Emergency Care Assessment Tool for Health Facilities: A Validity Study in Cameroon

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DECLARATION:

I, Paul Kim, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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TABLE OF CONTENTS

1. Chapter 1: Introduction 1
   1.1 Background 1
   1.2 Emergency care definitions 2
   1.3 Motivation 3
      1.3.1 Measuring emergency care system capacity 5
      1.3.2 Barriers to developing emergency care services 6
   1.4 Research Question 7
      1.4.1 African Federation for Emergency Medicine 7
      1.4.2 Development of the Emergency Care Assessment Tool 7
      1.4.3 ECAT refinement 8
      1.4.4 Problem statement 9
   1.5 Aim and objectives of study 10
      1.5.1 Aim and objectives 10
      1.5.2 Study purpose 10

2. Chapter 2: Literature Review 11
   2.1 Emergency care in Africa – a brief history 11
   2.2 Existing emergency care assessment tools 12
      2.2.1 WHO tools 15
      2.2.2 Non-WHO tools 17
   2.3 Previous validation studies using major tools 19
      2.3.1 WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care 20
      2.3.2 WHO Guideline for Essential Trauma Care 21
      2.3.3 Other current tools 22
   2.4 AFEM Emergency Care Assessment Tool 23
      2.4.1 Signal functions and sentinel conditions 23
      2.4.2 Origins of ECAT 24
      2.4.3 Previous ECAT Cameroon results 25
      2.4.4 Final form of ECAT 26

3. Chapter 3: Methodology 29
3.1 Study design 29
3.2 Study setting 29
3.3 Study population 30
3.4 Inclusion and exclusion 31
3.5 Data collection 31
3.5.1 Administration of ECAT 31
3.5.2 Survey procedures 31
3.5.3 Validation protocol 32
3.6 Data analysis and management 34
3.6.1 McNemar test 34
3.6.2 Data organisation 36
3.6.3 Data management 36
3.7 Ethics 37
3.7.1 Ethics approvals 37
3.7.2 Risk and benefits to interviewees 37
3.7.3 Informed consent 37
3.7.4 Language 38
3.7.5 Administrative reimbursement 38

4. Chapter 4: Results 39
4.1 Overall Trends 39
4.1.1 National level 40
4.1.2 Regional level 40
4.1.3 District level 40
4.2 McNemar tests of ECAT 42
4.2.1 National emergency facility 42
4.2.2 Regional emergency facility 42
4.2.3 Urban district emergency facility 43
4.2.4 Suburban district emergency facility 44
4.2.5 Rural district emergency facility 45
4.3 Sentinel conditions 46
4.3.1 Sentinel conditions as reported by facility heads of emergency 46
4.3.2 Sentinel conditions as directly observed by ECAT research team 47

4.3.3 McNemar analysis of sentinel conditions 49
4.4 Barriers to delivery 50

5. Chapter 5: Discussion 53
5.1 Statistical interpretation 53
5.1.1 National emergency facility 53
5.1.2 Regional emergency facility 53
5.1.3 Urban district emergency facility 54
5.1.4 Suburban district emergency facility 54
5.1.5 Rural district emergency facility 55
5.2 Signal functions 56
5.2.1 Rare signal functions 57
5.3 Sentinel conditions 57
5.3.1 Head of emergency report 57
5.3.2 ECAT research team observations 59
5.3.3 Interpretation of sentinel condition statistics 59
5.4 Overall validity of ECAT 60
5.5 Barriers to delivery 61
5.5.1 Infrastructure: resource and equipment location 62
5.5.2 Infrastructure: maternal health 63
5.5.3 Policies: pre-payment 64
5.6 ECAT administration 64
5.7 ECAT in context of existing tools 65
5.8 Value and utility of ECAT 67
5.9 Limitations of study 68

6. Chapter 6: Conclusions 70
6.1 Recommendations 70
6.1.1 Reliability and validity studies 70
6.1.2 Cultural appropriateness 70
6.1.3 ECAT administration and usability 71

7. References 72
8. Appendices 79

ABSTRACT

Background

To date, health facilities in Sub-Saharan Africa have not had an objective measurement tool for evaluating comprehensive emergency service provision. One major obstacle is the lack of consensus on a standardised evaluation framework, applicable across a variety of resource settings. The African Federation for Emergency Medicine (AFEM) developed an assessment tool specifically for these settings - the Emergency Care Assessment Tool (ECAT) - that assesses provision of key medical interventions. These interventions are referred to as signal functions for the six sentinel conditions that occur prior to death: respiratory failure, shock, altered mental status, severe pain/trauma, and dangerous fever. A signal function represents the culmination of knowledge of interventions, supplies, and infrastructure capable for the management of an emergent condition.

Previous studies aimed at the refinement and context modification of the ECAT have already been performed in multiple African countries. We undertook a validation study to help determine the applicability of the tool in assessment of emergency services throughout the continent.

Aims and Objectives

The aim of this study was to determine the content, construct, and face validity of the AFEM Emergency Care Assessment Tool in Cameroon. To achieve this, the study had the following objectives: (1) Employ the ECAT in district, regional, and central hospitals in Cameroon. (2) Use direct observation to determine whether the signal functions can be performed in these facilities.

Methods

This was an observational study at a convenience sample of five hospitals in Cameroon: three district, one regional, and one central. The goal of this study was to validate the instrument, not the facility, and so the sample size was related to the number of signal functions witnessed rather than the number of facilities visited. The tool was administered with the Head of Emergency at each facility. This completed ECAT was then compared with direct observations of the signal functions, a process which was conducted by the partner local emergency care specialists accompanied

by the ECAT researcher.

Results

In general, the higher the level of facility, the greater the emergency care capacity and the greater the number of signal functions that could be performed correctly and consistently. Discrepancies in funding, supplies, resource allocation, and care delivery ability were apparent through ECAT results, expounding on barriers to care delivery, and direct observation. McNemar tests on the ECAT results versus direct observation at each facility yielded statistically significant support for tool validation at the national level emergency unit as well as two of the district level emergency units. Concordance between reported and observed signal functions could not be achieved at the regional facility and one of the district facilities.

