Original Article

Assessment of Prehospital Emergency Care Resources in Urban and Rural Rwanda Using the WHO Health System Framework: A Cross-Sectional Study

Liberatha Rumagihwa[1*], Priscille Musabirema[1], Gerard Urimubenshi[2], Prinsloo Isabel[3], Jean Claude Byiringiro[4]

[1]*School of Nursing and Midwifery, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*
[2]*School of Health Sciences, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*
[3]*Department of Nursing Science University of Pretoria, Pretoria, South Africa*
[4]*School of Medicine and Pharmacy, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda*

***Corresponding author:** Liberatha Rumagihwa. School of Nursing and Midwifery, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda. Email: blessingtype@gmail.com. ORCID: https://orcid.org/0000-0003-0973-9832

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Abstract

Background
Prehospital emergency care is essential for reducing preventable deaths and disabilities from road traffic accidents. Evidence regarding the availability and distribution of prehospital emergency care resources in Rwanda remains limited.
Objective
This study assessed prehospital emergency care resources across three prehospital systems in Rwanda.
Methods
A descriptive cross-sectional study assessed prehospital emergency care resources using a locally adapted WHO prehospital emergency assessment tool. Key informants from one rural and two urban systems were purposively selected. Data were analyzed descriptively using WHO prehospital emergency system building blocks.
Results
Prehospital emergency care resources varied across systems. The urban public system employs 99 providers, mostly nurses, and operates 510 ambulances supported by a 24/7 toll-free dispatch system (912). The urban private system has 21 permanent staff members, including 18 prehospital care providers primarily emergency care assistants, and three administrative personnel, supported by 150 volunteers. It operates 12 ambulances and a 24/7 toll-free line (2100). The rural public system has 11 nurses and six ambulances relying on the urban public dispatch system for emergency activation.
Conclusion
Rwanda's prehospital system is expanding; however, rural and private systems continue to face resource limitations. These gaps should be addressed to ensure equitable and effective prehospital care.
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Keywords: Accidents, emergency medical services, health resources, Rwanda, survey and questionnaires, traffic

Introduction

The availability of timely and effective prehospital care is a critical determinant of survival and recovery following traumatic injuries, particularly in road traffic accidents. Evidence indicates that early prehospital interventions delivered by trained personnel with adequate equipment, effective communication systems, and standardized protocols significantly reduce preventable deaths and long-term disabilities.[1–3] These interventions are particularly important for road traffic injury victims, whose outcomes often depend on timely access to emergency care. Despite the demonstrated benefits of prehospital care, many road traffic injury victims in low-resource settings do not receive any form of prehospital assistance following accidents, often due to resource limitations.[4,5] Addressing these gaps requires well-resourced prehospital care systems capable of delivering timely and effective interventions.

Prehospital emergency care is an essential component of health systems,[6] and plays a key role in reducing preventable deaths and disabilities from acute illness and injuries. Effective prehospital emergency care depends on the availability of trained personnel, ambulances, medical equipment, communication systems, and appropriate organizational structures. These resources directly influence the quality and effectiveness of emergency care, particularly in resource-limited settings. Timely access to emergency care could prevent millions of deaths and long-term disabilities each year if appropriate services were available and patients received care without delay.[7] Achieving this requires adequate prehospital care resources and systems that can deliver timely and effective interventions, particularly for time-sensitive conditions such as road traffic injuries.

Globally, road traffic accidents (RTAs) contribute markedly to morbidity and mortality, causing approximately 1.19 million deaths annually, with 92% occurring in low- and middle-income countries (LMICs), and leaving 20-50 million people with long-term disabilities.[8]

In Rwanda, RTAs nearly doubled from 2018 to 2022, with higher mortality in rural areas than in urban areas.[9] This growing burden underscores the need for coordinated global and national efforts to strengthen emergency care systems.

The World Health Organization's (WHO) Decade of Action for Road Safety 2021–2030 aims to reduce RTA-related deaths and injuries by 50% by 2030.[10] Despite these efforts, persistent challenges continue to hinder the development of emergency medical services (EMS) in many LMICs. [11–13] Rwanda has strengthened and structured prehospital emergency care services, such as the Service d'Aide Médicale d'Urgence (SAMU) and the involvement of the Rwanda Red Cross Society (RRCS) to improve emergency response capacity.[6, 14]

However, challenges remain, including gaps in resource availability, system coordination, and access to timely care, particularly in rural settings.[14,15] While previous studies have explored aspects of emergency care systems and barriers to care in Rwanda, there is limited evidence on the availability and distribution of prehospital emergency care resources across different prehospital emergency care systems.

