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Mapping the processes and information flows of a prehospital emergency care system in Rwanda: a process mapping exercise

Rwanda912 RIGHT Group

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ABSTRACT

Objective A vital component of a prehospital emergency care system is getting an injured patient to the right hospital at the right time. Process and information flow mapping are recognised methods to show where efficiencies can be made. We aimed to understand the process and information flows used by the prehospital emergency service in transporting community emergencies in Rwanda in order to identify areas for improvement.

Design Two facilitated process/information mapping workshops were conducted. Process maps were produced in real time during discussions and shared with participants for their agreement. They were further validated by field observations.

Setting The study took place in two prehospital care settings serving predominantly rural and predominantly urban patients.

Participants 24 healthcare professionals from various cadres. Field observations were done on 49 emergencies across both sites.

Results Two maps were produced, and four main process stages were described: (1) call triage by the dispatch/call centre team, (2) scene triage by the ambulance team, (3) patient monitoring by the ambulance team on the way to the health facility and (4) handover process at the health facility. The first key finding was that the rural site had multiple points of entry into the system for emergency patients, whereas the urban system had one point of entry (the national emergency number); processes were otherwise similar between sites. The second was that although large amounts of information were collected to inform decision-making about which health facility to transfer patients to, participants found it challenging to articulate the intellectual process by which they used this to make decisions; guidelines were not used for decision-making.

Discussion We have identified several areas of the prehospital care processes where there can be efficiencies. To make efficiencies in the decision-making process and produce a standard approach for all patients will require protocolising care pathways.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Process and information flow mapping are recognised methods to show where efficiencies can be made within healthcare systems in low-resource settings such as Rwanda.
⇒ We collected detailed information to synthesise visual summaries of the processes and information flows of a prehospital emergency care system serving rural and urban patients in Rwanda.
⇒ The process maps depicted the entire patient's experience, starting from making an emergency call to arriving at an emergency department of a health facility.
⇒ Process mapping uses a collective approach to capture all processes, however, some that are less frequent may have been missed.
⇒ We only involved healthcare workers in the study and may have missed processes as seen from the perspectives of patients or community members.

INTRODUCTION

Prehospital emergency care systems provide essential medical assistance in situations of acute and severe illnesses.[1 2] A pillar of an efficient prehospital emergency care system is getting an emergency patient to the right hospital at the right time.[1] Ideally, this should occur within 1 hour, also known as the 'golden hour'[3] for severely injured patients, and no longer than 2 hours for other emergencies.[3 4] Studies have shown that chances of survival decrease at times beyond 60 min or with increasing time elapsed since injury.[4 5] However, in low- and middle-income countries (LMICs), injury and other emergency sufferers are often delayed for more than 2 hours before reaching a hospital.[5] As in many other LMICs, there are substantial delays in reaching a treatment facility in Rwanda.[5–7] While rapid transfer, including via helicopter, to major trauma centres is standard in most high-income countries,[8 9] this is unfeasible in many LMICs, due to resource constraints.[7]

Reducing delays in patients reaching a healthcare facility adequately capable of

treating their illnesses can decrease avoidable deaths and disabilities.[4 5 10] However, evidence highlights that prehospital emergency care systems are under-resourced and under-researched in LMICs.[11 12] Systematic reviews have documented unnecessary delays to reach care and the imperative to enhance health system functioning in low resources settings.[13 14] There is, therefore, an urgent need to improve the efficiency of existing systems.

Many LMICs are investing in ambulance services to provide timely care at the scene and to reduce delays in getting injured patients to facility-based treatment.[14–16] In 2007, the Rwandan Ministry of Health (MoH) developed a prehospital emergency care system (Service D'Aide Urgente (SAMU)), that has grown from being Kigali-based to a countrywide medical service covered by Community-based Health Insurance.[17 18] More than 300 ambulances are deployed, linked by a national dispatch centre ('Dispatch'), and a national emergency service number: 912. They currently transfer approximately 8000 patients per year, around 70% of whom have non-intentional injuries.[19] Prehospital care services are provided by the ambulance crews (non-physician anaesthetists and registered nurses), and a data-based quality improvement programme is in place to ensure the quality of this care.[20] Improving the efficiency of existing systems is a priority identified by the Rwandan MoH in the Emergency Medical Services Strategic Plan (2018–2024).[18] However, improving efficiency requires the identification of inefficiencies in the prehospital care processes, thus informing tailored interventions for programme optimisation.

