Standardization of Prehospital Care in Kigali, Rwanda

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ABSTRACT

Background: Injury in the prehospital setting is a leading cause of death worldwide, and noncommunicable diseases (NCDs) and injuries substantially burden low- and middle-income countries (LMICs). Timely and effective prehospital emergency care improves outcomes, and these systems of care have been recommended by the World Health Organization (WHO). However, there is a gap in the literature on strategies to support effective prehospital care in LMICs. Through our collaboration with Service d'Aide Médicale d'Urgence (SAMU), the prehospital emergency medical service (EMS) in Kigali, Rwanda, we aimed to develop and implement standardized checklists and protocols for commonly encountered emergencies and assess the initial implementation.

Study design: The eight most common conditions treated by SAMU were identified through a previously established electronic registry. Protocols and checklists were drafted using established and publicly available resources from a regional EMS body in Virginia and customized using stakeholder analysis to fit the resources and setting in Rwanda. The metrics for each condition were incorporated into a single ambulance run sheet, and a 1-month pilot trial tracked checklist use and metric adherence.

Results: We aimed to create eight protocols and checklists. We focused on the eight most common conditions including extremity injury, traumatic brain injury (TBI), altered mental status (AMS), hyperglycemia, hypoglycemia, postpartum hemorrhage, adult acute respiratory distress, and pediatric acute respiratory distress. Initial results showed variability in prehospital care across the different complaints and highlighted the benefits of using checklists. Subsequently, the Rwanda Ministry of Health (MOH) approved the checklists as the national standard for prehospital care. Implementation is in its initial stages with additional data to come in a later publication.

Conclusion: Standardization of prehospital care is important in order to ensure patients receive optimal, evidence-based care. The program described in this study demonstrates how protocols and checklists can be implemented in the prehospital setting.

Keywords: Africa, Prehospital, Protocols, Rwanda, Standardization.

RESUMEN

Introducción: Las lesiones en el período prehospitalario son una de las principales causas de muerte en todo el mundo, y las enfermedades no transmisibles (ENT) y trauma cargan sustancialmente a los países de ingresos bajos y medios (LMIC). La atención de emergencia prehospitalaria oportuna y eficaz mejora los resultados y la OMS ha recomendado estos sistemas de atención. Sin embargo, existe una brecha en la literatura sobre estrategias para apoyar la atención prehospitalaria efectiva en los LMIC. A través de nuestra colaboración con SAMU, el servicio médico de emergencia prehospitalario en Kigali, Ruanda, buscamos desarrollar e implementar listas de verificación y protocolos estandarizados para emergencias comúnmente encontradas y evaluar la implementación inicial.

Diseño del estudio: Las condiciones más comunes tratadas por SAMU se identificaron a través de un registro electrónico previamente establecido. Los protocolos y las listas de verificación se redactaron utilizando recursos establecidos y disponibles públicamente de un organismo regional de Servicios Médicos de Emergencia en Virginia y se personalizaron utilizando análisis de partes interesadas para adaptarse a los recursos y el entorno en Ruanda. Las métricas para cada afección se incorporaron en una sola hoja de prueba de ambulancia y una prueba piloto de un mes de seguimiento del uso de la lista de verificación y la adherencia métrica. Resultados: Nuestro objetivo fue crear 8 protocolos y listas de verificación. Nos centramos en las ocho afecciones más comunes, como lesiones en las extremidades, lesiones cerebrales traumáticas, estado mental alterado, hiperglucemia, hipoglucemia, hemorragia posparto, dificultad respiratoria aguda en adultos y dificultad respiratoria aguda pediátrica. Los resultados iniciales mostraron variabilidad en la atención prehospitalaria en las diferentes quejas y destacaron los beneficios de usar listas de verificación. Posteriormente, el Ministerio de Salud de Ruanda aprobó las listas de verificación como el estándar nacional para la atención prehospitalaria. La implementación está actualmente en progreso.

Conclusiones: La estandarización de tratamientos para condiciones comunes probablemente mejorará los resultados del paciente. Este importante paso puede mejorar la atención prehospitalaria.

Palabras clave: África sub-sahariana, Prehospitalario, Protocolos clínicos, Ruanda.