The WHO recommends assessing the availability and distribution of prehospital emergency care resources to support access.[7] This study aimed to assess the availability and distribution of prehospital emergency care resources in urban and rural areas of Rwanda using the WHO Prehospital Emergency Care Assessment Tool (PEAT), guided by the WHO prehospital emergency services building blocks framework, to identify resource gaps and inform strategies for strengthening emergency care services.

Methods

Study design

This was a descriptive cross-sectional study conducted to assess the availability and distribution of prehospital emergency care resources in urban and rural areas of Rwanda using structured key informant interviews.

Study settings

This study was conducted in urban (Kigali City) and rural (Musanze district) areas of Rwanda. The prehospital service providers in the City of Kigali include the SAMU and the RRCS, and the prehospital service provider in Musanze District was Ruhengeri Level Two Teaching Hospital (RL2TH). The prehospital service providers were purposively selected to include both public and private settings and both urban and rural areas.

The SAMU is a public prehospital service provider funded by the government, while RRCS is considered an NGO, non governmental funded service provider.

The three service providers were classified as urban (SAMU and RRCS) and rural (RL2TH) based on the primary operational base of each service, acknowledging that both Kigali and Musanze include mixed urban-rural characteristics. Out of the 13.2 million Rwandan population, the city of Kigali hosts around 1.7 million, and Musanze District is the most populated district in the northern province with a population of 476,522.[16] Moreover, Musanze district is mountainous with poor infrastructure, limiting its accessibility for ambulances.[14] Figure 1 illustrates the study settings.

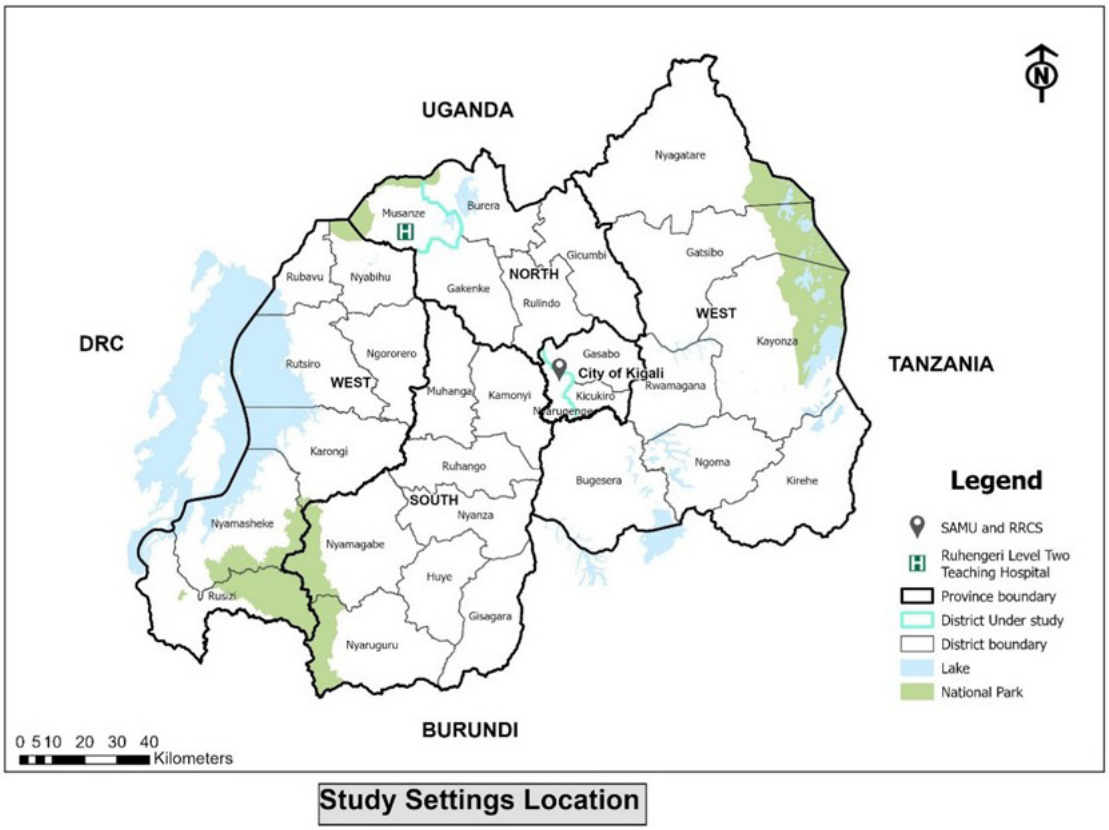

Figure 1. Map of the study settings in Rwanda. Adapted by the authors using Rwanda administrative boundary data from the National Institute of Statistics of Rwanda (NISR).[17]

Sample size and sampling strategy

The study included the leaders of the three prehospital care systems selected for assessment: SAMU, RRCS, and RL2TH.