In this study—which is part of a broader research project to develop a communication system to improve ambulance response times and patient outcomes in Rwanda—we aimed to understand the process and information flow used by the SAMU prehospital emergency services in transporting community emergencies in urban and rural areas in Rwanda.

METHODS

Design

The study adopted a process mapping methodology comprising of facilitated group discussions leading to the creation and adjustment of maps in real time until consensus on process and information flows was reached. This was supplemented with field observations to validate the process maps in real-time practice.

Setting

Process and information flow mapping workshops were conducted in April and May 2023 in the emergency departments (EDs) of the University Teaching Hospital of Kigali (CHUK) located in the city of Kigali, and Ruhengeri Level Two Teaching Hospital located in Musanze district in the northern province of Rwanda. Both hospitals, which serve predominantly urban and rural patients, respectively, receive emergency and trauma patients from the local area mostly transported by SAMU ambulances.[12] Prehospital care services, including transport, are covered by the Community-based Health Insurance to which over three-quarters of the Rwandan population are subscribed.[17]

Kigali was selected for study given it is the largest conurbation in and capital city of Rwanda. Musanze was selected as a rural site; although it is the second largest city in Rwanda, the patient population catchment is predominantly rural. Its processes are also similar to other districts outside Kigali.

Field observations took place in July 2023 at the SAMU call centre, CHUK ambulance centre and ED in Kigali, and at the ambulance service of the ED at Ruhengeri Hospital in Musanze.

Data collection

Identification of study participants

Healthcare professionals from various cadres involved in receiving emergency calls, transporting patients and receiving them in EDs were identified using local contacts of the research team and snowball sampling. Potential participants included the SAMU ambulance crew (non-physician anaesthetists, registered nurses and drivers), SAMU call centre staff (dispatch team) and ED physicians from both hospitals. Participants were selected purposively based on the relevance of their role to the study question, noting that roles differ between the urban and rural settings. Between 8 and 12 participants per facility were invited to take part. To assist with the recruitment of health facility staff, a senior staff leader from each facility selected a sample of participants with a deep understanding of the processes of prehospital care for injured or other emergency patients.

Process and information mapping conduct

Participants took part in two facilitated group process/information mapping sessions lasting approximately 2–3 hours each, at a convenient time and quiet location in each facility. Facilitation was done by trained facilitators, AN and JI. Proceedings were conducted in Kinyarwanda, the local language, to allow easy expression for healthcare professionals. Beginning with an introduction to the concept of process mapping (with examples of similar studies[21–23]), workshop participants were then instructed on the requirements and methodologies for this study.

The maps and information pathways were created with specific reference to four hypothetical emergency scenarios (representative of the most common emergencies in Rwanda) which were discussed sequentially: (1) a road traffic accident, (2) an injured patient with a reduced conscious level, (3) an obstetrical emergency and (4) a mass causality scenario. Greater emphasis was placed on discussing the first scenario, given road traffic accidents are the predominant emergencies encountered by ambulance services in Rwanda, while subsequent discussions revolved around adjusting the maps to highlight and capture any differences between the scenarios

resulting from the setting, mechanism or type of injury. For each scenario, participants were asked to consider what the usual processes and information flow would be.

Kigali participants were presented with an urban process map produced previously in 2018 with a focus on understanding dispatch processes[24] and requested to check its accuracy and make corrections when appropriate. In Musanze, a process map was created by participants de novo as no previous mapping work had been done. We used draw.io program (https://app.diagrams.net) in real time to create a detailed process map that captures the current practices described by participants. Standard process map connotations were used.

After the process maps were constructed, they were used as a basis to understand information pathways and how the information is used in decision-making. Participants were asked to list the information and key indicators they use at each decision point in the process map to enable a decision to be made. Questions about information flow covered subjects such as: you receive a call from the bystander; what do they tell you? What information do you ask? What do you do with that information? Who do you tell it to? What do they ask? How do you proceed? What do you tell the health facility? What do they (health facility) ask? This information was captured as a list for each process stage and was overlayed on the newly developed process maps.

At the end of the sessions, the process maps developed were presented to participants for their agreement.

