundant.

OTHER ANALYSES

A shorter transfer time of a patient from place of trauma to the hospital is dependent on quality pre-hospital care and it affects the health outcome of patients presenting with massive traumatic bleeding. The duration between trauma and emergency care for patients in Hospital A was significantly shorter than the duration between trauma and emergency care in Hospital B where some patients (9) received emergency care 8 – 9 hours after trauma. The majority of patients who were discharged in FGC were seen within 1 hour of their trauma. One unit increase in duration

between trauma and emergency care: will decrease the odds of being referred in comparison to being discharged in FGC by 0.1% (a.k.a. the odds will be multiplied by 0.9987). It will also increase the odds of being deceased in comparison to being discharged in FGC by 7.2% (a.k.a. the odds will be multiplied by 0.9275).

IV. DISCUSSION

KEY RESULTS AND INTERPRETATION OF STUDY

Statement of principle findings: Health outcomes of patients presenting with massive traumatic bleeding broadly fell in three categories, patient is discharged in a fair general condition the patient has prolonged hospital stay or referred to another facility for further care or the patient is deceased.

When you increase experience of healthcare workers by 1 year, the value of Health outcome of the patient increases by 0.252.

When a patient is admitted to Hospital B: the odds of being referred in comparison to discharge in FGC is: 0.3077. The odds of being deceased in comparison to being discharged in FGC is: 0.1692

Admission to Hospital A: will decrease the odds of being referred in comparison to being discharged in FGC by 46.4% (a.k.a. the odds will be multiplied by 0.5357). It will decrease the odds of being deceased in comparison to by 35.1% (a.k.a. the odds will be multiplied by 0.6494).

It was noted that the health outcome of a patient is influenced by age, with poorer outcomes in the patients at extremes of age.

Strengths and weaknesses of the study: The strength of the study lies in that the total population of patients presenting with massive traumatic bleeding in the two hospitals was taken therefore giving a good representation of expected health outcomes across different groups. The major weakness of the study is that the selected hospitals were both level 5 hospitals, therefore it may not be a good representation for highly urban settings and more rural settings.

Strengths and weaknesses in relation to other studies: When you increase experience of healthcare workers by 1 year, the value of Health outcome of the patient increases by 0.252. As per ^[11]Ratnawati et al. (2020), both work motivation and work experience exert a positive and substantial impact on employees' performance, with work experience playing a more prominent role, contributing to 67.6% of performance.

It was noted that the health outcome of a patient is influenced by age, with poorer outcomes in the patients at extremes of age. $p\text{-value} = 0.0002464$. Since $p\text{-value} < \alpha (0.05)$, H_0 is rejected. The data supports ^[9]Victorino et al (2003), that an established risk factor for poor outcomes in trauma patients is advanced age. The data further corroborates ^[12]Leonard et al.'s (2021) findings, where an analysis of patient characteristics, administered therapies, and clinical outcomes was conducted, involving a cohort of 449 children. He stated that children who had hypothermia and age-adjusted hypotension were more likely to bleed and had a poorer health outcome. However, children with

medical bleeding had a higher chance (65.2%) of developing complications than those with trauma (36.1%). Out of the 449 children, 82 children died and 86.5% of the deaths occurred within the first 24 hours.

GENERALIZABILITY

Discussion of important differences in results: ^[13]Grossman et al (1997), in his article on ‘Urban-rural Differences in Prehospital Care of Major Trauma’, he concluded that rural areas have lengthier response and transport times for professional, advanced life-support-trained paramedics responding to significant trauma occurrences than urban areas. The mean scene time was also longer in rural areas than urban areas ($p = 0.015$). The study did not put into account health facilities in rural setting therefore the health facility may have a bigger impact on the health outcome of the patient if rural facilities were factored in.

Meaning of the study: The study goes to show that there are three important factors that determine the health outcome of patients presenting with massive traumatic bleeding in the emergency department: the experience of the health care worker, the health facility and the patient factors. Patient factors (age and comorbid conditions) had the most significant impact on the health outcome, while the health facility had the least.