These entities were purposively selected because of their direct responsibility for planning, coordinating, and overseeing prehospital care services within their

respective prehospital emergency care systems. As only one leader occupied each of these positions, all eligible leaders from the selected prehospital systems were included. Consistent with WHO guidance on PEAT utilization,[18] and the aim of this study, these participants were considered key informants with comprehensive knowledge of system resources, operations, and governance. The sample size was further justified by the concept of information power, as each participant provided rich and relevant information aligned with the study objectives.[19]

Data collection instrument

Data were collected using the PEAT.[18] The tool comprises open-ended and discrete-answer questions. Discrete answers had three options: "No," "Somewhat," and "Adequate." "No" indicated completely absent items; "Somewhat" indicated that the item might exist but was not fully known or consistently used; and "Adequate" indicated that the item was clearly present, well- known, and consistently applied. The WHO prehospital emergency services building blocks assessed included: (1) EMS service delivery infrastructure, referring to the availability of ambulances, emergency bases, call centers, and headquarters; (2) universal access number and its use by the public; (3) licensed EMS workforce, encompassing the availability, qualifications, and training of prehospital care personnel; (4) EMS financing, including funding mechanisms supporting service delivery; (5) leadership and governance, referring to prehospital legislations, coordination structures, and management systems; and (6) availability of protocols and clinical checklists referring to the availability of standardized clinical protocols, operational checklists that guide prehospital assessment, treatment, referral, and patient transport.The figure 2 illustrates the WHO prehospital EMS building blocks.

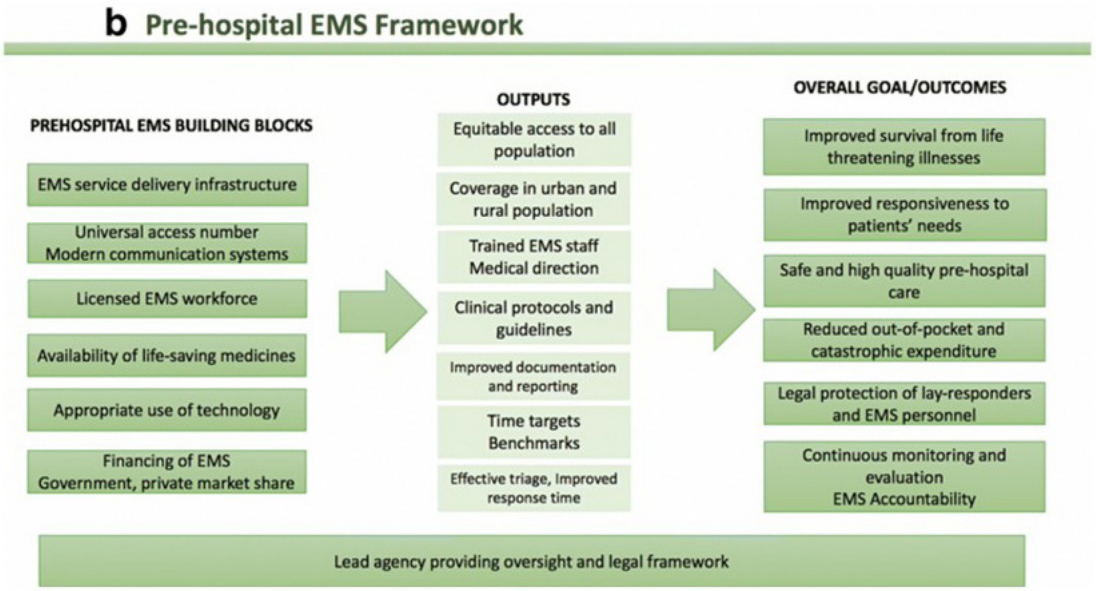

Figure 2:WHO prehospital EMS framework.[20]

The PEAT was contextualized to the Rwandan setting prior to use it for data collection. A one-day consensus meeting with local prehospital care experts was conducted led by the lead researcher (LR). The experts were purposively selected based on the inclusion criterion of having at least five years of experience in prehospital services or emergency departments. The panel comprised six experts, including three nurses, two non-physician anesthetists, and one emergency and critical care consultant, all with more than eight years of experience in emergency medical services.

During the content validity process, the PEAT was reviewed item by item for relevance and clarity using

a structured rating system. Most items demonstrated excellent content validity, with an I-CVI of 1.00. However, six items (1.6–1.8, 2.45, 2.46, and 3.3) yielded I-CVI values below 0.83 and were considered not applicable to the Rwandan context, in line with the recommended thresholds for expert agreement.[21]

During the consensus meeting, it was agreed to divide the tool into two sections based on the respondent' roles. Items 1.1 to 6.11 and 6.13 to 6.19 were designated for completion by prehospital system leaders. In contrast, item 6.12, which included 30 sub-items related to prehospital procedures, was assigned to prehospital care providers working directly in ambulance services.