Field observation

Two trained research assistants (DH and FH) conducted field observations to validate the process maps in real-time practices. Similar approaches were used for field observations. However, because clinical pathways were different in Kigali (urban) and Musanze (rural), the observations started at the call centre office in Kigali, while they started at the ED in Musanze because the ambulance service is integrated with the ED. A checklist (online supplemental appendix 1) was used to collect data on the workflow of the people involved in prehospital emergency care and how they interact. The checklist was developed from the process and information flow maps and additional information captured in the discussions for their development. All process stages and information guiding the decision were verified during field observation.

Kigali

In Kigali, observations were conducted at the SAMU call centre office and in the field with the ambulance team. The data collection was conducted over a period of 4 days from 07:00 to 17:00 (9 working hours per day of data collection). At the call centre, data were recorded following calls received by dispatch teams. The process of how the dispatch teams responded and triaged calls was recorded as well as how they checked the availability of ambulances, which information decisions to dispatch the ambulance were based on and how they checked health facility availability and readiness. Observation of the ambulance team at the scene focused on how ambulance crews make decisions at every process stage (and on which basis), record data, communicate with the dispatch team, provide on-scene care, stabilise the client during transport, as well as the handover process to the hospital.

Musanze

In Musanze, observations were conducted at the ED ambulance service of Ruhengeri Level Two Teaching Hospital. The research assistants collected data for the period of 4 days from 07:00 to 17:00 (9 working hours per day of data collection) by observing the process in the ambulance throughout its movement and recording it on a checklist. All the necessary data for the whole process was collected, that is, from receiving the call to the handover at the hospital.

Similar approaches were used for field observations in both Kigali and Musanze. However, because clinical pathways were different in Kigali (urban) and Musanze (rural), the observations started at the call centre office in Kigali, while they started at the ED in Musanze where the ambulance service is integrated.

Analysis

Analyses are descriptive. Process and information flow maps were created in real time to ensure participant agreement with the end product. Field observation notes were discussed among the research team directly after observations were made to ensure all processes and flows were noted and agreed upon. The initial process and information flow maps were constructed as flow diagrams and findings from field observations were used to adjust them. The final outputs are a visual summary of the process and information pathways following injury and other emergencies in rural and urban areas in Rwanda.

Patient and public involvement

No patients or members of the public were involved in this particular study. However there is a plan to involve patients and the public in the broader study 'development of a novel ambulance communication system' in which the current study is embedded. The research team's previous work on injuries in Rwanda has identified persons who have been injured and wish to form a group to advocate for better care for injured persons. A community engagement group (injured persons community group) has been formed in Musanze.

Workshop participants gave written informed consent prior to their participation. For field observations, we got approvals from the emergency services leadership to conduct the observations. Participants were assured that their identities would remain anonymous in all reports of the study and that their personal information would be kept confidential. A series of meetings with staff had been held to sensitive them to the ongoing research; where field observations were done in clinical areas, patients

Table 1 Process mapping workshop participants by role

Participants role	Kigali University Teaching Hospital	Musanze Level Two Teaching Hospital
Registered nurses	3	11
Non-physician anaesthetists	4	0
Emergency physicians	2	0
Communication specialists	2	0
Ambulance driver	1	1
Total	12	12

were informed, however, patients were not the subject of the observations.

RESULT

Process and information flow processing results and interpretation

24 healthcare professionals from various cadres took part in the process mapping workshops. The most common participating cadres were registered nurses, 58.3% (14/24), followed by non-physician anaesthetists, 17% (4/24) (table 1). In total, 12 participants participated in each workshop.

Process and information flow maps for Kigali are shown in figure 1 and Musanze in figure 2. These show the start and end of the process that an individual patient is taken through following an injury or any other type of emergency. The information that the team involved in prehospital emergency care (call centre team, ambulance team, health facility team) uses at each decision question to enable a decision to be made is overlayed (circled in red) on each process stage. Four main process stages are described: (1) call triage by the dispatch/call centre team, (2) scene triage by the ambulance team, (3) patient monitoring by the ambulance team on the way to the health facility and (4) handover process at the health facility.

Kigali participants indicated that the previously existing process map (created in year 2018) captured current practices in Kigali. However, they indicated that it is missing details (ie, the scenario when the patient deteriorates or dies in the ambulance on the way to the health facility, and handover to non-alerted facilities). Thus, a new detailed process map was created in this study.