Conclusions

The ECAT has good potential for facility level assessment of emergency care provision, and collects meaningful information that can guide effective improvements in the delivery of emergency care.

ACRONYMS AND ABBREVIATIONS

AFEM	The African Federation for Emergency Medicine
ECAT	Emergency Care Assessment Tool
EmOC	Monitoring Emergency Obstetric Care Handbook
G-TSET	Global Trauma System Evaluation Tool
HCW	Health Care Worker
IFEM	The International Federation for Emergency Medicine
IMEESC	Integrated Management for Emergency and Essential Surgical Care
INTACT	International Assessment of Capacity for Trauma
LMIC	Low- and Middle-Income Countries
MoH	Ministry of Health
PIPES	Personnel, Infrastructure, Procedures, Equipment, and Supplies
TSAAEESC	Tool for Situational Analysis to Assess Emergency and Essential Surgical Care
WHA	World Health Assembly
WHO	World Health Organization

LIST OF TABLES

Table 1	Emergency facility statistics	39
Table 2	Signal functions at health facilities in Cameroon	41
Table 3	McNemar 2x2 for national emergency unit	42
Table 4	McNemar 2x2 for regional emergency unit	43
Table 5	McNemar 2x2 for urban district emergency unit	44
Table 6	McNemar 2x2 for suburban district emergency unit	44
Table 7	McNemar 2x2 for rural district emergency unit	45
Table 8	Percentage of signal functions unable to be performed - reported	46
Table 9	Percentage of signal functions able to be performed - reported	47
Table 10	Percentage of signal functions unable to be performed - observation	48
Table 11	Percentage of signal functions able to be performed - observation	49
Table 12	McNemar test p-values for sentinel conditions at emergency facilities	50
Table 13	Reported barriers to delivery of signal functions	51
Table 14	Validity findings at emergency facilities	55

LIST OF APPENDICES

Appendix A	Emergency Care Assessment Tool (English)	79
Appendix B	Emergency Care Assessment Tool (French)	89
Appendix C	Instructions to Administer ECAT	99
Appendix D	Background Information Questionnaire	100
Appendix E	ECAT Consent Form (English)	102
Appendix F	ECAT Consent Form (French)	108
Appendix G	University of Cape Town HREC approval	114
Appendix H	Cameroon Ethics Approval	115
Appendix I	Cameroon Facility Approvals	116

CHAPTER 1
Introduction

1.1 Background

Medical emergencies can occur to any person at any time. Emergencies happen everywhere, and “all healthcare facilities will be faced with acutely ill patients, whether they are prepared or not” (1). The ideal sequence of events at these facilities would be for the emergency condition to be recognised and for rapid, evidence-based interventions to prioritise, stabilise, and properly manage patients, including access to further escalation of care if indicated (1). Currently, while many high-income countries have recognised this important role and have organised emergency care systems, the same is not true of most low and middle income countries (LMICs), where multiple barriers continue to exist, reducing access to those who are most in need of emergent care (2–5).

Well-functioning emergency care systems have been demonstrated to significantly improve morbidity and mortality on local, regional, and country-wide scales (6–8). Delays in adequate emergency care provision lead to avoidable deaths (7). This is particularly important as proper, expedient treatment can potentially ease the disease burden of a multitude of conditions that disproportionately affect low resource settings (9). In fact, the Disease Control Priorities in Developing Countries project calculated that 36% of disability and 45% of deaths in LMICs could be avoided by emergency care system development (10).

As an increasing literature demonstrates that emergency care provides life-saving interventions and benefits, demand for these services is rising, especially in countries that have not yet incorporated emergency care into their health systems (6). As a result, support for emergency care system development has seen a corollary increase in emergency care training in medical school curricula, nurse training, emergency medicine specialist training programmes, and the development of national ambulance services (11–14). However, despite this, progress is slow; formal structures, especially in low resource settings such as in Africa, are only in the beginning stages.

Recognising the significance of this work, the Sixtieth World Health Assembly (WHA) passed Resolution 60.22, which detailed the need for a country to have a “formal, emergency medical-care system,” urging its member states to “assess

comprehensively the prehospital and emergency-care context" (5,15). However, despite global recommendations for the evaluation and development of emergency care from significant health bodies, there is still a paucity of formal mechanisms to evaluate and develop such services.

1.2 Emergency care definitions

The terms 'acute care', 'emergency care', 'emergency medicine', and 'emergency services' are all widely used but understanding varies. They are often perceived as synonyms, used interchangeably but incorrectly. Recently, precise definitions were proposed in order to clarify the discussion surrounding the advancement of such services (4).

'Acute care', as defined by the African Federation for Emergency Medicine (AFEM), entails "*the provision of initial resuscitation, stabilisation, and treatment to acutely ill and injured patients, and delivery of those patients to the best available definitive care, regardless of their ability to pay*" (4). It is an expansive term that encompasses numerous domains such as emergency care, urgent care, prehospital care, trauma care, critical care, short term stabilisation, and acute care surgery (8). It thus refers to a wider, systems level service, requiring a functioning health system with proper infrastructure (4). Important to note is that this definition emphasises access to, and quality of, services in its definition.

The term 'emergency care' refers to a specific aspect of acute care - *"treatment of acute life- or limb-threatening medical and potentially surgical needs, such as acute myocardial infarctions, acute cerebrovascular accidents, or evaluation of patients with abdominal pain*" (8). The two essential concepts encompassed in the definition of emergency care are those of urgency and risk. Intervening in a timely and efficient fashion for patients with conditions of high morbidity and mortality are at the crux of what emergency care services must provide (1). The approach to this is twofold; one must first recognise life-threatening and time- sensitive syndromes and then subsequently take proper and necessary steps to stabilise and manage these patients (1). Importantly, at the root of this approach is the general implicit agreement of the universal right to emergency care. There is a tacit understanding that the provision of emergency care can determine outcome and mortality and therefore exert a profound influence on a person's and society's subsequent health (7).