The internal consistency of the contextualized tool was calculated yielding a Cronbach's alpha of 0.98. Following contextualization, the tool was pilot tested with two emergency care leaders who did not participate in the main study to assess its clarity, relevance, feasibility, and administration procedures. No major concerns were identified during the pilot, and no further modifications to the tool were required prior to the main data collection.

Data collection procedures and analysis

Participants completed the PEAT during individual interviews. The lead researcher (LR) documented the responses. Data were collected between August to October 2025, and individual interviews lasted approximately two hours.

The responses to the discrete items were descriptively analyzed. Responses were categorized as "No," "Somewhat," or "Adequate". Responses were compared across urban public, urban private, and rural public settings to enable contextual comparison. Some items generated numerical responses, while others provided categorical responses, which were analyzed descriptively. Findings were organized according to the WHO prehospital emergency services building blocks' framework. Summary tables are presented in the main manuscript, while detailed indicator level results are provided in the supplementary material Table S1 and Table S2.

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the University of Rwanda Institutional Review Board (Ref: 585/CMHS IRB/2025), with additional permissions granted by RBC/SAMU (Ref: 3949/RBC/2025) and Ruhengeri Level II Teaching Hospital (Ref: 918/RL2TH/DG/2025). No additional authorization from the Rwanda Red Cross Society was required, because approval from the University of Rwanda was deemed sufficient.

Participants received an information sheet prior to participation, and written informed consent was obtained from all participants. They were informed of their right to withdraw from the study at any time without consequences. Confidentiality was maintained through the use of unique participant codes, and no personal identifiers were collected from the participants. All data were anonymized.

Results

Results are presented according to the WHO prehospital EMS building blocks' framework, beginning with EMS service delivery infrastructure and followed by licensed EMS workforce, financing, leadership and governance, communication systems, and clinical protocols and clinical checklists.

Sociodemographic characteristics of the participants

Three participants (n = 3), from the SAMU, RRCS, and RL2TH completed the PEAT. Participants had nursing or medical backgrounds, were predominantly male, possessed varying levels of education, and had between 5 and 17 years of professional experience in emergency and prehospital care. The demographic characteristics of the participants are presented in Table 1.

Table 1. Sociodemographic characteristics of participants

Prehospital System	Sex	Level of Education	Field	Position	Years of Experience
Urban public(Service d'Aide Medicale d'Urgence)	Female	Masters	Epidemiology/ Nursing	Prehospital leader	17
Urban private (Rwanda Red Cross Society)	Male	Bachelor's degree	General Medicine	Prehospital leader	5
Rural public (Ruhengeri Level 2 Teaching Hospital)	Male	Bachelor's degree	Nursing	Prehospital leader	8

Emergency medical service delivery infrastructure

Table 2 summarizes the distribution of prehospital emergency service infrastructure across urban and rural settings, including ambulances, emergency bases, dispatch systems, and headquarters. Overall, urban areas, particularly public prehospital emergency care provider, demonstrated more developed infrastructure, with different categories of ambulances, established emergency bases, and a centralized dispatch system. In contrast, rural settings showed more limited infrastructure, with fewer dedicated ambulances and reliance on hospital-based resources and shared dispatch systems.

Urban public services were characterized by a well-coordinated system with multiple operational bases and a centralized 24/7 call center via the 912 toll-free number. In contrast, rural services largely relied on this centralized system, supplemented by local communication channels. Private providers contributed to both urban and rural coverage but operated with fewer resources and more limited infrastructure.

Across all settings, ambulances were generally well-branded and identifiable, and the basic organization of equipment (e.g., use of jump bags) was consistently reported. However, the rural setting had relatively fewer ambulances.

Table 2. Ambulances, emergency bases, call centers and headquarters in urban and rural areas

Prehospital infrastructure	Categories	Urban			Rural		
		Public	Private	Total	Public	Private	Total
Number of ambulances	BLS	21	7	28	5	5	10
	ALS	7	0	7	1	0	1
	Boat	0	0	0	1	0	1
Emergency bases	Main base	14	1	15	1	0	1
	Satellite bases	0	0	0	0	0	0
Call center/Dispatch	Main call center	1	1	2	0	0	0
Headquarter	Main	1	1	2	0	0	0

Abbreviations: BLS: Basic Life Support and ALS: Advanced Life Support

Universal access number (UAN); communication systems and appropriate use of technology

Table 3 summarizes the findings of universal access numbers (UANs), communication systems, and use of technology across settings. All participants reported the availability of a toll-free UAN for activating prehospital emergency care services.

