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Systemic Factors Influencing Pre-Hospital Medical Care Following Road Traffic Accidents Along Kenya's Nairobi-Mombasa Highway: A Mixed-Methods Study

Systemic Factors Influencing Pre-Hospital Medical Care Following Road Traffic Accidents Along Kenya's Nairobi-Mombasa Highway: A Mixed-Methods Study

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Abstract
Road traffic injuries remain a leading cause of preventable mortality worldwide and disproportionately affect low- and middle-income countries where pre-hospital emergency medical services (EMS) are often underdeveloped. Kenya continues to experience a high burden of road traffic crashes, yet pre-hospital medical care remains fragmented and inconsistently coordinated. This study assessed the systemic factors influencing pre-hospital medical care following road traffic accidents along the Nairobi-Mombasa Highway (A109), Kenya. The study was guided by Emergency Management Theory, Systems Theory, and High-Reliability Organisation Theory and employed a descriptive cross-sectional mixed-methods design involving emergency medical personnel, traffic police officers, hospital administrators, community health volunteers, emergency-service providers, bystanders, and road traffic accident victims. Quantitative data were analysed using descriptive statistics, while qualitative data from key informant interviews and focus group discussions were analysed thematically. The findings identified six interrelated factors influencing pre-hospital medical care: incident command and leadership, communication and inter-agency coordination, human-resource capacity, transport and logistical readiness, governance and policy implementation, and continuity of care through referral and patient handover. Participants expressed strong support for an integrated EMS system, including a structured EMS model for the corridor, the adoption of standardised operational procedures, and strengthened coordination among emergency response agencies. The study concludes that strengthening pre-hospital medical care along Kenya's principal transport corridor requires integrated emergency medical systems supported by coordinated governance, standardised operational protocols, competent emergency responder training, resilient logistics, interoperable communication systems, and continuous quality improvement. The findings inform EMS policy and trauma-system strengthening in Kenya and similar low-resource settings.

Introduction

Road traffic injuries remain among the leading causes of preventable death and disability globally, claiming an estimated 1.19 million lives annually and disproportionately affecting low- and middle-income countries (WHO, 2023). While road-safety efforts have traditionally emphasised crash prevention, survival after severe injury depends heavily on the emergency response that follows a crash: timely detection and dispatch, safe extrication, haemorrhage and airway management, appropriate triage, coordinated referral and prepared receiving facilities together constitute the trauma survival chain (Alinia *et al*., 2015). In many low- and middle-income countries, however, these systems are fragmented and under-resourced, and most trauma deaths occur before hospital arrival (Bhattarai *et al*., 2023; Kironji *et al*., 2018; Mould-Millman *et al*., 2017; Haghparast-Bidgoli *et al*., 2010).

Kenya reflects these regional challenges. Road traffic crashes are a long-standing and rising cause of death in the country (Odero, 1995), and the Nairobi-Mombasa Highway (A109) is its principal transport corridor, traversing dense urban areas, remote rural sections and recognised accident black spots, so effective response depends on coordinated action among community responders, police, ambulance and fire services, health facilities and county governments. Although Kenya has established relevant legal and policy instruments - including the Health Act (2017) and the Kenya Medical Emergency Care Policy (2020–2030) - implementation gaps continue to constrain integrated emergency medical services (Bachani *et al*., 2020; Mwenda *et al*., 2023). Existing research has largely examined individual components of emergency care in isolation, leaving limited evidence on how command, communication, workforce, equipment and governance deficiencies interact along high-risk corridors. This study addresses that gap by assessing the systemic factors influencing pre-hospital medical care following road traffic accidents along the corridor, using a convergent mixed-methods approach guided by Emergency Management, Systems and High-Reliability theories.

Literature Review

Eftekhari *et al*. (2019), in a qualitative study of 24 road-traffic-injury experts, identified six barriers to preventing pre-hospital deaths: poor crash-scene management, inadequate rules and protocols, poor time management, low-quality training and public education, weak communication and command, and deficient victim management - closely mirroring the domains examined in the present study.