'Emergency medicine' (EM) is a specialist-based service defined by the

International Federation for Emergency Medicine (IFEM) as a "*field of practice based on the knowledge and skills required for prevention, diagnosis and management of acute and urgent aspects of illness and injury affecting patients of all age groups with a full spectrum of episodic undifferentiated physical and behavioural disorders; it further encompasses an understanding of the development of prehospital and in-hospital emergency medical systems and the skills necessary for this development*" (16). It has a specific training programme with standardised and structured curricula and examination with a primary focus of providing emergency care (17). It should not be confused with 'acute care' or 'emergency care'.

In this dissertation, the terms 'emergency care' and 'emergency services' are used when describing the services provided by a facility to a patient presenting with an acute illness or injury. The wider system-based concept of 'acute care' was of too broad a scope to be evaluated.

1.3 Motivation

In 2007, at the 60th WHA, a resolution was passed stating emergency care as an essential component of a country's health system (15). However, despite the weight and significance of this global declaration, emergency care delivery remains largely underdeveloped in Africa. The level and specifics of care delivery vary throughout the continent, but the development of formalised structures for emergency care on the continent is only in the beginning stages (17). The majority of facilities do not have a discrete area for emergency care. Many only have a small area within a facility that has a limited ability to provide basic emergency services. Unfortunately, it is only a relatively infrequent occurrence to have a separate emergency unit or casualty ward (18). It is rarer still to have one that functions properly – those hospitals with dedicated emergency units frequently only have them in appearance. Rather than functioning to provide emergency care services and interventions, in practice, they often serve as mere arrival areas for patients (6).

Resources dedicated to these distinct facilities for emergency care can differ significantly based on facility levels and location. In basic level facilities, emergency care is frequently indistinct from general preventative care and is typically composed of a one-room facility with a single health care practitioner (2,3). Even at the district level, it is often the case that a designated area for emergencies is not available. Referral level facilities can also differ considerably in their capacity to manage acute

conditions due to widely varying circumstances in terms of equipment, infrastructure, and services provided (2,3). Clearly, there is currently no standardised definition of these facility designations that elucidates care provision ability or quality.

Access to emergency care is also varied and limited (17,19). Many countries in Africa lack formal transportation systems for emergencies; it thus falls on the patient and family have to organise, negotiate, and fund their passage to the most convenient local health facility, which then may not even be equipped to handle acute conditions (19). This fact, coupled with considerable barriers to seeking care such as poor health literacy and diminished faith in the health system, serves to exacerbate these limitations (19). Thus, too frequently, acutely ill patients use primary care centres, along with the centre's resources and staff, which are usually not equipped or trained in emergency care, delaying definitive care and worsening outcomes (20). These shortcomings become increasingly significant when one considers the fact that in practice, many patients continent-wide do not utilise preventative primary care services, but opt instead to engage in health seeking behaviours only when acutely symptomatic (21).

Furthermore, upon patient presentation to a health facility, the majority of hospitals in Africa do not yet utilise formal triage processes (3). Instead, a first come, first served model predominates over acuity-based prioritisation (3). Because of this, acutely or severely ill patients may have to wait long periods of time, delaying time critical interventions (22). This lack of triage has been shown to cause delays in crucial early interventions ultimately resulting in increased morbidity and mortality (22). In addition, facilities and training programmes often have a marked absence of proven treatment protocols that decrease mortality rates (23).

Emergency care development in Africa is also inhibited by an extreme paucity of available data documenting the burden of disease (18). This data void extends to the types of clinical presentations arriving at facilities, interventions attempted, and associated outcomes (24). Across such a huge and varied continent and population, there is very little information on what specific conditions different facilities or how each facility or region is managing these conditions (10,24). Thus, measures on quality, its regulation, and strategies for its improvement are also lacking (18). Recognising this absence of data, the Disease Control Priorities project emphasised the need for further research on critical condition epidemiology as well as targeted interventions addressing those conditions (10). In order to improve efficiency and outcomes as well

as establish cost-effective and locally-appropriate emergency services, it is necessary to first document the current state of emergency care in Africa (10).

1.3.1 Measuring emergency care system capacity

In defining the function and role of health systems, the World Health Organization (WHO) state that a responsibility of a health system is "t*o improve the health of the population they serve, while responding to people's legitimate expectations and protecting them against the cost of ill-health through a variety of activities whose primary intent is to improve health*" (25). Thus, a health system is necessarily a dynamic entity that is meant to not only evolve and improve, but have the means to identify where and how to do so. In order to strengthen health systems, there must first be a way to identify problems, a mechanism to measure the problems, and finally, a way to effect health improving changes through sufficient access, improved efficiency, increased quality, and financial coverage (25). Strengthening an emergency care system through these measures will augment the holistic function of the health system.

Before development and improvement of emergency care services can occur, governments must first determine the current state of function and availability of their facilities and services. (10). However, it has already been acknowledged that there is currently limited information on the resource and capacity state of facilities; most data are either limited in scope or give only incomplete insights into emergency care services as a whole (26). For example, instead of evaluating the full breadth of emergency services, a 2011 study at hospitals in Ghana, Rwanda, Uganda, Kenya, and Tanzania specifically evaluated the barriers to providing adequate emergency surgical care (20). None of the hospitals in the study met the WHO's essential minimum standards in basic infrastructure, equipment, medicine storage, infection control, education, quality control, or 24-hour services, however this represents only a small fraction of the state of emergency services at these institutions (20). A standardised, context-specific, and culturally-appropriate tool that can assess a facility's capacity to provide emergency services is required for evaluating deficits as well as to objectively inform the strengthening of a facility's delivery of care.

