

## Assessing the effect of “Stop the Bleed” training on external hemorrhage management by the lay first responders in prehospital settings in Kakamega County, Kenya

Dinnah Akosa Okwiri<sup>1</sup>  
Tecla Sum<sup>2</sup>

<sup>1</sup>okwiridinnah@gmail.com  
<sup>2</sup>tsum@mmust.ac.ke

<sup>1</sup>Texila American University, South America, <sup>2</sup>Masinde Muliro University of Science and Technology, Kenya

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### ABSTRACT

Trauma remains a major public health concern worldwide and contributes substantially to mortality and disability. Globally, an estimated 5–8 million deaths occur annually as a result of traumatic injuries. Among these, uncontrolled hemorrhage is a leading contributor to preventable trauma-related deaths. Early recognition and effective control of bleeding are critical in preventing complications and death following traumatic injury. In many low- and middle-income countries, bystanders and community members often serve as the first individuals to respond to emergencies before professional medical teams arrive. Their level of preparedness and practical skills in hemorrhage control, therefore, plays an important role in patient survival. The objective of this study was to assess the effect of “Stop the Bleed” training on external hemorrhage management by lay first responders in prehospital settings in Kakamega County, Kenya. The study was guided by the Health Belief Model and employed a quantitative approach using a quasi-experimental design. Sub-counties were selected using a census approach, while participants were recruited through simple random sampling. A total of 208 lay first responders participated in the baseline assessment prior to training. Baseline data was collected using structured questionnaires, simulated trauma scenarios, and observation checklists. Data analysis was conducted using SPSS version 28. The findings revealed considerable gaps in hemorrhage control practices among participants. 70.1% of the participants approached accident scenes without first assessing scene safety. Only 40% correctly applied direct pressure to control bleeding. The average time from injury to control of bleeding is approximately 24 minutes. An intervention was carried out by training them on external hemorrhage control skills. After training them on hemorrhage control using the “Stop the Bleed” package, post-training data was collected using similar tools used during the pre-training test. There was marked improvement in their practice. Factorial ANOVA showed post-training skills significantly influenced time to bleeding control ( $F = 5.18, p = 0.024$ ), while age, education, and their interaction were not significant. The study concludes that although bystanders are often the first to reach trauma scenes in resource-limited settings, many lack adequate skills in basic hemorrhage control. The “Stop the Bleed” training is effective in improving their skills. Therefore, the ministry of health and other stakeholders should implement the training widely in order to enhance community hemorrhage control during emergency trauma response in the county.

**Keywords:** External Hemorrhage, Lay First Responders, Pre Hospital Care, Stop the Bleed

### I. INTRODUCTION

Injury is a great health care problem that results to death of approximately 5-8 million people yearly worldwide (Holtz, 2023). It is the initial cause of disability and loss of life in individuals aged 1 to 44 years (Centers for Disease Control [CDC], 2017). Hemorrhage is the second leading cause of death in Trauma globally. (Chang et al., 2025) 94% of hemorrhagic deaths among adults occur within 24 hours of injury (Ishikura & Kitamura, 2017). Despite major advances in trauma care and medical devices, external hemorrhage continues to have significant morbidity and mortality to date. Early recognition and appropriate action is necessary to prevent complications and loss of life (Wollgemut et al., 2024). Hemorrhage is responsible for up to 40% of trauma deaths and 33% occur during the pre-hospital period. Studies on trauma support the need for early bystander intervention (Jones et al., 2023). The National Academies of Sciences estimated that 20% of trauma-related deaths may have been preventable with receipt of “optimal trauma care” and noted that the “greatest opportunity to save lives” is in the pre hospital setting (Bhaumik, 2025). In sub-Saharan Africa, hemorrhage is the most common reason for death among trauma patients, and shock contributes to organ failure (Evans, 2023). Early death from traumatic hemorrhage is preventable through early and quality resuscitation, beginning with pre hospital providers, and rapid transportation to definitive surgical care.

Practice and skill level of lay first responders in pre hospital external hemorrhage control constitutes a critical outcome variable. Effective practice includes timely recognition of life-threatening bleeding, correct application of direct pressure, appropriate wound packing techniques, proper tourniquet use, and prompt activation of emergency response systems. The quality of these practices directly influences morbidity and mortality outcomes (Nichols &

Horstman, 2022). However, the performance of these life-saving skills is influenced by several determinants. Key influencing factors include the level of knowledge regarding hemorrhage control, prior exposure to first aid or bleeding control training, educational level, availability of hemorrhage control equipment, previous experience with trauma situations, and perceived self-efficacy in emergency response (Hewett et al., 2024, Rossaint et al., 2023). Evidence suggests that individuals who receive formal training demonstrate significantly higher competency and confidence in hemorrhage management compared to untrained individuals (Abdul-Matinue, 2023).