Fadel and Shihab (2008) underscored rapid service delivery, response time, equipment adequacy, staff training and professional conduct as determinants of effective EMS in both developed and developing settings. Shaikh *et al*. (2011) grouped pre-hospital performance into trained personnel, appropriate equipment and response time, but stressed that these must be considered alongside workforce capacity, communication, transport, data recording, public education and inter-agency cooperation.

Ito *et al*. (2022), analysing 19,141 traffic-trauma cases in Japan with a generalised linear mixed model, found that the number of EMS calls before hospital acceptance most strongly increased on-scene time (5.69 minutes per call), with high-risk injuries, night-time incidents and older age also contributing - highlighting how communication and coordination efficiencies shape pre-hospital delay.

Theoretical Perspective

This study was anchored in Emergency Management Theory (EMT), High-Reliability Theory (HRT), and Systems Theory, which collectively provide a comprehensive framework for examining the systemic factors influencing pre-hospital medical care following road traffic accidents along Kenya's Nairobi-Mombasa Highway. Together, these theories explain why emergency medical services (EMS) performance depends not only on the availability of resources but also on preparedness, organisational reliability, and effective interaction among the multiple components of the emergency response system.

Emergency Management Theory (EMT), grounded in the Comprehensive Emergency Management (CEM) model, emphasises that effective emergency response is achieved through coordinated investments across mitigation, preparedness, response, and recovery rather than through reactive response alone (Waugh & Tierney, 2007; McEntire, 2004). Applied to the Nairobi-Mombasa Highway, the theory suggests that recurrent delays in trauma response, inadequate responder preparedness, fragmented institutional coordination, and the absence of standardised operational procedures reflect systemic weaknesses in preparedness rather than isolated operational failures. Consequently, strengthening pre-hospital medical care requires proactive planning, continuous training, public education, coordinated multi-agency preparedness, and resilient emergency management systems established before road traffic accidents occur.

High-Reliability Theory (HRT) explains performance in high-risk environments, holding that organisations operating under uncertainty and time pressure achieve consistently safe outcomes through standardised procedures, continuous learning, redundancy, effective communication and resilience (Roberts, 1990; Weick & Sutcliffe, 2015). Recurring deficiencies - grounded ambulances, fragmented command, inconsistent triage and reliance on untrained responders (Chokotho *et al*., 2017) - mark departures from high-reliability characteristics, while standardised protocols, simulation training, interoperable communication and coordinated command are practical mechanisms for strengthening reliability in Kenya's pre-hospital system.

Systems Theory, drawing on General Systems Theory and the Viable System Model, conceptualises pre-hospital EMS as an interconnected network of community responders, dispatch centres, police, ambulance, fire and rescue services and receiving facilities (Von Bertalanffy, 1968; Beer, 1972). Effectiveness therefore depends on the interaction of these components rather than any single agency, and weak communication, fragmented referral, inadequate logistics and poor coordination represent systemic integration failures. The theory supports integrated systems characterised by coordinated governance, interoperable communication, standardised procedures and collaborative decision-making.

These theoretical perspectives are reinforced by existing literature demonstrating that pre-hospital emergency care remains one of the weakest components of trauma systems in many low- and middle-income countries. Previous studies consistently identify prolonged ambulance response times, inadequate communication systems, fragmented inter-agency coordination, shortages of trained emergency personnel, insufficient ambulance equipment, weak governance structures, and inconsistent financing as persistent barriers to effective emergency medical services (Bachani et al., 2020; Kironji et al., 2018; Mould-Millman et al., 2017; Bhattarai et al., 2023; Mwenda et al., 2023). These deficiencies delay patient stabilisation, prolong transport to definitive care, and reduce the likelihood of achieving internationally recognised trauma benchmarks such as the Platinum Ten Minutes and the Golden Hour.

Although previous studies have substantially advanced understanding of individual barriers affecting emergency medical services, limited evidence exists on how multiple operational, institutional, logistical, and governance factors interact within high-risk transport corridors. This study addresses that gap by adopting a systems perspective to examine six interrelated domains influencing pre-hospital medical care along the Nairobi–Mombasa Highway: incident command and leadership, communication and inter-agency coordination, human-resource capacity, transport and logistical readiness, governance and policy implementation, and continuity of care. By integrating quantitative and qualitative evidence across these domains, the study demonstrates that pre-hospital preparedness is an emergent property of the entire emergency response system rather than the outcome of isolated organisational performance.