However, public awareness was low and UANs were not always appropriately used. Public education on how to use the UAN was limited in the urban public system and non-existent in the urban private and rural public systems.

Regarding broader communication and information systems, the urban public system reported adequate availability of most components, including dispatch centers, real-time information sharing, medical direction, and data management systems. In contrast, the urban private system demonstrated partial or absent capacity in several areas, including dispatch centers, automated location tracking, and backup communication systems. However, functions such as clinical advice, call prioritization, and data recording were reportedly as adequate. The rural public system showed pronounced gaps, with most components reported as absent, including dispatch centers, communication with providers, data systems, and performance monitoring. However, basic functions such as clinical advice, facility notification, patient documentation, and interfacility communication were reportedly adequate.

Table 3. Universal access number, communication system, and use of technology

Indicators	Urban public	Urban private	Rural public
There is a toll-free UAN that patients or bystanders can use to activate the prehospital component of the emergency care system.	Adequate	Adequate	Adequate
The public is aware of and can use the UAN.	Somewhat	Somewhat	Somewhat
There is education for the public on when to appropriately call the UAN to activate the system.	Somewhat	No	No
This service has designated emergency communication and dispatch centers to dispatch and coordinate emergency responses between all involved parties.	Adequate	No	No
Communication centers can give basic clinical advice to bystanders.	Adequate	Adequate	Adequate
There is automated tracking of the caller's location by phone.	Adequate	No	No
Prehospital providers can receive up-to-date information on local emergencies.	Adequate	Somewhat	No
Prehospital providers can report details of the emergency to the communication center and to others involved in the response.	Adequate	Adequate	No

Licensed emergency services workforce

The prehospital workforce varied considerably across the three service providers in terms of their profession and level of education (Table 4). Overall, the workforce comprised both licensed health professionals and a substantial number of volunteers, with notable differences between public and private providers. The SAMU had the most structured and professionally trained workforce, mostly composed of nurses and a few non-physician anesthetists. These professionals were mainly deployed in urban settings, with limited presence in rural areas, primarily for specialized services such as boat ambulance operations.

In contrast, the RRCS relied heavily on volunteers, particularly during high-demand events, with a relatively small core of permanently employed staff members. Its workforce included emergency care assistants with one year of basic emergency training, while there were few licensed professionals such as nurses.

The RL2TH operated with a small workforce primarily composed of nurses drawn from the existing hospital staff members.

Across all providers, there were no formally trained paramedics or emergency medical technicians.

Table 4. Composition of the prehospital workforce in urban and rural settings

Workforce	Urban (Kigali City)		Total urban	Rural (Musanze District)		Total rural
	Public (SAMU)	Private (RRCS)		Public (RL2TH)	Private	
Profession						
Nurses	85[a]	1	86	11[b]	0	11
Non-physician anesthetists	14[a]	0	11	0	0	0
Emergency care assistants	0	1	1	0	0	0
Medical doctors	0	1	1	0	0	0
Volunteers	0	150	150	0	0	0
Education level of licensed professionals						
A1 (3-year university training)	39 (39.3)	0	39	8	0	8
A0 (4-year university training)	51 (51.5)	1	52	3	0	3
Master's degree	9	1	10	0	0	0
1 Year certificate (ECA)	0	1	1	0	0	0

Abbreviations: RRCS, Rwanda Red Cross Society; RL2TH, Ruhengeri Level Two Teaching Hospital; SAMU, Service d'Aide Médicale d'Urgence.

[a]Among 99 urban public prehospital health care providers, 96 were permanently working in urban areas, while three, who include one nurse and two non-physician anaesthetists, were deployed in the Western Province for boat ambulance services.

[b] The number of rural public nurses is only for RL2TH hospital, which exemplifies other rural hospitals providing prehospital care for road traffic-injured patients in this study.

[c]Education level and deployment location were reported only for licensed professionals; volunteers are excluded from these subcategories.

Financing and private market share

Findings summarized in supplementary Table S1 describe differences in financing and private sector participation across settings. Both urban public and rural public systems reported adequate public funding and centralized financing mechanisms, supported by national health insurance coverage for prehospital emergency care. In contrast, the urban private system reported no public funding and no centralized financing, with only partial integration into the National Health Insurance Scheme. There was no coordination between private and public ambulance in Kigali City.