Despite growing international advocacy for community-based hemorrhage control training, limited empirical data exist in many low and middle income settings regarding the actual practice and skill levels of lay first responders and the factors associated with these outcomes. Understanding how knowledge, training exposure, confidence, and resource availability influence hemorrhage management practices is essential for designing targeted interventions, strengthening community preparedness, and reducing preventable trauma deaths. Therefore, this study seeks to assess the practice and skills of lay first responders in pre hospital external hemorrhage control. Generating context-specific evidence will contribute to improving early trauma response systems and advancing strategies aimed at reducing preventable mortality due to traumatic bleeding.

### 1.1 Statement of the Problem

Globally trauma is the leading cause of death and disability. Both unintentional and violence related injuries take the lives of approximately four million individuals around the world each year and constitute almost 8% of all deaths (Peng et al., 2023). Bleeding is responsible for up to 40% of trauma deaths and 33% occur during the pre-hospital period (Ashwin et al., 2024). Studies on trauma support the need for early bystander response. The National Academies of Sciences estimated that 20% of trauma-related deaths may have been preventable with receipt of “optimal trauma care” and noted that the “greatest opportunity to save lives” is in the pre hospital setting (Kulkami et al., 2024, Koome et al., 2020). In sub-Saharan Africa, hemorrhage is the most common reason for death among trauma patients. Early death from traumatic hemorrhage is preventable through early and quality resuscitation, beginning with pre hospital providers, and rapid transportation to definitive surgical care (Bhaumik, 2025). In Africa, there is lack of well-coordinated and equipped ambulance transport, and patients often wait and evacuate for more than triple the international recommended response time (Botchey et al., 2017).

In Kenya 27.6% mortality rate for injury cases die from hemorrhage (Kobusingye et al., 2005). The most common cause of external bleeding in Kakamega County in road traffic accidents. Motorcycle transportation commonly known as “Boda”, is utilized in rural parts of Kenya due to poor infrastructure. Statistics from Kenya Police indicate that this mode of transport accounts for most road accidents hence severe hemorrhage warranting community intervention. No study has been carried out to explore the effect of “Stop the Bleed” training on improving hemorrhage control skills among bystanders in pre hospital settings in Kakamega County, Kenya.

### 1.2 Research Objective

The objective of this study was to assess the effect of “Stop the Bleed” training external hemorrhage management by lay first responders in pre hospital settings in Kakamega County, Kenya

### 1.3 Research Question

What is the effect of “Stop the bleed” training on external hemorrhage management by lay first responders in pre hospital settings in Kakamega County?

## II. LITERATURE REVIEW

### 2.1 Theoretical Review

#### 2.1.1 Health Belief Model

The Health Belief Model proposes that individuals are more likely to take action if they: Perceive a condition as serious (perceived severity), believe they are susceptible to encountering it (perceived susceptibility), believe action will reduce harm (perceived benefits), perceive minimal barriers to action (perceived barriers), are exposed to cues that trigger action and have confidence in their ability to act (self-efficacy). Lay first responders are more likely to intervene if they: recognize that severe bleeding is life-threatening, understand that early bleeding control prevents death, believe they are capable of performing bleeding control techniques, have access to necessary equipment. Health Belief Model supports this study by explaining how knowledge of hemorrhage severity and benefits of early intervention influences the likelihood of appropriate practice.

## 2.2 Empirical Review

### 2.2.1 Skills in Hemorrhage Control

A research by Hewett et al. (2024) revealed substantial enhancements in participants' proficiency in accurately applying tourniquets and executing wound packing after training sessions. The results indicate that specialized training can improve practical abilities necessary for bleeding management in prehospital environments. Rossaint et al. (2023) indicated that participants exhibited enhanced technical proficiency in simulation-based evaluations following bleeding management training. Their research highlights the prospective advantages of simulation activities in cultivating the competencies required for proficient bleeding control. A systematic review by Jones et al. (2023) determined that bystander first aid, including interventions like hemorrhage management, positively affects trauma outcomes before the arrival of emergency medical personnel. The review emphasized the significance of prompt intervention by lay responders in controlling hemorrhage and enhancing patient survival, while also acknowledging that the efficacy and results of these interventions may differ according to training and circumstances.