Methodology

This study adopted a descriptive cross-sectional convergent mixed-methods design and was conducted along the Nairobi-Mombasa Highway (A109), Kenya's principal transport corridor of approximately 500 kilometres linking Nairobi to the Port of Mombasa and characterised by high traffic volumes and frequent road traffic crashes. The target participants were stakeholders directly involved in pre-hospital emergency response along the corridor, including emergency medical technicians and paramedics, ambulance nurses and clinical and medical officers at casualty departments, traffic police and NTSA safety officers, emergency-service providers (Kenya Red Cross Society and St John Ambulance), health-facility administrators, community health promoters and first responders, and road traffic accident survivors. A combination of purposive, stratified and simple random sampling was used to ensure representation across these stakeholder categories, and the sample size was determined using established procedures for mixed-methods health-systems research, yielding 226 survey respondents.

Primary data were collected using structured questionnaires, key informant interviews (KIIs), focus group discussions (FGDs) and observation checklists, complemented by a review of policy documents, emergency care guidelines and government reports. Quantitative data were analysed using descriptive statistics (frequencies, percentages and summary statistics), while qualitative data were transcribed and analysed thematically; the two strands were then integrated during interpretation, with methodological triangulation across multiple data sources, stakeholder categories and methods providing validation in the absence of inferential testing. The research instruments were pre-tested to improve clarity and reliability. Ethical clearance was granted by the Masinde Muliro University of Science and Technology Institutional Ethics Review Committee, and a research licence was issued by the National Commission for Science, Technology and Innovation (NACOSTI Licence No. NACOSTI/P/25/4176021); all county and institutional authorisations were obtained before data collection, participation was voluntary and based on informed consent, and confidentiality and anonymity were maintained throughout.

Results and Discussion

This section presents the study findings for each of the six systemic domains influencing pre-hospital medical care, integrating the descriptive survey results with participant accounts from the interviews and focus group discussions. Each subsection opens with the domain's quantitative pattern and is then interpreted in light of stakeholder perspectives.

Incident Command, Leadership and Scene Organisation

Effective incident command, leadership and scene organisation are fundamental to coordinated pre-hospital emergency care, particularly during road traffic accidents involving multiple casualties and emergency response agencies. Table 1 presents respondents' ratings of incident command, leadership and scene organisation.

Table 1: Incident command, leadership & scene organisation factors influencing Pre-Hospital Medical Care in the Management of RTAs

Statement	n	SA (%)	A (%)	Neutral (%)	D (%)	SD (%)
The crash-scene is usually managed in a coordinated and structured manner.	226	19.9	36.3	14.6	20.8	8.4
Emergency response personnel have clearly defined roles during crash-scene interventions.	226	21.3	38.5	12.4	20.9	6.9
A unified command system is always established at the scene of major road traffic accidents.	226	16.8	35.5	13.7	26.5	7.5
The absence of leadership at the scene often delays effective emergency response.	226	36.7	44.2	5.3	11.6	2.2
Time management during crash response is critical but often compromised by lack of coordination.	226	31.0	57.5	4.0	7.1	0.4
The command-and-control chain during crash responses is often unclear or poorly enforced.	226	26.4	26.4	13.5	27.9	5.8

Source: Field Data, 2025

As shown in Table 1, weaknesses in command structures, unclear leadership responsibilities and limited inter-agency coordination substantially constrained pre-hospital care, with many respondents reporting delayed decision-making, duplicated responsibilities and inefficient deployment of emergency resources.

Participant accounts reinforced these patterns: responders often operated independently rather than within an integrated incident-management structure, with police, ambulance, fire and hospital teams arriving sequentially rather than simultaneously, delaying extrication, triage and evacuation. The absence of designated incident commanders created uncertainty over responsibilities, communication channels and resource coordination, and these early delays frequently cascaded through the trauma care continuum.