1.3.2 Barriers to developing emergency care services

There is an increasing evidence base indicating overall health systems

performance would significantly improve with the development and improvement of emergency care systems in LMICs, especially via improved morbidity and mortality metrics (7). Despite data demonstrating the benefits of these services, and calls for its development from large health bodies as well as governments, there still exist significant barriers that prevent the improvement of emergency care services and their incorporation into health systems (7).

AFEM has outlined and targeted several particularly pressing barriers. These include:

- Lack of data on burden of acute disease
- Lack of an integrated approach to triage, resuscitation, and stabilisation of acutely ill patients
- Limited resources for health care in Africa, including a critical shortage of trained healthcare personnel in all cadres
- Lack of standardised regionally-appropriate clinical guidelines for acute care at the sub-district and community level
- Essential components of acute and emergency care have not been established, and there is no consensus on how to define the success of initiatives
- No current advocacy plan for placing acute care on the global health agenda (4)

This lack of information, resources, guidelines, and advocacy strategy can be informed and mitigated using an assessment tool designed to take a more critical look at the capacity for emergency care services in facilities. By evaluating capacity, such a tool would simultaneously serve to identify areas of opportunity and thus function as an invaluable instrument in providing targeted recommendations for improvement. More specifically, it could help address multiple barriers by quantifying lack of resources and training, specifying problem areas, improving guidelines at local, regional, and country levels, and advocating for acute care. Evaluative strategies via such an assessment tool would also allow for targeted educational interventions maximizing the skills of a limited health workforce in the field.

1.4 Research question

1.4.1 African Federation for Emergency Medicine

Formed in 2009, The African Federation for Emergency Medicine (AFEM) is an international association that organises, networks, and supports national societies, organisations, and individuals dedicated to the development of emergency care across Africa. AFEM hosted its first consensus conference in 2011 where leaders in emergency and acute care in Africa formally acknowledged the absence of a standardised way to evaluate the impact of emergency care interventions (18). This conference highlighted the significant need to develop a mechanism to measure outcomes for acute care interventions and to collect burden of disease data at the facility level.

In 2013, the second AFEM consensus conference was held, attracting 130 experts representing over 30 countries. During this meeting, the mandate of developing acute care outcome metrics was continued by defining and adopting the necessary components of a facility providing emergency care (18). The development of these required features was guided by utilisation of the core sentinel conditions established by the WHO Integrated Management of Adolescent and Adult Illness (IMAI) and was achieved using the format of signal functions developed around each sentinel condition (1,27). The consensus conference workgroup discussed and confirmed each signal function as the minimum, essential service required to identify and stabilise patients. It was also agreed that all hospitals, regardless of level, resources, or setting should be equipped to distinguish and manage sentinel condition presentation.

1.4.2 Development of the Emergency Care Assessment Tool

The Emergency Care Assessment Tool (ECAT) was subsequently developed based on the signal function work from the Consensus Conference (Appendix A,B). It was then employed in multiple regions and facility levels in Ghana, Tanzania, Cameroon, and Botswana for refinement and context modification (28). The ECAT was designed to assess a facility's ability to deliver time-sensitive and resource-appropriate emergency care for the sentinel conditions. It was intended to identify a facility's strengths and challenges in performing signal functions. However, it is important to point out that there is still no agreement in the literature on whether assessing signal functions or undertaking an in-depth resource and skill audit is the best way to determine a health system's preparedness and/or effectiveness (29).

Moreover, several existing tools, such as EmOC, categorise facilities using language such as “Basic”, “Intermediate”, or “Advanced”. ECAT’s primary intent is neither to assign such categorisations nor to undertake a resource audit. The tool will be used to evaluate whether facilities can function to manage basic emergencies and if an agreed upon standard of care is provided.

In addition, ECAT includes barriers to delivery in the survey, elucidating why a signal function cannot be performed at all times. These barriers to delivery were selected to be translational between different healthcare specialties. They are also linked to key elements of health systems function. An ability to assess how often and which barriers to delivery occur most in a given facility is essential for improving emergency care.

1.4.3 ECAT refinement

The original ECAT, derived from the AFEM Consensus Conference, was a list of 280 signal function items: 185 stratified by specific sentinel conditions, 67 regarding specific materials, and 28 involving facility infrastructure. The sentinel conditions were assessed based on availability and the specific materials and facility infrastructure were assessed by their degree of presence. The original ECAT required significant revisions to its organisation, inclusions, exclusion, redundancies, layout, and formatting. Also, despite the fact that the signal functions were agreed upon at the conference, there was no additional consensus on what these items should be evaluated against: time, barriers to delivery, availability, etc. Thus, in an attempt to optimise the tool, the ECAT research team engaged in a sequence of studies that would lead to multiple revisions of the survey.

An early study was a pilot test of a preliminary tool at a referral level facility in South Africa. Interviewee feedback was to make considerable language revisions for improved clarity and usability. During a research study performed in 2014-2015, the instrument was exposed to additional layers of refinement by undergoing multiple iterations and extensive revision using feedback from interviewees in several countries (28). The survey was administered at three facilities per country, undergoing changes including formatting, changes in methodology, and clarifications on wording. This prospective study aimed at refining ECAT sampled facilities in four countries, chosen to represent the major geographic African regions: Egypt, Botswana, Uganda, and Cameroon to represent North, South, East, and West/Central Africa, respectively (28).

Notably, as South Africa was specifically not chosen to represent Southern Africa. Due to its relatively greater level of resources compared to other southern African countries, a country offering a more accurate representation of the southern region was chosen (30). Different health facility levels (one district, one regional, and one referral/university health facility) were surveyed per country for a total of 12 unique facilities overall.

The ECAT refinement study interviewed different providers at each facility to evaluate inter-rater reliability. To evaluate intra-rater reliability, after one week, a repeat assessment was performed at one randomly selected site per country, using the same tool, and with one of the clinicians who had been previously interviewed.

1.4.4 Problem statement

There is a pressing need to develop, improve, and integrate emergency care into health systems in Africa. Mounting evidence shows that such development can significantly and positively impact morbidity and mortality.