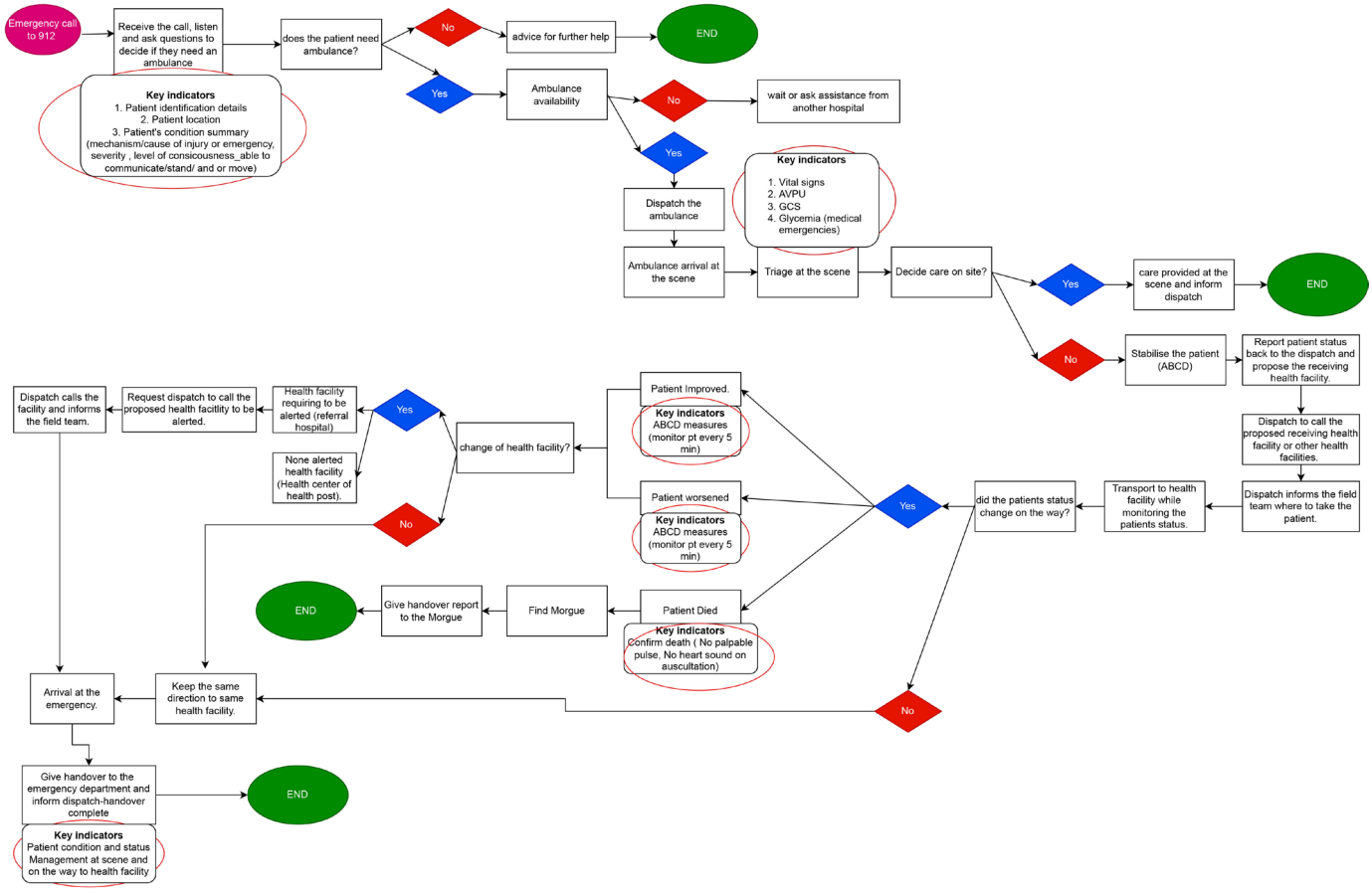

Figure 1 Kigali process map. ABCD, airway, breathing, circulation, disability; AVPU, alert, pain, voice, unresponsive; GCS, Glasgow Coma Score; pt, patient.