These findings align with evidence that coordinated incident command improves emergency response efficiency and patient outcomes. Mould-Millman *et al*. (2017) identified fragmented institutional leadership as a major impediment to EMS development across Africa, and Kironji *et al*. (2018) linked poorly coordinated systems to delayed dispatch and inconsistent referral. In Uganda, Jayaraman *et al*. (2009) similarly found that the absence of standardised command structures produced chaotic scenes with responders operating without centralised coordination - reinforcing the need for integrated command supported by defined roles and standardised protocols.

Command, Coordination and Inter-Agency Operations

Effective pre-hospital emergency care depends on coordinated action among emergency medical services, police, fire and rescue services, hospitals, and community responders. Table 2 summarises respondents' ratings of command, coordination and inter-agency operations.

Table 2: Command, coordination and inter-agency protocol factors

Statement	n	SA (%)	A (%)	Neutral (%)	D (%)	SD (%)
There is efficient real-time communication among emergency responders during pre-hospital care.	226	10.8	35.8	16.8	24.9	11.7
Communication breakdowns frequently affect the effectiveness of crash response operations.	226	32.7	49.6	11.5	5.8	0.4
There are formal communication protocols guiding inter-agency coordination at crash scenes.	226	8.8	24.3	31.2	27.3	8.4

Source: Field Data, 2025

Table 2 indicates that fragmented command and weak inter-agency coordination were major barriers along the corridor: most respondents reported a lack of unified leadership, standardised procedures and coordinated decision-making, producing delayed extrication, inefficient deployment and inconsistent referral.

The quantitative findings were consistent with participant accounts indicating that emergency agencies often respond independently rather than as a coordinated incident-management team. Participants described situations in which ambulance crews, police officers, and fire and rescue personnel arrived at different times, with no designated incident commander responsible for directing operations. Consequently, casualty stabilisation, triage, evacuation, and referral were frequently delayed despite the availability of multiple responding agencies. These experiences highlight the operational consequences of fragmented command structures during road traffic emergencies.

From a systems perspective, these findings illustrate that effective emergency response requires more than the presence of multiple agencies; it depends upon clearly defined leadership structures capable of integrating personnel, information, and resources into a unified operational response. The absence of standardised Incident Command Systems (ICS) reduces situational awareness, weakens accountability, and increases duplication of effort, thereby compromising the continuity and quality of pre-hospital medical care.

These findings corroborate evidence that fragmented institutional coordination constrains EMS development in low- and middle-income countries. Mould-Millman *et al*. (2017) linked poor inter-agency coordination to delayed response and inefficient resource use, while Bigley and Roberts (2001) showed that standardised Incident Command Systems improve multi-agency coordination, and Kironji *et al*. (2018) noted that weak organisational integration constrains care across African settings. Comparable delays from absent integrated communication have been reported in Nigeria (Akinreni *et al*., 2023) and Ethiopia (Ragasa *et al*., 2022).

Communication and Information Systems

Effective communication and information management are fundamental to timely pre-hospital medical care, enabling rapid dispatch, coordinated emergency response, and continuity of patient care. The communication and inter-agency indicators for this domain are reported in Table 2 and are interpreted below in relation to information flow, dispatch and inter-agency coordination. The findings indicate that deficiencies in communication systems, fragmented information sharing, and the absence of standardised inter-agency communication protocols substantially constrain emergency response along the Nairobi-Mombasa Highway. Respondents consistently reported delays in relaying incident information, limited interoperability between emergency response agencies, and inadequate communication between field responders and receiving health facilities. These deficiencies reduced situational awareness, delayed resource mobilisation, and weakened coordination throughout the emergency response process.