In order to most effectively implement emergency care development, a proper understanding of the current functionality is required. Currently, there is no validated objective measurement tool that can comprehensively evaluate essential emergency care provision by a healthcare facility. Such a tool would be an invaluable addition to existing assessment tools as it would provide a unique ability to efficiently assess a facility's capacity, strengths, and deficiencies through a focus on clinical service delivery. The implications are considerable; the results of a tested and validated assessment tool could reliably assist hospital managers, curriculum directors, policy makers, and other stakeholders in the development of action plans and the overall improvement of emergency care delivery.

AFEM has developed such a tool, based on sentinel conditions and signal functions, and has field tested it for refinement in diverse locations throughout the continent. We seek to add a level of rigour to this tool by establishing its validity in African health facilities.

1.5 Aim and objectives of study

1.5.1 Aim and objectives

The aim of this study is to determine the content, construct, and face validity of the AFEM Emergency Care Assessment Tool in Cameroon.

To achieve this aim, the study has the following objectives:

- Employ the ECAT in different facility levels (district, regional, and national) in different regions of Cameroon
- Use direct observation to determine whether the signal functions defined in ECAT can actually be performed in these facilities

1.5.2 Study purpose

The ECAT has been employed in Ghana, Tanzania, Cameroon, and Botswana for modification, refinement, and piloting. The next step in the development of the instrument is to incorporate an additional level of rigour by establishing the validity of the ECAT against direct observation.

Validity testing allows one to extract meaning and make interpretations of the tool being studied by estimating how close to the truth the data it collects are. It refers to the extent to which the assessment tool is actually measuring what it intends to measure (independent of its reliability). Validity is not an inherent property of the ECAT but rather an ongoing evaluation of scale, comparing the ECAT against the external reference or gold standard of a directly observed, correctly performed signal function (28).

CHAPTER 2
Literature Review

2.1 Emergency care in Africa – a brief history

The concept of emergency care is relatively young in even high income countries globally (6). Thus, it is interesting to realise that the concept was recognised as an important priority and was not particularly novel in low-income countries in Africa compared to when it began evolving in higher resource settings. However, it is important to note that a systems-based model was not, and to this date, has not been functionally adopted on the continent. Starting with the government of Mozambique in 1979, emergency care was included and recognised as a country-wide health priority (6). However, there is a distinct difference between recognition and action. Only in recent years, more than three decades later, have an increasing number of countries in sub-Saharan Africa acted upon the need for improved emergency care systems. For example, there has been a recent emergence and development of EM specialist training programmes in several countries as a strategy to improve the emergency health workforce and thus emergency care services by proxy (12,13,31–33).

Egypt was among the first African countries to establish EM as a specialty, having initiated specific training programmes in 2001 (34). Currently, universities in Alexandria, Suez Canal, and Tanta offer Master's degrees in EM with a combined total of over 200 graduates as of 2013 (34). Sub-Saharan Africa was not far behind with the first specialist training programme established jointly at the University of Cape Town and Stellenbosch University in 2004, and the first cohort of specialists graduated in late 2007 (31,32). This training model was quickly adopted by other South African programmes and consists of a four-year Master of Medicine degree, a dissertation, and two sets of examinations (33). Following suit, both Ethiopia and Tanzania introduced three-year Master of Medicine programmes in EM at Addis Ababa University and Muhimbili University of Health and Allied Sciences respectively. Both programmes produced their first specialists in 2013 (12,33). Rwanda traces its EM training to 2013 when it started a Postgraduate Diploma in Emergency and Critical Care Medicine which later incorporated a 4 year Master of Medicine degree in 2015 (35). On the other hand, Ghana has had an advanced training programme in emergency care at the Komfo Anokye Teaching Hospital in Kumasi since 2009 but recently established a formal EM specialist training programme in 2015 (13). Other

residency programmes exist in Botswana, Sudan, and Rwanda.

In addition to formal residency programmes, countries are beginning to establish professional EM societies, including several without formal training programmes. These include AFEM, the Emergency Medicine Society of South Africa, the Egyptian Society of Emergency Medicine Professionals, the Emergency Medicine Association of Tanzania, the Rwanda Emergency Care Association, the Libyan Emergency Medicine Association, the Society of Emergency Medicine Practitioners of Nigeria, the Ethiopian Society of Emergency Medicine Professionals, and the Sudanese Emergency Medicine Society (36). These organisations aim to develop emergency care in their respective countries, improve access to emergency care, and strengthen collaborative networks across the continent.

2.2 Existing emergency care assessment tools

The development of formalised structures for emergency care in Sub-Saharan Africa is only in its nascent stages. Access is steadily improving as dedicated emergency care units are being established, emergency medicine as a stand-alone specialty is being recognised, and prehospital systems are achieving higher levels of organisation. However, the region still faces a significant infrastructure, personnel, and education gap between the burden of emergency presentations and the holistically competent systems required to maximise patient outcomes (1). Despite the unmistakable need for a mechanism to comprehensively assess the prehospital and emergency-care context, at present, there is still no tool that covers the breadth and scope of all emergency services of a health facility (15).

Emergency care provision is variable throughout the continent but shares common and persistent issues of resource-limited settings – being largely underdeveloped, lacking formalised structure, and being poorly integrated into health system planning (2,17). In basic facilities, emergency care often consists of a multipurpose room with a single health care provider (2,4). Similarly, a “district level” facility may not have a designated area for emergencies. Acute condition management capability in referral facilities also differs greatly, including differences in equipment, infrastructure, protocols, and services (2,4). Furthermore, the value of these designations is diluted as they currently have no standardised or universally accepted definitions in terms of providing care to a patient (2,4).