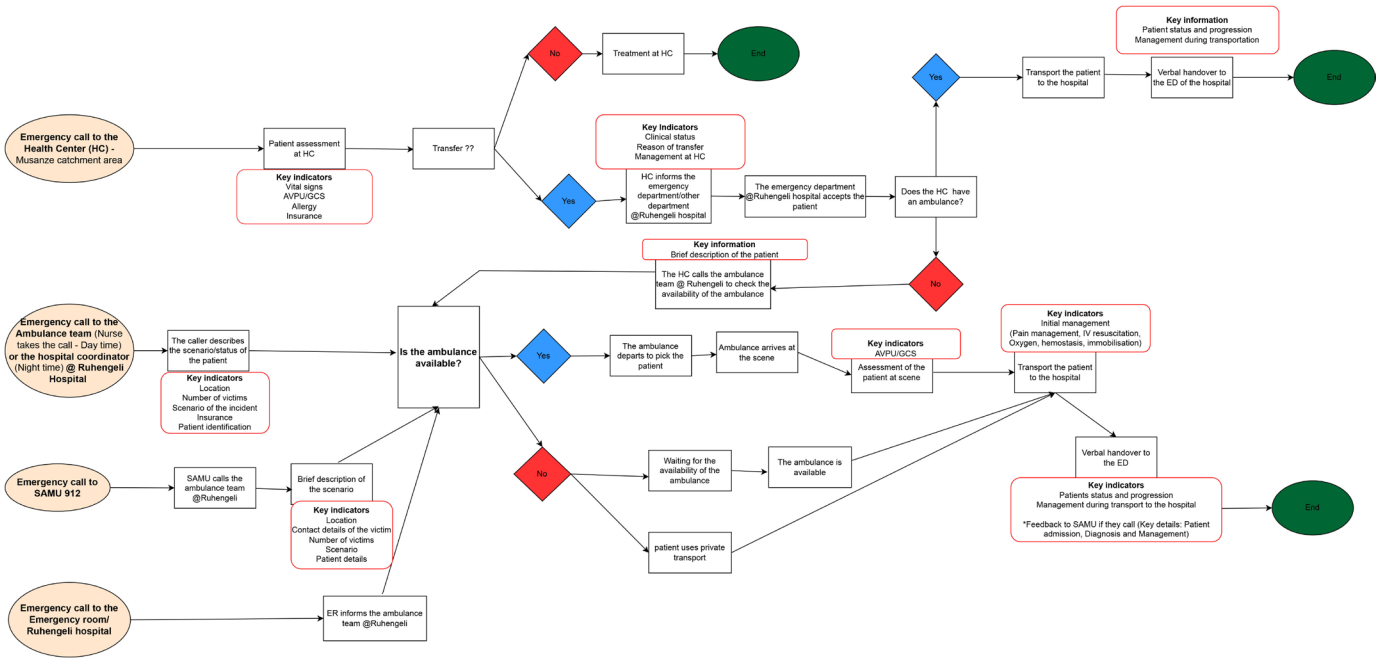

Figure 2 Musanze process map. AVPU, alert, pain, voice, unresponsive; ED, emergency department; ER, emergency room; GCS, Glasgow Coma Score; IV, intravenous; SAMU, Service D'Aide Urgente.

Process stage 1: call triage

The call triage process consisted of triaging emergency calls by dispatchers after receiving an emergency call through 912 for Kigali or through one of the four coordination phone numbers for Musanze (including one route through 912). The following key steps were typically followed in both sites: determining the location of the emergency; gathering basic information about the nature of the emergency; assessing the severity and urgency of the situation based on the information provided by the patient or bystander; determining priority for ambulance dispatch; dispatching the ambulance to the scene; or providing advice when no ambulance is prioritised.

There were four main call routes of entry into the rural site prehospital emergency system (four hospital coordination phone numbers—no call centre), whereas there was only one for the urban prehospital emergency system (the SAMU national emergency number; 912).

The entire catchment area for Musanze is served by one ambulance staffed by a nurse and a driver. The nurse in the ambulance is responsible for receiving and triaging emergency calls. Calls received come mainly from health centres except for one health centre that possesses its own ambulance. Patients—even if severely injured—usually go first to a health centre rather than the Ruhengeri level two referral hospital. Although some patients call an ambulance from the scene of the emergency, this is rare.

In Kigali, calls are received by a dispatch team composed of a communication specialist and a non-physician anaesthetist, also called a regulator. The regulator leads the decisions on dispatch ambulances and later supports with the choice of appropriate health facility destination. Table 2 details the key indicators that guide decisions in the call triage process for both sites.