The quantitative pattern on communication and inter-agency coordination was triangulated with a key informant account:

> *"Simu mara mingi huwa tunapokea kabla traffic halafu tunapigia traffic Salama since they have our number then at the same time we call the dispatch centre in Wote tukiomba ambulance. During response, we have to tell number level 5… so they prepare. Sometimes we look at the distance, kama past Malili, sirudi na mgonjwa huku- I have to go to Machakos kwa sababu ya distance and before I go to Machakos- I have to call them" (Often, we receive the call before the traffic authorities, and then we contact Traffic Salama since they have our number. At the same time, we call the dispatch centre in Wote to request an ambulance. During the response, we*

> *have to provide the patient's details so they can prepare. Sometimes we consider the distance - for example, past Malili - and I cannot return with the patient here; I have to go to Machakos because of the distance, and before going to Machakos, I have to call them) - Ambulance EMT, Level IV Hospital, Makueni County, 2025*

Qualitatively, communication challenges extended beyond technical limitations to institutional fragmentation. Responders relied on personal mobile phones and informal networks rather than centralised dispatch (Lee *et al*., 2024), and information on casualty numbers, injury severity and location was often delayed or incomplete, producing inappropriate deployment and poor preparation at receiving facilities. Organisational boundaries and inconsistent reporting created bottlenecks, so responders developed separate operational pictures of the same incident - weakening coordinated action and continuity of care into hospital emergency departments.

These findings are consistent with previous studies demonstrating that effective communication systems are among the strongest predictors of emergency medical service performance. Kironji et al. (2018) identified fragmented communication infrastructure as a major limitation to EMS development across Sub-Saharan Africa, while Mould-Millman et al. (2017) emphasised that poor information sharing between emergency agencies contributes to delayed response and inefficient utilisation of available resources. Similarly, recent studies have shown that integrated emergency dispatch systems and interoperable communication platforms substantially improve coordination, reduce response times, and enhance patient outcomes during trauma emergencies.

Human Capacity and Clinical Competency

Human-resource capacity and clinical competency emerged as critical determinants of pre-hospital medical care along the Nairobi-Mombasa Highway. Table 3 presents respondents' ratings of human capacity and clinical competency.

Table 3: Human capacity & competency factors influencing Pre-Hospital Medical Care in the Management of RTAs

Statement	n	SA (%)	A (%)	Neutral (%)	D (%)	SD (%)
Emergency medical technicians (EMTs) are adequately trained to handle road traffic crash victims.	226	19.9	37.3	12.9	17.9	12.0
Regular refresher training is provided to EMTs and paramedics on trauma response.	226	13.3	31.0	28.3	20.6	6.8
Lay bystanders or first responders are trained and know how to assist appropriately during accidents.	226	4.7	6.8	7.5	29.2	51.8
The quality of victim management is influenced by the level of training of first responders.	226	35.4	60.2	2.6	1.8	0.0
Involvement of untrained individuals often disrupts proper emergency response procedures.	226	50.2	38.4	4.6	4.9	1.9
Human errors frequently occur during pre-hospital care due to fatigue, stress, or poor decision-making.	226	35.4	51.4	8.9	2.7	1.6

Source: Field Data, 2025

As summarised in Table 3, shortages of emergency-trained personnel, inconsistent clinical competencies, inadequate trauma training and human factors such as fatigue and operational stress substantially constrained the quality and reliability of pre-hospital care.

Variations in EMT clinical preparedness, together with inadequate trauma training among police and other early responders, produced inconsistent assessment, stabilisation and transport. Respondents strongly supported standardised EMT training, continuous professional development and simulation-based exercises, and evidence from comparable settings shows that training lay and community first responders in basic trauma care and life support improves early pre-hospital response (Tiska *et al*., 2004). Workforce development should therefore strengthen competency, standardisation and operational readiness rather than personnel numbers alone.

These competency and staffing gaps were echoed by frontline clinicians and by survivors of road traffic accidents:

> *"You may find the clinician on the ground is not able to handle some issues especially when the patient on the ground is so bad that they need other services such as an urgent CT scan or ultra sound so you may have to call these officer from wherever they are which eats into time for definitive care. Most of the staff are not trained on emergency response and even those present may lack adequate knowledge on how to proceed with particular cases" (The clinician on the ground may be unable to handle certain cases, especially when the patient requires urgent services such as a CT scan or ultrasound, so specialists must be called in from elsewhere, which eats into the time for definitive care) - Clinical Officer, Level IV Hospital, Makueni County, 2025*

Survivors likewise recalled being assisted by bystanders who lacked first-aid skills:

> *"Naĩmutetheku tayalĩ lakinĩ ala mandwaiye sivitalĩ mayaĩna ũmanyi ukonetwe ũiiti kana first-aid" (After the accident, I regained consciousness while in hospital undergoing treatment; those who helped me did not have first-aid knowledge) - Road traffic accident survivor, Wote Town, Makueni County, 2025*

An equally important finding concerns the influence of human factors on emergency response performance. Respondents identified fatigue, prolonged working hours, burnout, and human error as significant contributors to compromised clinical performance during emergency operations. These observations were illustrated by an account from an emergency nurse who described responding continuously to a major road traffic incident throughout the night and into the following morning because of limited staffing:

> *"Accident ilifanyika saa tisa ya usiku na walikuwa wengi sana wenye wameumia, tulifanyia kazi kwa matent na tukakaa mpaka saa tatu mchana kushughulikia watu." (The accident occurred at 3AM and there were many injured people. We worked in temporary tents and remained on duty until 9 AM managing the casualties.)* (Emergency Nurse, Level IV Hospital, Makueni County, 2025).

Workforce shortages affected not only service availability but also reliability and safety: operating beyond normal capacity increases fatigue, reduces vigilance and heightens error during time-critical care. Viewed through High-Reliability Theory, organisational resilience depends on adequate staffing, continuous competency development and supportive systems that reduce human error under operational stress.

These findings are consistent with evidence that shortages of trained personnel remain a major barrier to EMS development across Africa. Mould-Millman *et al*. (2017) reported systems operating with insufficient paramedics and EMTs, while Delaney *et al*. (2024) showed that workforce shortages limit response capacity and that structured community first-responder programmes can provide early stabilisation before ambulance arrival. The present study extends this by showing that sustainable improvement requires an integrated workforce strategy spanning professional training, competency

standardisation, simulation-based learning, responder wellness, and the formal incorporation of trained community responders.

Equipment, Fleet Readiness and Facility Support

The availability and operational readiness of ambulances, emergency medical equipment, and receiving health-facility resources emerged as fundamental determinants of effective pre-hospital medical care along the Nairobi-Mombasa Highway. Table 4 presents respondents' ratings of equipment, fleet readiness and facility support.

Table 4: Equipment, fleet readiness and facility support factors

Statement	n	SA (%)	A (%)	Neutral (%)	D (%)	SD (%)
There are adequate ambulances available for emergency response along the Nairobi-Mombasa Road.	226	8.4	11.5	11.5	35.4	33.2
Ambulances are equipped with essential tools to stabilise victims during transit.	226	9.6	26.1	16.4	26.2	21.7
EMTs have access to adequate pre-hospital medical equipment during emergencies.	226	14.7	25.7	20.9	28.8	9.9
Emergency response kits are regularly maintained and ready for deployment.	226	8.0	18.6	25.7	35.8	11.9
Shortages in basic supplies (e.g., trauma kits, splints) hamper effective crash response.	226	35.4	53.5	5.8	3.5	1.8

Source: Field Data, 2025

Table 4 shows that shortages of appropriately equipped ambulances, inadequate medical supplies, inconsistent maintenance and limited logistical support substantially constrained emergency response and the capacity to sustain care in transit.

Ambulance availability alone did not guarantee effective response. Participants noted that some ambulances lacked essential trauma equipment while others suffered mechanical failure or prolonged downtime from inadequate maintenance, so responders often worked under resource-constrained conditions that limited airway management, haemorrhage control, immobilisation and monitoring in transit. Operational readiness therefore depends on both fleet availability and the functionality of on-board equipment.

Corroborating quantitative data, qualitative evidence collected linked these supply and transport constraints directly to delays in reaching definitive care:

> *"We have several challenges like fuelling, sometimes mafuta inaisha. Unapata unaenda mpaka kwa ile hospitali na hawajapokea mgonjwa so unatafuta ingine mpaka wakubali. During that time mgonjwa anatumia oxygen of which pia inaweza enda na iishe" (We have several challenges such as fuelling; sometimes the fuel runs out. You drive to a hospital and, if they have not accepted the patient, you must find another that will - and during that time the patient is on oxygen, which may also run out) - Ambulance EMT, Level IV Hospital, Makueni County, 2025*