The development of emergency care systems can directly improve health

systems (1). Functioning emergency care systems produces timely recognition and management of patients with acute injury or illness. This leads to improved morbidity and mortality and a decreased burden of disease (7). The multiple attempts to evaluate specific aspects of emergency care service delivery have most frequently taken the form of facility checklists. They have also tended to focus on specific areas such as trauma. Currently, a tool that possesses the breadth and scope to assess all emergency services of a health facility has yet to be firmly established (37,38).

Previous efforts to create expansive and effective assessment tools have occurred in high-income countries such as the United Kingdom and Australia. They produced the Quality Outcomes Framework and the Australasian Clinical Indicator Report respectively. However, these are not culturally or contextually appropriate for the mostly resource-limited settings in sub-Saharan Africa (39,40). There are considerable differences in established research, disease burden, and public and facility infrastructure between high and low resource environments. This difference effectively makes these tools unsuitable for most of Africa where there are fewer resources, fewer capabilities, and less frequent use of emergency services (1,41).

In lower income countries, determining a facility's capability to treat patients requiring emergency care does not have a standard framework for assessment. Consequently, it is currently impossible to evaluate facility level effectiveness (1). The only available tools at present are specific to particular conditions such as trauma or to particular specialities such as surgery or obstetrics and gynaecology (1).

There is a concerning absence of an accurate, appropriate, and standardised assessment tool to guide healthcare facilities in the systems development of effective emergency care. The World Health Organization (WHO) has previously released several resources for quantifying disease-specific emergencies such as Guidelines for Essential Trauma Care (37,42), Integrated Management for Emergency and Essential Surgical Care toolkit (43-45), Prehospital Trauma Care Systems (38), and Monitoring emergency obstetric care handbook (46). There are also non-WHO tools that also possess similar limitations: the Harvard Humanitarian Initiative tool (47), PIPES: Personnel, Infrastructure, Procedures, Equipment, Supplies (48), G-TSET: Global Trauma System Evaluation Tool (49), and INTACT: International Assessment of Capacity for Trauma (50). While helpful in assessing capacity, these resources are not and were not intended to be comprehensive evaluations of emergency service provision. In order to assist in emergency care system development, particularly at the

facility level, a standardised tool for assessment is required.

The tools that currently exist are limited by the fact that they are largely facility checklists. They determine whether certain items are present, but are not specifically focused on comprehensive service provision or capacity. As an example, the WHO Guidelines for Essential Trauma Care is a checklist of over 200 items necessary for the management of trauma in a facility. It determines the presence of specific resources, but does not collect data that might provide insight into whether there are a sufficient number of providers, the skill level of providers, or policy barriers to effective care delivery (37,42). Other existing tools exemplify a similar facility checklist design. These include the Essential Resources for the Delivery of Emergency Care in Hospitals (7), Prehospital Trauma Care Systems (38), and the Integrated Management for Emergency and Essential Surgical Care Tool for Situational Analysis to Assess Emergency and Essential Surgical Care (51). These tools capture important information; however, they are unidimensional due to the fact that they only assess resource availability. To better capture emergency care capacity, a tool is required that attempts to collect data on not only the majority of emergency conditions, but the capacity to deliver the service addressing that condition. As well, this tool must build a picture of the larger emergency care system rather than just a description of a facility. This involves a much more detailed, involved, and ultimately powerful assessment tool than can be offered by a facility checklist.

The creation of such checklists is critical for low and middle income countries to be able to strive towards providing affordable emergency care services in a targeted and data-driven manner (37). Checklists will inform policy and infrastructure and will allow for increased patient access to health facilities as well as ensuring “that they benefit from their subsequent surgery, inpatient treatment and post-hospital care” (37).

At present, there is no standardised and validated assessment tool to guide health care facilities in the development, implementation, or improvement of effective emergency care. Instead, there exist multiple checklists that focus exclusively on certain clinical conditions or specialty areas. This is not to say that the existing tools do not possess value; each tool reveals meaningful data for a specific purpose, however none use service indicators in their evaluation and none have been formally validated.

2.2.1 WHO tools

The WHO has developed multiple tools that are currently used to reach specific goals, which will be elucidated below. Unfortunately, none of these instruments specifically or adequately addresses emergency care.

The *WHO Guidelines for Essential Trauma Care* is a well-known checklist tool that is comprised of 260 human and physical resource items. These items are based on 11 essential trauma services and should be present at all health care facilities in order to provide appropriate care to an injured individual (37). This tool is in fact three different checklists: one for a basic level facility, one for a district level hospital staffed by general practitioners, and one applicable for either a specialist-staffed hospital or a tertiary care facility (37). The checklist items are categorised based on these facility levels as “essential”, “desirable”, “possibly required”, or “irrelevant” (37). These trauma care guidelines were envisioned to function as a thorough checklist for what health facilities of a particular level should have, but it cannot perform the inverse. That is, it does not possess a standardised way to assign a health facility level based on the results of the tool and instead employs a checklist and makes recommendations based on an initial subjective assignment of facility level (37,42). Furthermore, this tool concentrates on trauma, and although trauma constitutes a large percentage of the global burden of disease, this design inevitably fails to consider the contribution to morbidity and mortality from other emergency conditions. This checklist is the WHO’s minimum requirements and recommendations to countries in terms of concrete human and physical resources necessary to provide adequate trauma care services (1).

The *WHO Prehospital trauma care systems* document was developed to ascertain the requirements to “enable lay people and health-care providers to assess, stabilise and transport injured victims” to appropriate facilities (38). The principle behind the tool’s design is that a composite of two factors are required when assessing trauma care: first, knowledge and skills, and second, equipment and supplies (38). The equipment items and services are categorised as “Essential”, “Desired”, “Physically Remote”, or “Irrelevant”. These designations were based on a predetermined importance and economic efficiency of each item in achieving a positive outcome (38). Thus, the goal of the tool is to first describe and then to guide governments in instituting effective prehospital phase systems of care to the injured patient (38). This document also adds a layer of complexity by specifying items and services as “essential” and “desired” and then stratifying these designations by the

type of health worker in the prehospital setting: basic first aid provider, advanced first aid provider, basic prehospital trauma care provider, or advanced prehospital trauma care provider (38). This checklist is administered at a trauma facility, where prehospital care is handed off, to determine areas for improvement including in the domains of quality assurance, hospital inspection, and training (38). Again, however, it was conceived only for trauma care and therefore does not account for the supplies, equipment, medicines, or clinical skills needed to treat common medical or obstetrical problems (38).