Process stage 2: scene triage

In Kigali, ambulance crews perform a rapid initial assessment of the patient on arrival at the scene, to identify whether an immediate life-saving intervention is needed. Using the principles of ABC (airway, breathing, circulation) and examination of the patient, including vital signs, they prioritise management based on the urgency and severity of the patient's condition and categorise patients as those requiring immediate life-saving interventions, urgent medical care, those with minor injuries or those who are stable. Ambulance crews provide urgent medical interventions at the scene to stabilise those with life-threatening conditions or significant injuries. This may involve administering medications, airway management such as intubation, performing cardiopulmonary resuscitation or controlling bleeding. After the patient is assessed to be stable, the ambulance crews inform the dispatch team about the patient's condition and suggest an appropriate health facility through a radio phone. The regulator uses phone calls (sometimes multiple) to communicate with health facilities trying to find one that is ready to receive the patient. Once a health facility is confirmed, the dispatch team communicates with the ambulance crews through radio phone to announce the chosen health facility. The patient is then transferred to the health facility for further management. Table 2 illustrates the key indicators that guide decisions when prioritising patients at the scene. In Kigali, the ambulance team is composed of one non-physician anaesthetist, one registered nurse and one driver. We found that even though, large amounts of patient information is collected, ambulance crews do not use any standard triage guidelines to support their decision in triaging

Table 2 Process stages and key indicators that are collected and guide decisions in prehospital care

Process stages	Key indicators	
	Kigali	Musanze
Call Triage	► Patient identification. ► Number of patients. ► Patient location. ► Summary of patient condition.	► Patient identification. ► Number of patients. ► Patient location. ► Summary of patient condition.
Scene triage	► ABC (airway, breathing, circulation). ► Assessment of patient's conditions. ► Vital signs. ► Glasgow Coma Score. ► AVPU (alert, pain, voice, unresponsive). ► Glycaemia (for medical emergencies).	► Assessment of airways (is the patient breathing?).
Patient monitoring on the way to the health facility	► ABC measures and vital signs check (monitor patient every 5 min).	► Monitor airways.
Handover to emergency department	Verbal handover: ► Patients' condition and status. ► Initial management at scene and during transport to the hospital.	Verbal handover: ► Patient condition's summary.

patients and the decision is based on an individual judgement, taking vital signs and the emergency condition in consideration.

In Musanze, one nurse is dispatched to the scene together with the ambulance driver and, on arrival, performs airway checks and immediately transports the patient to the hospital; no other triage is performed. We found that patients who are attended by ambulances from the Musanze catchment area are transported to the Ruhengeri Level Two Teaching Hospital regardless of the patient's condition. Other hospitals existing in the area are district hospitals at the level of secondary health facilities.

Process stage 3: patient monitoring

In Kigali, when a decision is made to transport the patient to a health facility, the patient is monitored on the way to the facility by the ambulance crews. They continue to measure vital signs every 5 min to check the stability of the patient and in the case of severe deterioration, they may advise dispatch to change the health facility destination. In this case, they radio to dispatch suggesting a new facility (for instance opting for a tertiary hospital with advanced care abilities) and the process described above is repeated. In Musanze, the nurse in the ambulance monitors the patient's airway on the way to the health facility.

Process stage 4: handover process

We found that the handover is done verbally in some facilities and in others the information is documented in registries. The patient handover communication is not consistent or complete with some loss of patient information regarding initial assessment and management during transit.

Field observation results and interpretation

Table 3 illustrates the types of observed emergency cases during the filed observation period in both Kigali and Musanze.

Kigali (SAMU)

During the observation period, a total of 41 calls were recorded at the SAMU call centre located at the Rwanda Biomedical Centre, 32 of which were made from Kigali and 9 from outside Kigali. 24 calls were concerning trauma-related cases, 3 obstetrical cases, 4 palliative cases and 10 calls for other medical conditions. The majority (85%) of the calls were received in the afternoon. For the trauma cases, the dispatch team usually asked the caller (bystander) about the location of the scene, mechanism of injury, the severity of the injury, number of people involved, body part affected, if the victim is bleeding, the age of the victim, the ability of the victim to sit, ability to talk and breathing patterns. For non-trauma cases, the dispatch team asked the following: age, sex, type of emergency, patient location, and patient consciousness as well as the time of the last meal specifically for diabetic cases.

Table 3 Process mapping workshop participants by role

Types of observed emergency cases	Kigali (SAMU)	Musanze
Trauma cases	24	1
Medical cases	10	4
Obstetrical cases	3	3
Palliative cases	4	0
Total	41	8

SAMU, Service D'Aide Urgente.