The difficulty of meeting time-critical thresholds such as the Golden Hour was similarly emphasised:

> *"Hiyo 10 ni kidogo, when it comes to the public hospitals. Like now yesterday we had an accident along Wote Road. Walipiga simu around 4:30PM but the patient arrived after 30 minutes but fortunately wengi hawakuwa wamepata severe injuries. That Golden hour to achieve it I don't know but ni ngumu sana" (Ten minutes is too few when it comes to public*

> *hospitals. For example, yesterday we had an accident along Wote Road; they called around 4:30 PM, but the patient arrived after 30 minutes. Achieving the Golden Hour in such circumstances is very difficult) - Emergency Nurse, Level IV Hospital, Makueni County, 2025*

Continuity between pre-hospital services and receiving facilities also mattered: shortages of supplies, limited resuscitation capacity, inadequate blood products and constrained emergency-department resources sometimes delayed definitive treatment even after arrival - showing that weaknesses in hospital preparedness diminish the benefits of timely ambulance response, and that trauma care must be treated as a continuous system from scene to definitive management.

These findings echo evidence that equipment deficiencies and weak fleet management persistently undermine EMS performance in low- and middle-income countries. Kironji *et al*. (2018) and Mould-Millman *et al*. (2017) documented limited ambulance capacity and inadequate equipment, Reynolds *et al*. (2020) emphasised preventive maintenance and logistics management, and Bhattarai *et al*. (2023) identified inadequate logistical infrastructure as one of the most persistent barriers to effective pre-hospital care.

Governance, Policy and Continuity of Care

Governance, policy implementation, and continuity of care emerged as fundamental determinants of pre-hospital medical care along the Nairobi-Mombasa Highway. Table 5 presents respondents' ratings of policy, legal framework, governance and monitoring.

Table 5: Policy, legal framework, governance & monitoring

Statement	n	SA (%)	A (%)	Neutral (%)	D (%)	SD (%)
There are clear national or county-level guidelines regulating pre-hospital emergency care.	226	7.5	18.6	35.8	25.8	12.3
Existing guidelines are effectively implemented during real-time accident responses.	226	8.3	14.7	35.8	27.9	13.3
The legal framework guiding emergency medical services needs improvement to support field teams.	226	27.9	19.9	31.8	14.6	5.8
Resource allocation for EMS along the Nairobi-Mombasa Road is adequate and consistent.	226	3.6	5.8	18.6	44.6	27.4
Stakeholders (police, medics, firefighters) regularly participate in joint emergency drills.	226	16.9	33.6	23.5	18.5	7.5
There is a tracking system for monitoring response times and care quality during RTAs.	226	6.6	10.6	18.6	40.7	23.5

Source: Field Data, 2025

As summarised in Table 5, respondents expressed limited confidence in the governance of pre-hospital emergency care. Only a minority agreed that clear national or county guidelines exist or are effectively implemented, while a large proportion were neutral or in disagreement. Resource allocation was widely viewed as inadequate and inconsistent, monitoring and tracking systems were reported to be largely absent, and although joint inter-agency drills were acknowledged in some settings, they were not consistently institutionalised. Taken together, these results indicate weak policy clarity, unstable financing and limited accountability mechanisms across the corridor's emergency response system.

The disconnect between regulatory enforcement and operational realities was captured by an ambulance operator:

> *"Government check-unit wanasumbua sana… operator ameshashikwa na check-unit akiwa ana respond. Wanatuambia zimeni hiyo siren mpaka vile mtabeba mgonjwa ndio muwashe" (The government check-unit causes a lot of problems; an operator has been stopped while responding and told to switch off the siren until they see physically the patient being carried - which contradicts emergency-response protocol) - Ambulance EMT, Level IV Hospital, Makueni County, 2025*

Overall, fragmented governance, inconsistent policy implementation, inadequate financing and weak referral systems constrained emergency response, and respondents consistently reported that the absence of standardised operational frameworks, limited regulatory oversight and weak coordination between pre-hospital responders and receiving facilities delayed patient management and reduced continuity of trauma care.