A component of the Integrated Management for Emergency and Essential Surgical Care (IMEESC) tool is a needs assessment and equipment list called the *WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care* (TSAAEESC). This checklist attempts to specifically address surgical capacity by focusing on the treatment of surgically-managed conditions found in acute surgical and trauma care as well as obstetrics and gynaecology (51). However, this automatically makes it a limited scope checklist specifically targeting essential equipment for resuscitation. The needs assessment too is limited to a surgically-capable referral health facility (43,51). Because surgical services are generally unavailable at basic level facilities, this tool's applicability is excluded from facilities with fewer resources, with diminished surgical capacity, and with providers possessing less training. However, the tool is not purely focused on surgical outcomes and includes questions about specific interventions, infrastructure, equipment, and human resources (44,45). Similar to other tools, the IMEESC reveals insufficiencies exclusively in the domain of surgical services rather than for any emergency condition (52). Currently, the TSAAEESC is the most frequently used tool in low resource settings to measure surgical capacity (53).

The *Monitoring emergency obstetric care* handbook, EmOC, was designed specifically for obstetrical emergencies. More significantly though, especially for this study, it created a standardised way to interpret the information gathered from a simple survey into a meaningful designation (46). In a sense, this handbook switched the script. Instead of conforming to the parameters of a survey based on an arbitrarily assigned ostensible facility level, EmOC aimed to "define a health facility with regard to its capacity to treat obstetric and newborn emergencies" (46). The tool asks facilities a series of nine questions pertaining to the treatment of these emergencies and are subsequently categorised as either "basic" or "comprehensive", which references the

level of care than can be provided (46). An obvious advantage of this is that patients using these facilities could quickly ascertain care capacity and service availability. Hospital administrators would also be able to gain knowledge on areas needing improvement.

The EmOC was ground-breaking due to the fact that it is a facility assessment built upon signal functions rather than a long, cumbersome checklist of equipment and supplies. In other words, it emphasised the importance of service delivery (1,46). However, EmOC recognises its own limitations and advises that for future versions and future related tools, a more detailed list of functions and supplies would be advantageous and add strength to advising on areas of improvement (46). This assessment makes a significant assumption that each of the signal functions of an EmOC facility is available 24 hours a day, seven days a week, but does not specifically address this potential data modifier (46). An opportunity to record time availability as well as other qualitative information is lacking in EmOC but would be very useful information to collect. The development of the EmOC was an important gateway as it introduced the idea of assessing signal functions (46). This idea has now been extended to specifying signal functions for distinct emergency conditions in the ECAT.

It must be reiterated that these facility checklists play an important role, capture valuable information, and do not require replacement. There are, however, considerable gaps in assessing facility functionality and tool validation.

2.2.2 Non-WHO tools

Several informative non-WHO tools that have also been developed, each with its unique design and manner of collecting different information.

The *Harvard Humanitarian Initiative* is a survey developed specifically for sub-Saharan Africa to assess surgical and anaesthesia capacity (47). It is a binary survey using yes or no responses, with follow-up questions aimed at quantifying amounts and frequencies. The survey is based on eight main components: “access and availability”, “access to human resources”, “infrastructure”, “operating room information and procedures”, “outcomes”, “equipment”, “non-governmental organisation delivery of surgical services”, and “pharmaceuticals” (47). The Harvard Humanitarian Initiative had a multifaceted and constructive goal to evaluate infrastructure, training programmes, and the ability of a health system to collect data on surgical outcomes. To its credit, it was able to collect targeted information on education, resources, and

development inadequacies (47). However, a major criticism of its yes/no model has been the lack of ability to comment on extenuating circumstances that may have precipitated a yes or no answer. Overall, this tool was found to be usable and meaningful for future directions, however, like so many of the tools currently in existence, it has not been tested for reliability or validity.

The *Personnel, Infrastructure, Procedures, Equipment, and Supplies* (PIPES) tool was developed by Surgeons OverSeas and was largely inspired by the WHO's TSAAEESC. It too was created for LMICs and was designed to simplify the process of data analysis (48). This is accomplished through the calculation of an index score derived from 105 items pertaining to the number and availability of operating rooms, procedures, personnel, equipment, supplies, and infrastructure. For each item, data are recorded using a binary format of "always available" or "not always available" and a weighted index score is derived; higher index scores are associated with better conditions (48). The advantage of this simple tool is that changes and improvements over time can easily be tracked through repeat administration. The score also permits easy and rapid comparison to other facilities. By providing a straightforward mechanism to quantify capacity, the PIPES tool attempts to objectify findings and remove ambiguous, subjective, and potentially unreliable data on hard to quantify concepts such as skill (48). However, as with most of the tools being discussed, it does not provide a direct skill or service provision assessment, focuses more on quantification of materials and resources, and has never been assessed for quality via validity or reliability studies (48).

Contrary to many instruments, the *Global Trauma System Evaluation Tool* (G-TSET) was developed to assess trauma at a systems level rather than at individual facilities. The idea behind this design was that the tool would provide insight and recommendations on a broad scale, which would allow for "nation-centred development" (49). G-TSET only assesses trauma; it evaluates what it has deemed the seven necessary elements in a trauma system: "system leadership", "access to care", "initial resuscitative care", "acute injury care", "rehabilitation", "prevention", and "education/research/quality improvement". Each of these seven elements is accompanied by recommended benchmarks and indicators (49). To evaluate these elements, they are each given a separate score, with the option of supplementary detail input on areas requiring improvement and areas that meet standards. These values are then used to develop a total composite score (49). The benefit of this

systems-level approach is that it allows for the additional assessment of prehospital care on top of facility-based care, rather than at the facility level alone (49).