Unanswered questions and future research: The study was done in two level 5 hospitals in Kiambu county Kenya. It is still not clear if facility factors have a great impact therefore future research can compare the health outcomes in a level 6 hospital to a level 5 hospital or a level 5 hospital to a level 4 and below hospital.

V. LIMITATIONS

Sample size in the emergency department: Due to understaffing in the emergency departments of both hospitals, it posed a challenge to get an adequate sample to find significant relationships from the data. Therefore, the researcher used census in sampling of the staff in the emergency department.

VI. CONCLUSION

In conclusion, age and comorbidities are the most significant predictors of the health outcome patients presenting with massive traumatic bleeding in the emergency department in selected hospitals in Kiambu county ($p < 0.001$). Regarding the experience of the healthcare workers, 11.6% of the variability of the health outcome of the patient can be explained by experience of healthcare workers ($p\text{-value} = 0.0138$). Comparing the health facility factors in the two facilities, the chi-square statistic is 3.2373. The $p\text{-value}$ is 0.19817. The result is not significant at $p < .05$. We do not have sufficient evidence to reject H_0 . Thus, there was no difference in health outcome in hospital B as compared to hospital A since both were Level 5 hospitals. Additional observation needs recording. These findings highlight the importance of a comprehensive evaluation of

patients' medical history, including age and comorbidities, in determining the appropriate management and treatment strategies.

VII. RECOMMENDATIONS

In as much as this paper broadly assessed health care workers, health facilities and patient factors and their effects on the health outcomes of patients presenting with massive traumatic bleeding, it is also important to recognize that there are other issues beyond the ones discussed in this paper can affect the health outcomes of patients presenting to the emergency department with massive traumatic bleeding for instance staff numbers, specific infrastructure and patients with malnutrition and this can also affect the health outcomes of these patients. It is also recommended that development and testing of a protocol for management of patients with massive traumatic bleeding in a Level 5 Hospital facility can be researched so as to optimize patient management in such a set up with the available resources.

VIII: FUNDING

The study was funded fully by the chief researcher who is the corresponding author.

WHAT IS ALREADY KNOWN IN THIS TOPIC

- In 2010, Rossaint noticed that one third of trauma patients presenting with massive traumatic bleeding developed coagulopathy leading to multiple organ failure and death.
- According to Malone et al (2006), if massive traumatic bleeding is managed appropriately within the first 24 hours, coagulopathy and poor health outcomes of patients with massive traumatic bleeding would be avoided.
- According to Ojuka. et al (2018), majority (52.1%) of the patients who presented with traumatic bleeding at Kenyatta National Hospital (KNH) developed coagulopathy and this accounted for prolonged hospital stay and mortality. Furthermore, DRC strategies are not set in place or followed therefore there is increased mortality from massive bleeding.

WHAT THIS STUDY ADDS

- The findings of this study can directly benefit patients who present with massive traumatic bleeding in the emergency department by preventing associated complications.
- The recommendations may be incorporated by health facilities in the routines used in management of massive traumatic bleeding.
- The findings may also be included in the training of clinicians, first-aiders and other health workers in the support departments to optimize knowledge and skills on management of bleeding.

COMPETING INTEREST

The authors declare no competing interests.

AUTHORS CONTRIBUTION

Manuscript title: Determinants of Health Outcomes Of Patients Presenting With Massive Traumatic Bleeding In The Emergency Department In Selected Hospitals In Kiambu County, Kenya

Author 1: Odaro Anne Edith

- Conceived and designed the analysis
- Collected the data
- Contributed data analysis tools
- Performed the analysis
- Wrote the paper

Author 2: Dr. Alfred Owino Odongo

- Assisted in designing the analysis
- Contributed data analysis tools
- Supervised data management

Author 2: Dr. Josphat Njuguna

- Assisted in designing the analysis
- Contributed data analysis tools
- Supervised data management

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