Leadership and governance across settings

Key leadership and governance indicators across settings are summarized in supplementary Table S1 whereby urban public systems exhibited the most structured framework, with adequate transport systems, defined emergency response processes, standardized protocols, and established leadership, supported by relatively developed legislation. However, gaps remained in medical oversight and public awareness. Urban private systems showed moderate organization, with adequate operational processes but weaker leadership and limited legal frameworks, reflecting fragmented governance. In contrast, rural public systems demonstrated the weakest structures, characterized by limited protocols, the absence of leadership roles, lack of service differentiation, and minimal legislative support.

Protocols and clinical checklists

Although not explicitly included in the WHO

prehospital system building blocks, clinical protocols are captured within the PEAT. The availability of clinical protocols varied across prehospital systems. The urban public system had the most comprehensive set of protocols, whereas the urban private system followed a more limited set. The rural system relied primarily on locally developed checklists and lacked formal protocols. Supplementary file Table S2 presents the distribution of available protocols and clinical checklists across the study settings.

Discussion

This study evaluated Rwanda's prehospital care resources using the WHO prehospital EMS building blocks 'framework. Prehospital care resources varied across settings in terms of EMS service delivery infrastructure, universal access number, communication and use of technology, licensed EMS workforce, financing, and leadership and governance.

Rwanda's prehospital system remains highly centralized in urban areas under the SAMU, which operates the largest and best-equipped ambulance fleet distributed nationwide across districts and referral hospitals, as well as at its main and satellite emergency bases. The SAMU benefits from advanced communication capacity and GPS-supported dispatch, reflecting national progress compared with earlier reports that highlighted fewer ambulances and limited technological capacity.[22] In contrast, the RRCS and RL2TH operate at a more basic level, mostly with basic life support (BLS) ambulances, which conflict with international recommendations that call for a mix of BLS and advanced life support (ALS) services.[23,24]

These findings align with those of previous studies demonstrating higher ambulance density, which is associated with improved response times and patient outcomes, whereas rural communities often have reduced emergency service coverage and delayed access to care.[25,26] These disparities in ambulance fleet capacity and distribution, coupled with the limited availability of advanced life support ambulances reported by urban private and rural public prehospital system, suggest unequal access to timely and comprehensive prehospital care.

In this study, a UAN was observed in all assessed systems; however, the public awareness was limited, and the UAN was not always appropriately used. This indicates the gap between system availability and its effective use. In Rwanda, 61.3% of participants were not aware of prehospital services, and 67.8% were not aware of the toll-free number.[27] A recent scoping review found that low community knowledge of emergency phone numbers is a global problem.[28] These findings are further supported by a recent published qualitative study from the same authors, in which participants reported limited awareness of the emergency contact number and uncertainty regarding how to activate prehospital services.[15] This convergence of quantitative and qualitative findings highlights a persistent gap between system availability and community-level utilization.

We found different levels of human resource capacity and training among prehospital care providers in Rwanda. Although the urban public prehospital system is structured and has a professional workforce with accredited training and ongoing continuous professional development, personnel are not specifically trained or licensed as prehospital care providers, indicating a need to regular in-service training. A systematic review similarly indicated that prehospital care system in LMICs often lack trained medical personnel.[6] Inequality have been previously observed in the distribution of qualified personnel and inadequate training in emergency case management.[3,29,30]

In the present study, the urban private prehospital system relied mainly on volunteers trained in first aid and basic life support. Community-based volunteer systems can be effective and resilient

when supported by adequate training, coordination, and resources.[31] However, relying on volunteers may also present challenges, particularly regarding the consistency of skills, availability, and the retention of trained responders. In addition, volunteers may have limited clinical training compared to that of professional emergency medical personnel which may affect the quality and scope of care provided, especially in complex or time-critical cases.

The rural public prehospital system depends on a small, hospital-based team comprised primarily of nurses. This may hinder effective responses to complex emergencies as evidenced from sub-Saharan Africa emergency report which indicated that pre-service nursing education may not adequately cover emergency care competencies, and nurses may be not fully prepared for prehospital roles.[32] Furthermore, nurses working in prehospital settings in resource-constrained environments reported limited clinical knowledge, the need to make independent decisions, and the need to manage patients during prolonged transport.[33]

The three prehospital systems differed in terms of financing mechanisms for prehospital services. The SAMU, benefits from relatively stable government funding and national health insurance coverage, which supports accessibility and equity, including funds for vulnerable populations. However, the SAMU experiences persistent challenges in recovering service-related revenue.[14] In contrast, the RRCS, relies largely on self-generated income from first aid training and the sale of first aid kits, whereas RL2TH, relies on hospital budgets. These funding models may constrain the expansion and sustainability of emergency services because of limited and unstable financing. Similar challenges have been reported in other settings, where inadequate and inconsistent funding undermines operational readiness and remains a key barrier to effective emergency medical services.[32, 34]