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INTRODUCTION

Injury in the prehospital setting is among the leading causes of death worldwide.¹ The need for organized EMS systems in low and middle income countries (LMICs) has been well established; but as of 2015, trauma systems only existed in 10 LMICs with development primarily limited by cost.^{2,3} The World Health Organization (WHO)

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encouraged prehospital trauma care systems development through formal resources with case studies from Thailand, Mexico, Romania, and Cambodia, where effective trauma and emergency systems were developed and tailored to local needs.⁴ Checklists have been shown to improve patient outcomes in the hospital and prehospital settings and have been promoted by the WHO in LMIC settings as a mechanism to standardize care delivery for trauma and emergency services.^{5–10}

In Rwanda, the Ministry of Health (MOH) established the Service d'Aide Médicale Urgente (SAMU) in 2007 as one of the only publicly run national EMS services in sub-Saharan Africa. In 2014, a simple continuous trauma quality improvement program consisting of five basic clinical metrics was initiated and led to immediate and sustained improvement in all five metrics as well as a composite trauma quality score. If standardized, minimum basic injury care can reliably be provided by the SAMU staff.¹¹ Building on this experience, we hypothesized that developing and implementing protocols and checklists for the most commonly seen emergencies will improve the standardization of prehospital care and the quality of prehospital care delivery in this setting. In this pilot study, we describe the creation of standardized, context-appropriate protocols and checklists for common conditions managed by SAMU and report our preliminary results.

MATERIALS AND METHODS

Study Context and Setting

Rwanda is an East African country with a population of nearly 13 million.¹² Based in Rwanda's capital city of Kigali, SAMU treats approximately 3,500 patients annually. Its staff consists of 70 members, including nurses and nurse anesthetists, with a scope of practice higher than that of a basic emergency medical technician in the United States; however, there is no established EMS training or paramedic program in Kigali. The clinical staff are trained as bedside nurses and nurse anesthetists. Additional hands-on training through trauma, medical, maternal, neonatal, and pediatric emergency care courses were provided by Virginia Commonwealth University Medical Center (VCU) over the last year. A previously established deidentified electronic prehospital registry was used to determine the eight most common conditions treated by the SAMU staff for standardization: extremity injury, traumatic brain injury (TBI), altered mental status (AMS), hyperglycemia, hypoglycemia, postpartum hemorrhage, adult acute respiratory distress, and pediatric acute respiratory distress.¹³ It was decided to broaden the scope of standardization by including a variety of prehospital conditions, given prehospital care for trauma events had already been standardized and proven successful in the 2014 Quality Improvement (QI) program. Additionally, extremity injury and TBI encompassed the majority of traumatic injuries reported by SAMU staff.

Our collaboration has extensive experience in EMS systems based on our engagement locally and at the state level in Virginia. Virginia Commonwealth University, located in Central Virginia, has a catchment area equivalent to the country of Rwanda and is the largest level 1 trauma center in the state by volume. Multiple VCU faculty members lead EMS agencies around the region as operational medical directors and the senior author has been appointed by the current and previous governor to the Virginia State Governor's Advisory Board for EMS. Furthermore, the Old Dominion Emergency Medical Services Alliance (ODEMSA) which is a group of nearly 100 EMS agencies covering Central Virginia is known nationally and internationally for setting best practices in prehospital care and has established 83 protocols for various emergencies. The ODEMSA protocols served as a foundation for the

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development of the SAMU protocols. The ODEMSA protocols were molded to fit the Rwandan setting. Through collaboration across SAMU staff, emergency physicians, obstetricians, and pediatricians working at the University Teaching Hospital of Kigali (CHUK) and experts from VCU, context-appropriate evidence-based protocols and checklists were developed.¹⁴ Paired checklists were created for each of the protocols with 4–6 metrics that are likely to be the most valuable for each condition. An excel database and dashboard were created to track data prospectively and assess checklist adherence and quality of care.

Ethical Approval

The MOH Rwanda and VCU approved the study plan. The approval included access to SAMU's records. The project is part of a formal memorandum of understanding between VCU and the MOH of Rwanda to facilitate trauma and emergency systems development in Rwanda.

RESULTS

Forty-two protocols and checklists with associated metrics were developed and implemented in December 2018 across all 60 SAMU staff for use in Kigali, Rwanda. Our original goal of eight was exceeded as there was a request to have protocols for a range of common conditions of the ambulance. These protocols expanded on the current standard for prehospital care in trauma events and addressed a variety of conditions from emergency medical, obstetrics, and pediatrics. Every member of the ambulance service provided input into what they felt was important to be included in each protocol. They all participated in the review of the protocols as they were printed to allow for written comments over several weeks. The protocols were formally presented in a full-day intensive training session prior to the institution of all 42 protocols and checklists. An embedded fellow was present for the first 3 months of their use to provide assistance in the training of the protocols and checklists. The SAMU service has always held daily meetings to debrief on the patients transported over the previous 24 hours. These meetings continued, but a specific emphasis was placed on the understanding and utilization of the eight checklists, chosen as a pilot, in patients who qualified for their use. Since SAMU is a branch of the MOH of Rwanda, this facilitated high-level meetings with their staff. The protocols and checklists were formally presented and approved by the MOH as the standard for SAMU's prehospital care.