### 2.2.2 Relationship between Knowledge and Practice

Research indicates a positive correlation between information acquisition and the execution of practical skills, with self-efficacy significantly impacting the conversion of knowledge into action (Khakhuli, 2023). Khakhuli's (2023) study examined the effect of self-efficacy on competency-based teaching and learning outcomes, indicating that self-efficacy may influence learners' confidence, albeit it did not specifically assess hemorrhage management or lay responders. Abdelrahman et al. (2025) performed a comprehensive evaluation evaluating the effects of external bleeding control training courses on lay first responders in low- and middle-income countries, indicating that such training enhances participants' knowledge, skills, and attitudes. Reed et al. (2018) assessed a bleeding-control training program conducted with a rural police department, discovering that the program correlated with enhancements in responders' confidence and perceived readiness for hemorrhage care. Gowen et al. (2020) examined the incorporation of hemorrhage-control training in medical education curricula, highlighting its significance while acknowledging that the efficacy of such training is contingent upon factors including curriculum design and implementation.

Although these studies underscore the prospective advantages of hemorrhage management training, there is a paucity of research in sub-Saharan Africa that has recorded both pre- and post-training practice levels among lay first responders in real emergency contexts. Literature identifies bleeding as a significant preventable factor in trauma-related mortality, with early intervention by lay responders being seen advantageous, while the degree of impact fluctuates based on circumstance and execution.

## III. METHODOLOGY

### 3.1 Study design

This was a quantitative study. Experimental design was used. There was baseline assessment of the lay first responders' skills on management of external hemorrhage in the community. Quasi-experimental study design was used. Every participant's skills were tested in a simulation setting, external hemorrhage control skill gaps were identified. There was an intervention by training the participants on how to control hemorrhage using "stop the bleed package." After the training, the participants were subjected to a post-test to ascertain any changes in their skills hence assessing the effect of "Stop the Bleed" training on external hemorrhage management by lay first responders in pre hospital settings ,

### 3.2 Study Area

The study was conducted in 8 Sub Counties in Kakamega County, which is located in the Western part of Kenya. The County has both rural and urban settings. It has 12 Sub Counties. The most common means of transport is motor cycles due to the poor roads. Lay first responders (motor cycle riders locally known as "boda boda") in 4 Sub Counties had been earlier trained on first aid therefore they were excluded from this study.

### 3.3 Target Population

Lay first responders, (motor cycle riders) locally known as "Boda". The boda working on highways were selected because they witness road traffic accidents frequently. All the "boda bodas" operating on highways were approximately 4000 in total.

#### 3.3.1 Inclusion Criteria

People aged 18 years and above. People who signed consent to participate in the study and motor cycle riders operating on highways within the selected Sub Counties.

### 3.3.2 Exclusion criteria

People who had any priors training on hemorrhage control.

### 3.4 Sampling and Sample Size

The sample size was determined using Fisher's et al method. The calculated sample size was 215. However 208 respondents participated in the study because 7 dropped out. Census method was used to select 8 Sub Counties in Kakamega County. Simple random sampling method was used to select the motor cycle riders. Proportional distribution of the motor cycle riders across the Sub Counties was done.

### 3.5 Data Collection

Baseline data was obtained using structured questionnaires to assess lay first responders practice on hemorrhage control.

Furthermore, observation checklists were used to assess lay first responders' skills on external hemorrhage control in a simulation setting.

### 3.6 Data Analysis

Data were analyzed using SPSS version 28. Both descriptive and inferential statistics were applied. Paired t-tests were used to compare pre- and post-training performance, while factorial ANOVA was used to assess predictors of skill utilization.

### 3.7 Ethical Consideration

Ethical approval was sought from Institutional Scientific and Ethics Review Committee of Masinde Muliro University of Science and Technology. Research permit was obtained from the National Approval Research Committee of Science and Technology in Kenya. Permission to carry out research was sought from the County secretary and granted. Study participants signed informed consents, prior to participating in the study.

## IV. FINDINGS & DISCUSSION

### 4.1 Findings

#### 4.1.1 Socio- Demographic Characteristics of Study Participants

A total of 208 Lay First responders took part in pre training assessment. More than half, 67.8% were aged between 25 and 54 years (Table 1). More than two-thirds (69.2%) were married. The proportion of those who had attained primary (42.3%) or secondary (40.9%) level of education was comparable.

**Table 1**

*Socio-Demographic Characteristics of Study Participants*

Variable	Categories	N	%
Age group (in years)	< 25	35	16.8
	25 – 34	43	20.7
	35 – 44	54	26.0
	45 -54	44	21.1
	≥ 55	32	15.4
Marital status	Single	47	22.6
	Married	144	69.2
	Separated	5	2.4
	Divorced	1	0.5
	Widow	11	5.3
Level of education	None	22	10.6
	Primary	88	42.3
	Secondary	85	40.9
	College/University	13	6.2

#### 4.1.2 Skills in External Hemorrhage Management

Post-training, significant improvements were observed in all skills including calling for help, ensuring safety, applying PPE, direct pressure, tourniquet application, and pelvic binder use ( $p < 0.001$  for all). Average time to control bleeding reduced from 24 minutes to 8.7 minutes.