Overall, the observation exercise confirmed that for most cases, activities were in line with the process map. Additional observations at the call/dispatch centre, not previously detailed on the process map included (1) when the ambulance is not available, the dispatch team advised the bystander to take the patient to the nearest health facility in the vicinity to wait for its availability, (2) for severe cases, the dispatch sends an ambulance to an appropriate health facility before informing the facility, fearing that the negotiation process with the facility might take a long time which in turn could result in delay of receiving care, (3) for calls from outside Kigali, the dispatch team called the ED or coordination team of the district hospital nearest to the caller, informing them about the patient and providing them with all the necessary information of the incident, and requesting them to send the ambulance to the scene. The dispatch team then informs the bystander that the ambulance from the hospital will arrive, (4) for special cases with compromised security and when SAMU had no immediate intervention, the police are called to intervene and provide emergency services to the victim, (5) there is no shared patient identification number between the ambulance services and the hospital, thus it is not possible to link prehospital and hospital information on the same patient, (6) some equipment for monitoring vital signs is fixed in the ambulance, therefore vital signs are not always assessed in the immediate patient appraisal.

Musanze

During the observation period, a total of eight calls were followed at Ruhengeri Hospital. The calls were all from different health centres. No call was received from the community or SAMU services in Kigali. Out of eight calls, four calls were obstetrical emergencies, two were respiratory emergencies (severe pneumonia in children), one call was trauma-related (fall) and one was a cardiopulmonary case. For medical cases, the nurse receiving the call asked about the clinical situation of the patient including type of emergency, age, severity, vital signs including fetal heart rate (specifically for obstetrical cases) and whether the patient had health insurance. For the trauma case, the ambulance nurse asked about the severity of injury, body part affected, age of victim and the management done at the health centre. In some situations, the ambulance was available for the first call while subsequent callers were informed that the ambulance was unavailable and were advised to wait for its availability.

In summary, for the observed emergency cases referred from Health Centres to Ruhengeri Hospital, the pathway followed the previously developed process map. Other routes for receiving patient calls, as detailed in the process map, were not observed. No triage was observed at the scene and there was no intervention in the community during the observation period. We also noted that the ambulance nurse was responsible for finding patient documents (eg, health insurance document, referral form) required for admission post arrival at the ED; this extended handover duration and created delays in responding to the other emergency calls.

DISCUSSION

In this study, we present a novel application and analysis of process and information flow mapping by visually representing the entire process of a prehospital care system using process maps. We described four main process stages: (1) call triage, (2) scene triage, (3) patient monitoring and (4) handover process at health facility. Process maps can be used not only to illustrate the care pathways, but also to gain a deeper understanding of the system complexity; our process and information flow mapping led to two important findings. While each of these findings could be the primary reason for an intervention to improve efficiency, they also provide the necessary knowledge to ensure the intervention is tailored to the need. The first is that the rural site had multiple points of entry (hospital coordination phone numbers) into the system for emergency patients, whereas the urban system had one place of entry (the SAMU national emergency number; 912). The second was that, although large amounts of information are collected to inform decision-making, participants found it challenging to articulate the intellectual process by which they used this information to make decisions and standard guidelines were not used for decision-making.

Process mapping technique has been studied previously for health systems assessments across multiple healthcare systems in LMICs.[21–23] In our study, we supplemented the process and information flow maps with observations. This approach led to the identification of multiple areas of inefficiencies in prehospital care processes, such as inefficient communication via mobile phones, organisational differences between urban and rural areas, non-protocolised prehospital care pathways, lack of adequate data capture and non-standardised and potentially erroneous handovers. Similarly, Ofosu *et al*, who used process mapping to establish process details of emergency obstetrical referral systems across different levels of public healthcare facilities in Ghana[25] found a range of barriers in relation to communication, transport system, resources, staffing, healthcare providers knowledge and compliance to referral policy and guideline and financing for referral.[25] These barriers had direct implications for delays in accessing care in Ghana.[25] Other researchers have also used process mapping to inform process re-design in emergency care and to address operational inefficiencies that contribute to issues such as ED overcrowding.[26–28]