In the present study, urban prehospital systems reported the routine use of structured clinical checklists and standardized protocols, which was not similar to rural public prehospital system. Such gaps have been commonly reported in low- and middle-income settings, where the lack or poor implementation of protocols negatively affects prehospital care.[35] Although national emergency medical service protocols have been implemented in Rwanda,[36] they are not widely used rural prehospital systems suggesting that these protocols have not been universally adopted. Prehospital care systems can be strengthened by ensuring the availability, dissemination, and regular review of protocols.[37]

The SAMU operates under the Rwanda Biomedical Center and demonstrates the clearest governance structure, aligning with recommendations that emergency medical service systems should have defined leadership, coordinated management units, and clear accountability mechanisms.[1] Urban private system operates under the Rwanda Red Cross Director General and lacks several prehospital legislative frameworks. In contrast, the rural prehospital system was supervised by nursing leadership without a dedicated prehospital governance unit, a pattern observed in many low- and middle-income settings where ambulances function primarily as transport services rather than integrated emergency systems.[32] These governance gaps may hinder strategic planning, policy implementation, resource allocation, and quality assurance processes within rural prehospital services. Furthermore, across all three prehospital systems, key legal protections such as Good Samaritan laws and legislation safeguarding prehospital responders were absent. As previously reported these protections are essential for strengthening community responses, ensuring provider safety, and improving emergency care outcomes.[38] Their absence may discourage bystanders from providing first aid or activating emergency services due to fear of legal liability, while also limiting protection for

prehospital personnel acting in good faith during emergency response.

Limited public awareness of existing legislation reported in this study, aligns with global concerns about the implementation gap in disseminating emergency care policies in LMICs.[39] Poor awareness of emergency care laws and policies may reduce public engagement with available emergency services, limit compliance with established procedures, and hinder the intended benefits of legislative and policy reforms.

Strengths and limitations

This study has several strengths. It is among the first studies to comprehensively assess prehospital emergency care resources in Rwanda using the WHO Prehospital Emergency Care Assessment Tool (PEAT) and the WHO prehospital EMS building blocks framework. The inclusion of both urban and rural prehospital systems enabled contextual comparison of resource availability across different settings. In addition, the study included key leaders responsible for planning, coordinating, and overseeing prehospital care services, providing detailed system-level information relevant to emergency care delivery.

Several limitations should be considered when interpreting the findings. The study employed purposive sampling and included only leaders from three selected prehospital care systems, which may have introduced selection bias and limited the generalizability of the findings. In addition, the analysis relied on responses to closed-ended questions, potentially limiting deeper understanding of contextual factors influencing prehospital care resources and services. The length of the questionnaire may also have contributed to participant fatigue. Furthermore, the assessment tool did not capture the availability of life-saving medicines. Despite these limitations, the study provides valuable insights into the availability and distribution of prehospital emergency care resources across selected urban and rural settings in Rwanda.

Conclusion

Prehospital emergency care resource availability and distribution varied across prehospital systems in Rwanda, with the urban public system demonstrating relatively greater capacity in governance, infrastructure, workforce, financing, and clinical protocols. Major gaps included uneven resource distribution, workforce shortages, reliance on volunteers, the absence of formally trained paramedics and a shared dispatch system, as well as weaknesses in legislation, financing mechanisms, and the availability of standardized protocols in urban private and rural public prehospital systems. Strengthening governance, legislation, financing, workforce development, and coordination systems is essential to improve equitable access to emergency care across Rwanda. Future studies should include a broader range of prehospital service providers, incorporate qualitative approaches to explore contextual factors, and assess the availability of life-saving medicines to provide a more comprehensive understanding of prehospital care systems in Rwanda.

CRediT authorship contribution statement

All authors have substantially contributed to this study. LR conceptualized, designed, collected and analyzed the data and drafted the manuscript as part of a PhD research project under the guidance of PM, IC, GU, and JC.B. All authors have reviewed and approved the final version of the manuscript.

Declaration of AI use

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with language editing, improving clarity, grammar, sentence structure, and overall readability. All scientific content, study design, data collection, data analysis, interpretation of findings, and final manuscript revisions were conducted and verified by the authors, who take full responsibility for the content of the manuscript.

Competing interests
The authors declare no competing interests.