Fig. 1: Emergency medical services reference guide for service d'aide medicale d'urgence (SAMU) teams and example checklist from the guide

A new ambulance run sheet was developed for SAMU staff to record patient information in the field. The run sheet was designed to capture items in the eight checklists. Additionally, a quality improvement electronic dashboard allowed for run sheets to be electronically recorded and provided real-time metrics for staff to evaluate the care they provide.

To provide additional support to SAMU employees, the "EMS Reference Guide for SAMU Team" (Fig. 1) was created for easy access to checklists while providing services in the field. Included in this reference guide are checklists for the eight most common conditions treated by SAMU, including extremity injury, TBI, AMS, hyperglycemia, hypoglycemia, postpartum hemorrhage, adult acute respiratory distress, and pediatric acute respiratory distress (Fig. 2). All checklists included airway, breathing, circulation (ABC) assessment and universal care, measure of oxygen saturation (SPO₂), and administering oxygen if SPO₂ <90%, measure systolic blood pressure (SBP) and if SBP <100 place an intravenous (IV), i.e., for adults give a 500-mL bolus and for pediatrics 20 mL/kg bolus, and those appropriate include assess pain and treat according to pain scale ladder: step 1: mild pain (1–3): brufen/diclofenac/paracetamol; step 2: moderate pain (4–6): diclofenac/morphine/pethidine; step 3: severe pain (7–10): morphine/fentanyl/pethidine. Additional checklist items were created to specifically address the treatment for each condition. The reference guide included additional pages such as Glasgow Coma Scale definitions; a faces pain scale (0–10), a modified adult and pediatric pain scale ladder, a burn percentage assessment, a manual for pneumatic

Adult Acute Respiratory Distress

Possible Acute Asthma vs. COPD

- 1 ABCs, initiate general assessment and universal care.
- 2 Measure SpO₂ – administer oxygen if SpO₂ <90%. For COPD patients, use clinical judgment.
- 3 Give SALBUTAMOL 2.5-5.0mg via small volume nebulizer.

☐ Nebulizer with mouthpiece or facemask.
☐ Repeat salbutamol total 3 times every 20 minutes if respiratory distress persists and heart rate less than 120.
- 4 If wheezing give 10mg DEXAMETHASONE IV/IM/PO.
- 5 If asthmatic and not responsive to above, give:

MgSO₄
 40 mg/kg IV over 20 min
 (max dose of 2g)

ADRENALINE
 1:100,000 or 0.1 mg/kg IM
 every 5-15min to 0.3mg
- 6 If in critical respiratory distress:

☐ Patient responsive and breathing? **Support with bag mask valve ventilation (BVM).**
☐ Patient unresponsive? **Use BVM plus airway adjunct.**
☐ BVM is inadequate? **Consider BI-PAP or endotracheal intubation.**

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Fig. 2: Example checklist for adult acute respiratory distress

tourniquet application, pelvic binder application, and Kendrick binder application. The reference guide also contains the contact numbers for all emergency hospitals located in the four Rwanda provinces as well as Kigali city.

Although our main focus was the creation of the checklists, we report its first month of implementation. In its first month of use, SAMU was dispatched to 539 calls. Fifty-seven percent patients were female ($n = 307$), with a majority of patients between 18 years and 34 years of age ($n = 317$). The most common patient type treated was trauma ($n = 323$), followed by medical ($n = 91$) and obstetrics and gynaecology ($n = 89$) (Table 1). Checklists were used for 247 (48.5%) of the 539 calls. The most common patient condition collected within the checklists was extremity injury ($n = 164$) followed by AMS ($n = 27$) (Table 2). Checklist evaluation metrics were collected for each condition (Tables 3 to 10). Percentage adherence was highest for the metric administered oxygen when SPO₂ <90%, i.e., close to 100% of patients received oxygen when appropriate. The metric with the next highest adherence was assess the ABCs, adherence was between 64% and 100%. All metrics were appropriately treated for patients with hyperglycemia ($n = 2$) but varied for other checklists (14.3–87.5%). Only two patients had all metrics treated for postpartum hemorrhage, which was later determined to be a supply issue.