Table 6: Continuity of care, referral & handover

Statement	n	SA (%)	A (%)	Neutral (%)	D (%)	SD (%)
Poor handover practices from field teams to hospital staff result in care delays.	226	47.3	39.4	7.5	5.4	0.4
Health facilities receiving crash victims are well-prepared to continue post-ambulance care.	226	23.0	23.5	14.6	14.6	24.3

Source: Field Data, 2025

Continuity of care extended beyond transport to hospital. Participants emphasised that effective trauma management requires seamless transfer of clinical information, standardised referral procedures, timely ambulance-to-department communication and coordinated handover. Inconsistent documentation, incomplete information transfer and variable referral practices frequently disrupted continuity and delayed definitive treatment - indicating that weak referral systems undermine the benefits of timely pre-hospital intervention.

Delays in referral and continuity of care were similarly attributed to hierarchical approval processes. This was noted during a key informant interview:

> *"The patient may need neuro-surgeon care and so we have to refer this patient to Makueni which may take a lot of time. In such cases, you may need the Medical Officer in charge to do the referral but that may mean stepping them off other medical processes. This is a lot of time" (A patient needing neurosurgical care must be referred to Makueni, which takes considerable time; the referral may require the Medical Officer in charge, pulling them away from other clinical duties) – (Clinical Officer, Level IV Hospital, Makueni County, 2025)*

Qualitatively, responsibilities for ambulance services, referral coordination and oversight were distributed across multiple organisations with limited integration; although supportive policies exist, implementation remained inconsistent because of resource constraints, overlapping mandates and absent monitoring - showing that governance shapes every stage of the response continuum, from dispatch to definitive care.

These findings are consistent with evidence that governance is central to resilient emergency medical systems. Kironji *et al*. (2018) and Mould-Millman *et al*. (2017) linked fragmented governance, inconsistent policy implementation and weak regulation to constrained EMS development across Africa, while Bachani *et al*. (2020) highlighted coordinated referral and standardised policy as

important for trauma outcomes - supporting the present finding that governance is the framework integrating communication, workforce, logistics, financing and clinical care.

Integrated Interpretation of the Findings

The six domains demonstrate that pre-hospital medical care along the corridor is shaped less by isolated deficiencies than by the interaction of command, communication, workforce, logistics, governance and continuity of care. Weakness in any one domain propagates through the others, so that delays in command or communication cascade into transport, handover and definitive care failures.

Viewed through Emergency Management, Systems and High-Reliability theories, these findings indicate that improving pre-hospital care requires strengthening not individual components but the interactions between them - through coordinated preparedness, reliable standardised procedures and integrated system design that together build resilience across the emergency response chain.

Conclusion

This study examined the systemic factors influencing pre-hospital medical care following road traffic accidents along Kenya's Nairobi-Mombasa Highway. Guided by Emergency Management Theory, Systems Theory and High-Reliability Theory, the findings show that the effectiveness of pre-hospital care is shaped by the interaction of multiple, mutually reinforcing health-system components - incident command and leadership, communication and information systems, human-resource capacity, equipment and logistical readiness, governance and policy implementation, and continuity of care - rather than by isolated operational factors, such that a deficiency in one component generates cascading delays across the wider emergency-response chain. Pre-hospital medical care should therefore be understood and strengthened as a systems function spanning the entire emergency care continuum.

These findings carry clear policy and practice implications: Kenya should institutionalise a nationally coordinated Emergency Medical Services system supported by standardised incident command structures, interoperable communication and integrated dispatch; invest beyond ambulance procurement in competency-based workforce training, fleet maintenance, standardised equipment and resilient supply chains; harmonise implementation of existing emergency care policies with standardised referral and handover protocols, monitoring and evaluation, and sustainable financing; and strengthen community-based first-responder programmes through Basic Life Support and Pre-Hospital Trauma Life Support training and multi-agency simulation. The study was limited to a single corridor and relied on stakeholder perceptions rather than operational indicators such as response times or survival rates; future research should therefore incorporate longitudinal operational and clinical outcome data and comparative studies across other high-risk corridors and county systems to strengthen emergency medical services in Kenya and comparable resource-constrained settings.

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