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Supplementary

Table S1. Source of finance, private market share, and leadership and governance across prehospital systems

Financing of EMS/Private market share	**Urban Public**	**Urban Private**	**Rural Public**
There are public funding sources for the system.	Adequate	No	Adequate
Financing is organized and administered at the central level.	Adequate	No	Adequate
There is a government funded national health insurance scheme that covers prehospital emergency care.	Adequate	Somewhat	Adequate
Private ambulance services in the system's area are regulated.	Adequate	Somewhat	NA
Private ambulance services are coordinated with public services.	NA	No	NA
Leadership and governance			
There is an organized, defined system or process to transport patients to a healthcare facility	Adequate	No	Adequate
There is a distinction made between primary emergency responses and interfacility transfers.	Adequate	Adequate	No
There are mechanisms in place to repair broken equipment in a timely manner.	Adequate	Adequate	No
There are mechanisms in place to check, replenish and dispose of medications and equipment for prehospital providers.	Adequate	Adequate	Adequate
There are mechanisms in place to repair broken vehicles.	Adequate	Adequate	Adequate
The prehospital emergency care system is governed by a central authority.	Adequate	Adequate	Adequate
There are standardized system-wide operational protocols for providers to follow.	Adequate	Adequate	No
There is a chief executive officer (CEO) managing the prehospital system.	Adequate	Somewhat	No
There is a medical director or medical control officer (MCO) for the system.	No	Adequate	No
There is a chief operations officer (COO) for the system.	Adequate	No	No
There is someone responsible within the system for each of the following areas:			
clinical training.	Adequate	No	No
clinical governance and quality improvement.	Adequate	No	No
financial management.	Adequate	Adequate	No
supply chain management.	Adequate	No	No
human resource management.	Adequate	Adequate	No
facility and infrastructure management.	Adequate	Adequate	No
fleet management.	Adequate	Adequate	No
Communication and dispatch centres have dedicated managers.	Adequate	Adequate	No
The system has district managers	No	No	No
The system has station/base managers.	No	No	No
There is a method for the medical director to ensure the clinical compliance of the system.	No	Adequate	No
There are time targets for highest priority calls.	Adequate	Somewhat	No
There is a framework and plan in place to further develop the system as more resources become available.	Adequate	Adequate	No

Table S1. Continued

Financing of EMS/Private market share	Urban Public	Urban Private	Rural Public
Legislation mandating a universal method for system activation	No	No	Adequate
Legislation requiring telephone companies to be responsible for calls to the universal access number (UAN)/toll free number	Adequate	No	No
Legislation mandating universal access to prehospital emergency care, including removing financial barriers	No	No	No
Legislation protecting patients from theft and assault	Adequate	No	No
Legislation to protect bystanders who call for help or provide assistance to the acutely ill or injured.	No	No	No
Legislation to protect prehospital responders who provide care to the acutely ill or injured What does the legislation protect?	Somewhat	No	No
Legislation describing the role, responsibilities, and scope of practice of responders	Adequate	No	No
Legislation that mandates the prehospital emergency care system and defines its responsibilities.	Adequate	No	No
Prehospital legislation is well known to the public	Somewhat	No	No
Legislation regulating the use of emergency response vehicles	Adequate	No	No
Non-governmental ambulance services in Rwanda are regulated by the MoH	NA	Adequate	NA
RAHPC defines the prehospital emergency care system managed by the RRCS, defines its responsibilities, and provides oversight at the central level	NA	Adequate	NA

Abbreviations: EMS, emergency medical services; NA, Not applicable; RAHPC, Rwanda Allied Health Professional Council; RRCS, Rwanda Red Cross Society; MoH, Ministry of Health.

Table S2: Distribution of protocols and clinical checklists across urban and rural prehospital systems

Protocols/Clinical checklists	Urban Public	Urban Private	Rural Public
Initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	Adequate	Adequate	No
Trauma	Adequate	Adequate	No
Burns	Adequate	Adequate	No
Difficulty in breathing and asthma exacerbation	Adequate	Adequate	No
Shock	Adequate	Adequate	No
volume resuscitation of children and adults	Adequate	Adequate	No
Adjusting interventions for malnourished patients	No	Adequate	No
Altered mental status	Adequate	Adequate	No
Labour and delivery in low-risk women	Somewhat	Somewhat	No
maternal hemorrhage	Adequate	Adequate	No
Neonatal resuscitation	Adequate	Adequate	No
Pediatric resuscitation	No	No	No
Adult resuscitation	Adequate	Adequate	No
Trauma care checklist	Adequate	Adequate	No
Medical resuscitation checklist	No	Adequate	No
Backup medical guidance protocol for responders if needed.	Adequate	Somewhat	No
Pre-defined criteria to decide which healthcare facility a patient should be transported to.	Adequate	Somewhat	No
Handover protocol between the responders and the healthcare facility.	Somewhat	No	No
Triage patients' protocol in mass casualty incidents	Somewhat	Somewhat	No
Coordination with other services (police, fire, electricity)	No	No	No
Backup protocol when communications are down	Adequate	No	No
There is a protocol and process for interfacility transfers.	Adequate	Adequate	No