DISCUSSION

We collaboratively developed and implemented 42 protocols, 8 of which were piloted for the most common conditions seen by SAMU in Kigali, Rwanda. Our preliminary results are based on a

small sample size and short period of implementation; however, they provide evidence that the current model of prehospital training has room for improvement. Our results show that common metrics,

such as assessing the ABCs or the administration of oxygen in hypoxic patients, had the greatest adherence; however, condition-specific metrics had lower adherence. These discrepancies in adherence are likely attributed to protocols being new. Additionally, adherence was greater in the more frequent complaints, such as extremity injury and TBI, and lower in those that were less commonly seen, such as hypoglycemia or postpartum hemorrhage. Postpartum hemorrhage had the lowest adherence across all metrics when compared to all other complaints. This could have been because some of the metrics for postpartum hemorrhage were not recorded on previous run sheets and staff were not used

Table 1: Patient demographics from 1-month pilot trial

	<i>Total number of patients</i>	<i>Percentage</i>
Patient type		
Trauma	323	60
Medical	91	17
Obstetrics/gynecology	89	16.5
Neonatal	10	1.9
Pediatric	8	1.5
Not specified	18	3.3
Gender		
Female	307	57
Male	221	41
Missing	11	2
Age range (years old)		
<18	37	6.9
18–34	317	58.8
35–58	136	25.2
60+	31	5.8
Unspecified	18	3.3

Table 2: Checklists utilized from 1-month pilot trial

<i>Checklist condition</i>	<i>Total number of patients</i>	<i>Percentage</i>
Extremity injury	164	66.4
Altered mental status	27	10.9
Postpartum hemorrhage	14	5.7
Adult acute respiratory distress	12	4.9
Pediatric acute respiratory distress	11	4.5
Hypoglycemia	9	3.6
Traumatic brain injury	8	3.2
Hyperglycemia	2	0.8

Table 3: Extremity injury prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	146	164	89
Administer oxygen if SPO ₂ <90%	4	4	100
IV fluid bolus if SBP <90 mm Hg	3	3	100
Check pulses in all extremities	139	164	84.8
Pain management w/pain score >0	135	159	84.8
All assessments appropriately completed	101	164	61.6

Table 4: Traumatic brain injury prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	8	8	100
Administer oxygen if GCS <8	1	1	100
Administer oxygen if SpO ₂ <90%	4	4	100
IV fluid bolus if SBP <100 mm Hg	–	0	–
Apply cervical collar if GCS <8	1	1	100
Admin. dextrose if glucose <60 mg/dL	–	0	–
Apply dressing with scalp/facial bleeding	3	3	100
Pain management w/pain score >0	4	5	80
All assessments appropriately completed	7	8	87.5

Table 5: Altered mental status prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	20	27	74.1
Administer oxygen if SpO ₂ <90%	3	3	100
IV fluid bolus if SBP <100 mm Hg	1	3	33.3
Administer dextrose if glucose <60 mg/dL	–	0	–
All assessments appropriately completed	19	27	70.4

Table 6: Hyperglycemia prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	2	2	100
Administer oxygen if SpO ₂ <90%	–	0	–
IV fluid bolus if SBP <100 mm Hg	1	1	100
If mental status altered measure blood glucose level	–	0	–
If glucose level >300 mg/dL administer IV fluid	–	0	–
All assessments appropriately completed	2	2	100

Table 7: Hypoglycemia prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	6	9	66.7
Administer oxygen if SpO ₂ <90%	–	0	–
If mental status altered measure blood glucose level	–	0	–
If blood glucose <60 mg/dL administer IV dextrose or oral glucose 15 g	4	4	100
All assessments appropriately completed	6	9	66.7

Table 8: Postpartum hemorrhage prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	9	14	64.3
Uterine massage	2	14	14.3
Administer oxygen if SpO ₂ <90%	–	0	–
Measure SBP, administer IV fluid bolus	5	14	35.7
All assessments appropriately completed	2	14	14.3

Table 9: Pediatric acute respiratory distress prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	7	11	63.6
Administer oxygen if SpO ₂ <90%	1	1	100
Administer salbutamol	–	0	–
All metrics appropriately treated	7	11	63.6

Table 10: Adult acute respiratory distress prehospital management

<i>Assessment</i>	<i>Number of patients who received assessment</i>	<i>Total number of patients who could have had assessment</i>	<i>Percentage adherence</i>
Assess ABCs	10	12	83.3
Administer oxygen if SpO ₂ <90%	3	3	100
All assessments appropriately completed	10	12	83.3

to marking it off as an action item on the new run sheet. Several of the metrics that were included in the checklists were not easily measurable (i.e., reduction of a pulseless extremity) or not available on the ambulance (i.e., cardiac monitoring). While these findings may have a variety of explanations from supply chain constraints to novelty of the checklists, our results suggest that standardizing care through the use of protocols will require additional education for condition-specific care moving forward to ensure consistent delivery of high-quality prehospital care.