An efficient prehospital care system requires coordinated care processes. Our finding of multiple points of entry into the system in the rural area with no single emergency call number for patients could potentially lead to confusion, difficulty coordinating emergency responses and loss of information. A unified call process has been shown elsewhere to result in more efficient and reliable

emergency system responses.[29] The fact that the majority of patients in the rural area who were deemed to need higher-level care first presented to local health facilities could also have caused delays in accessing appropriate care. Similar challenges have also been documented in other low-resourced settings.[30] Although health education may solve some of these issues, health education needs to be accompanied by ensuring that higher-level facilities are ready to manage an increased number of patients that might come directly to them.[31]

Also, inefficient mobile phone communication and coordination between ambulance, dispatch and receiving hospitals made it challenging for the ambulance team to achieve the goal of transporting the right patient to the right hospital within the right time. In many higher-resourced settings, the delays experienced in multiple phone calls to identify the facilities to which to transfer patients have been reduced by either designating some hospitals as being centres for particular types of patients or mandating that facilities cannot refuse patients unless under extreme circumstances, or both.[29] In low-resourced settings, the aforementioned solutions used in high-income countries may not be appropriate for reasons of challenges of facility readiness (eg, infrastructure, staff, equipment or medicines availability) which may make the ability of facilities to receive patients more fluid.[31 32] However, guidelines to prevent ready facilities from refusing patients should be considered for introduction, where possible.

Our finding that processes are not protocolised and standard clinical guidelines are not used is similar to other ambulance services in low-resource settings, where clinical decisions are mostly based on an individual clinician's judgement.[33 34] This means that decisions might not be appropriate and leads to inconsistency in decision-making; a patient seen by an experienced clinician one day may have a different decision made compared with if seen by a less experienced clinician on another day. A scoping review (including Rwanda and other 12 countries) by Malherbe *et al* evaluated the status and quality of prehospital clinical guidances in sub-Saharan Africa, revealed that the few existing guidance documents in use lacked an evidence foundation and failed to transparently report the guidance development process.[35] Similarly, other researchers highlight the limited clinical guidelines that directly address the needs of prehospital care in LMICs and recommend that strengthening guideline development capacity is a priority.[33 36]

The final major finding that the data capture and handover process is often not complete is a cause for concern given the plethora of information collected by ambulance crews and the utility of that information in informing initial care in the ED—especially for patients with communication issues.[37] That there is no shared patient code between the ambulance services and hospitals makes assessment of the clinical outcomes of prehospital care provided in the ambulance challenging, whereas this is a foundation of clinical audit and learning health systems.[38] This offers an opportunity to improve the handover and use a structured manner to ensure continuity of treatment.

Other studies that investigated ambulance services in LMICs highlighted that efficient and well-organised prehospital care systems are crucial for providing timely care at the scene and reducing delays in getting injured patients to facility-based treatment.[13 39] Likewise, Boschini *et al*, who assessed the effectiveness of a developing trauma system in Malawi, recommended that strengthening prehospital care and timely transfer from district hospitals could mitigate trauma-related mortality in resource-poor settings.[15] Therefore, unified and well-coordinated processes are required for better functioning prehospital care systems in low-resource settings including Rwanda.

Rwanda's investment in emergency medical services is rapidly growing. There is a political desire to improve the quality and efficiency of these services.[5 7] Our study has highlighted several issues and recommendations that could be addressed to support this political priority. The first recommendation is to protocolise prehospital care pathways by using context-specific clinical guidelines to both improve efficiency and standardise the decision-making process. The second recommendation is to improve prehospital communication by reducing the number of mobile phone calls and the number of points of entry into the system with a unified call centre number.

Our study has the following limitations. First, we acknowledge the limited consideration of participants' opinions of their usual processes. This was influenced by the focus of our study as we did not intend to analyse conversations with participants rather describe the processes and produce real-time process maps. Second, in our study of complex processes in this complex environment we may have missed some processes conducted with less frequency. Finally, involved solely healthcare professionals as participants and may have missed insights from a patient or community perspective. Nevertheless, our findings set the stage for further explorations of this interesting topic.

CONCLUSION

Process mapping provides an efficient method to understand and visually represent the processes and information pathways for community emergencies in Rwanda. This is an essential step for understanding complex prehospital emergency care systems and further processes re-design for the improvement of patient outcomes. Our findings suggest that, in order to optimise a well-functioning prehospital care system in Rwanda, there is a need to protocolise care pathways and improve the efficiency of communication. This suggestion is likely to ensure that injured patients and other emergency patients receive timely and quality care. Our approach and findings can also benefit other researchers wishing to evaluate prehospital emergency care systems for quality improvement in similar contexts.

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