**Table 2***Lay responder skills pre- and post-intervention*

Variable	Before (Mean ± SD)	After (Mean ± SD)	t	p-value
Calls for help	0.4 ± 0.7	2.0 ± 0.3	-28.0	<0.0001
Ensure safety	0.4 ± 0.7	2.0 ± 0.3	-30.1	<0.0001
Apply PPE	0.5 ± 0.8	1.9 ± 0.3	-25.7	<0.0001
Expose & identify bleeding	1.1 ± 0.7	2.0 ± 0.3	-15.6	<0.0001
Direct pressure/control	1.5 ± 0.6	2.0 ± 0.2	-13.0	<0.0001
Pressure bandage	1.2 ± 0.7	2.0 ± 0.3	-13.6	<0.0001
Bandage securely	1.3 ± 0.7	2.0 ± 0.3	-13.2	<0.0001
Tourniquet 5–10cm above	0.4 ± 0.7	1.7 ± 0.5	-19.2	<0.0001
Record tourniquet time	0.3 ± 0.7	1.7 ± 0.6	-21.2	<0.0001
Pelvic binder	0.6 ± 0.8	1.9 ± 0.4	-20.7	<0.0001
Overall skill score	7.6 ± 4.4	18.9 ± 2.1	-32.6	<0.0001
Average time to control bleeding	24.1 ± 7.5	18.4 ± 8.7	7.23	<0.0001

**4.1.3 Knowledge Retention and Utilization**

Factorial ANOVA showed post-training skills significantly influenced time to bleeding control ( $F = 5.18$ ,  $p = 0.024$ ), while age, education, and their interaction were not significant.

**Table 3***Knowledge retention and utilization*

Variable	df	F	p-value
Post-training skills	1	5.18	<b>0.024</b>
Pre-training skills	1	0.06	0.806
Age	4	0.81	0.518
Education	3	0.88	0.454
Age*Education	10	0.86	0.572

**4.2 Discussion**

This study identified gaps deficiencies in baseline external bleeding management skills among by standers, with marked improvement following “Stop the Bleed” training program. The results exhibit both the vulnerability associated with untrained bystander response and the benefits of structured skill-based interventions in pre hospital care. According to the study, 70.1% of participants did not assess scene for safety before starting care. This contradicts standard emergency response principles, where scene safety assessment if the first priority. In a study carried out by Hillary and McGear (2026), it was noted that inadequate training and limited awareness contribute to unsafe practices among first responders in LMIC. Moreover, in most cases, bystanders prioritize immediate assistance over scene safety assessment, increasing the risk of becoming casualties (20). Approximately, 40% correctly applied direct pressure prior to the training this agrees with the study carried out by Thoolen and Maybritt (2023) which showed that effective bleeding control techniques were inconsistently performed in the absence of prior training. The baseline average time to bleeding control was 24 minutes, given the fact that massive hemorrhage can lead to death within a short timeframe if not promptly managed (Mock et al., 2015). In this study, there was marked improvement in external hemorrhage management this is similar to a study carried out by Lei et al., (2019) which showed that targeted training significantly increased participants’ ability to perform bleeding control techniques correctly. Furthermore, Zhu and Liu (2021) study findings showed sustained skill retention after training. The statistical analysis further revealed that post-training skill acquisition had a significant effect on reducing time to bleeding control ( $F = 5.18$ ,  $p = 0.024$ ). This is similar to a study conducted by Nichols and Hortsman (2022) where it was found that trained individuals not only performed better but also acted faster in simulated bleeding scenarios. Age and education level did not significantly influence post-training outcomes. This suggests that the training was equally effective across different population groups. . This concurs with the study carried out by Rafael et al. which found minimal differences in skill acquisition across age categories (Consunji et al., 2024). These findings illustrates that Stop the Bleed training can be broadly implemented without age or education boundaries.

## V. CONCLUSION & RECOMMENDATIONS

### 5.1 Conclusion

Bystanders play a vital role in early trauma intervention but often lack the necessary skills to respond effectively in Kakamega County, Kenya. However, with Stop the bleed training, they can become valuable assets in external hemorrhage control therefore preventing related complications and death.

### 5.2 Recommendations

The ministry of health and other stakeholders should scale-up “Stop the Bleed” training Programs to enhance external hemorrhage management in the pre hospital setting. Researchers should conduct longitudinal studies to assess long-term external hemorrhage control skills retention after training.

### Conflict of interest

The authors declare that there is no known competing financial interests or personal relationships that could appear to influence the work in this paper.

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