Globally 45–50% of deaths are preventable with effective emergency care.¹⁵ Therefore, resource-constrained settings must ensure delivery of high-quality care. While standardization of care

through protocol and checklist development can improve care delivery, fewer than 1% of existing protocols are directly applicable to LMICs, as most of the data comes from the United States, Europe, and Australia.¹⁶ Developing prehospital protocols may be a time-consuming process, especially as they need to be customized to settings with a wide range of resources in order to be useful.^{8,17} Based on discussions with SAMU and evaluation of their existing database, we adapted 42 protocols to become context-appropriate standards for prehospital care in this setting. Some interventions needed to be adjusted due to resource limitations, such as the lack of a cardiac monitor on the ambulances in Rwanda. Several medications needed to be contextualized due to availability in

Rwanda, such as the use of salmeterol instead of albuterol for management of respiratory distress. We made changes with expert input from a wide range of fields, which is integral to high-quality protocol development.^{16–18} Nevertheless, there were large variations in preliminary adherence to various checklists and within each checklist to each metric being measured which indicate that this process can be used to identify constraints to high-quality care delivery in the prehospital setting in an LMIC.

Our study has inherent limitations. While we assessed adherence to checklists, we did not aim to show changes in clinical outcomes as our focus was on the creation of the protocols and checklists and the month they were introduced. Based on the previous QI program, we expected an immediate improvement in the quality of care provided by SAMU upon implementation of the checklists and new run sheet. While we anticipated that most of the staff would be interested in learning about the motives and internally motivated to meet them, this project did not provide any incentives or disincentives to staff for meeting or not meeting the metrics. This likely contributed to the overall lack of adherence to the checklists during the pilot month. We aimed to engage staff during the metric development process to promote buy-in as this was sufficient and effective for the injury metrics, but this was a much larger project and required much more engagement. We did not include specific variations among each provider in adherence to the protocols/checklists, so it is difficult to determine whether there is a systemic issue in adherence or individual oversight.

Furthermore, this database is a new system, and there is no data entry audit which means that transcription and entry errors may have contributed to low adherence rates. It is unclear whether the focus on measurable metrics affected the rates of completion of metrics that were unmeasured. Lastly, this study may have limited applicability outside Rwanda or outside major metropolitan cities in Africa as resources and political environments vary across settings and affect the quality and efficacy of existing trauma and emergency systems in each setting.

Several challenges were faced during collaboration with the government agencies at a local, regional, and national level. French was the national language of Rwanda until recently, which led to an inherent language barrier between the authors and SAMU staff. The previously used run sheets were written in French and needed to be translated. Additionally, many of the new run sheets were completed in French, which could lead to a loss of information in translation as they were entered into the database by an English speaker.

Owing to our previous work and collaboration with the MOH, and the fact that SAMU was a division of the MOH, we were able to arrange meetings with MOH officials. Multiple drafts of the protocols and checklists were made and revised before everyone agreed and approved the documents. Obtaining approval for implementation of the protocols and checklist was a long and time-consuming process requiring several meetings with the ambulance staff, the director of SAMU and Rwandan MOH. Several inherent barriers existed including the time difference, geographical distance between Rwanda and Virginia, and potential internet connectivity problems when entering data. Having an embedded research fellow in Rwanda dedicated to the project allowed for a more streamlined process.

CONCLUSION

Standardizing treatments of common conditions ensure optimal patient outcomes. The increasing burden of NCDs and injuries in

LMICs requires effective trauma and emergency systems to limit needless morbidity and mortality. The literature regarding the development and implementation of protocols for prehospital care in LMICs is limited, but we were able to demonstrate the feasibility of successfully developing and implementing standardized protocols and checklists for prehospital care in Kigali, Rwanda. Further follow-up is in progress to evaluate the consistency of protocol use and checklist adherence over time.

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