The *International Assessment of Capacity for Trauma* (INTACT) index is another facility-based focused on the assessment of trauma care provision. As the title indicates, this tool is also specifically focused on and limited to trauma. It is interesting because it adopts components of PIPES and the TSAAEESC (50). INTACT is composed of 40 criteria based on the broader themes of resuscitation, fracture repair, chest tube insertion, laparotomy, and burn management. It assesses personnel, supplies, equipment, procedures, and infrastructure (50). Like many other tools, INTACT employs a binary scoring system indicating the presence or absence of items considered to be necessary at all times for trauma care; a greater score indicates better resources and conditions (50). However, INTACT elected to remove certain items that are included in PIPES such as adjunct medical professionals, obstetrical procedures, and medical records (50).

The *Essential Resources for the Delivery of Emergency Care in Hospitals* was created through the efforts of The Disease Control Priorities Project. It was designed to stratify resources across the various levels of emergency facilities: major emergency care centre, regional emergency care centre, district emergency care centre, and primary care centre (7). Most of the criteria measured by this tool are of specific equipment and medications. Therefore, recommendations gleaned from it best inform those particular metrics rather than the actual delivery of care (7). However, the tool does attempt to observe criteria pertaining to quality improvement measures, personnel, laboratory services, and organisation and administrative capacities.

2.3 Previous validation studies using major tools

Studies using existing tools are not a rare phenomenon, but reliability or validity studies that test a tool's quality are much more uncommon. Furthermore, the studies that have evaluated such quality measures achieved conclusions that were not generalisable as they specifically assessed only one component of emergency care. There is currently no existing tool that assesses a facility's capacity to manage all possible emergency presentations, let alone a validated one.

2.3.1 WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care

The most commonly used tool in the literature is the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care (TSAAEESC), which as the name suggests, is specifically surgery oriented. Numerous studies have used this tool, including research in Liberia, Sierra Leone, Ghana, the Gambia, Rwanda, and Uganda. TSAAEESC was employed in these various countries to evaluate surgical care capacity, especially since country-wide assessments had never been previously conducted in any of these countries (53-58). The results of these studies showed that TSAAEESC yielded thorough, qualitative and quantitative data elucidating the baseline conditions of training, services, infrastructure, equipment and supplies, interventions, and human resources – all of which are important for future planning (53,54). TSAAEESC was able to delineate a rudimentary outline of a country's surgical intervention capacity as well as its major weaknesses. In Uganda, for example, several elements of adequate surgical care were rated as "severely limited" as no hospital surveyed had a sustained supply of essential blood, a regular oxygen source, readily available medications, or accessible pulse oximeters. The data indicated that there existed a severe need to resource imbalance with 0.2 major operating theatres per 100,000 people as well as an extremely high number of cases per operating theatre: 1,877 procedures per operating theatre (56).

Although not its primary function, the TSAAEESC tool also uncovered interesting geographical patterns. For instance, in Rwanda, the tool highlighted geographical disparities in the provision of caesarean sections. 80% of operating theatres exist at district hospitals scattered throughout the country, but 80% of trained obstetrical surgeons practice and reside in Kigali (53). In Uganda, a similar geographical discrepancy was detected: most hospitals are anywhere from 30 to 500km away from the capital, yet 90% of physicians reside in Kampala (53,56).

It is plain to see that the data gleaned by this tool allow for improved evidence-based advising, consulting, and solutions with policymakers and ministries of health (53). The focus on capacity rather than outcomes is a major advantage of the TSAAEESC as compared to standard morbidity and mortality rates (53). Furthermore, it makes direct comparison possible between settings and with international standards. TSAAEESC is important in that it demonstrates how a tool can inform programmatic changes, priority setting, policy and infrastructure development, budgeting, and

identifying supply deficits (54,55).

For most of the aforementioned studies which utilise the TSAAEESC, the tool had to be locally adapted (53,56). However, no rigorous confirmation of the validity of any of these local adaptations was ever conducted. Perhaps partially due to this, there were wide-ranging and inconsistent interpretations using this survey, even when administered as an on-site interview. Another factor that likely contributed to these varying interpretations is that the tool primarily collected qualitative data and had poor consistency in the personnel being assessed (53,55,56). In addition, due to the scope of the tool, only surgical data were collected, and information on emergency care capacity of the facilities was not assessed.

As stated, there have been very few attempts to assess reliability or validity of the TSAAEESC tool, and the ones that exist tend to lack rigour. Those attempts usually tried to verify data informally from direct interviews, physical inspection, or via referencing log books and reports. However, these studies possessed significant inconsistencies such as recall bias, ambiguity in data, and source dependent data discrepancies (55,56). A formal validation study of the TSAAEESC tool was attempted in Ghana. The kappa, or level of agreement, for the whole survey was 0.43, which indicated a moderate test-retest reliability. A kappa of 0 was obtained for the surgical procedures section and higher scores were obtained for human resources (0.77), infrastructure (0.81), and emergency surgical equipment (0.81) (59). Kappa values above 0.80 are considered to have very high level of agreement and hence reliability (59). Ultimately, the tool was found to be reliable for parameters surrounding infrastructure as well as structure and setting, however, the study noted the relatively weak overall kappa value and recommended revision of the tool in terms of measuring “process of care” parameters (59).

2.3.2 WHO Guideline for Essential Trauma Care

The WHO Guideline for Essential Trauma Care similarly successfully identified barriers to adequate care in trauma in diverse international settings such as Mexico, Ghana, India, and Vietnam. This allowed for informed recommendations for improvements in each country (60,61). In India, the tool indicated that there was a significant “mismatch of resources”. Examples of this finding were that there might have been a functional X-ray machine as well as a trained technician but a lack of X-ray film, or that a functioning CT machine was available but there were prohibitively

few trained CT technicians (60). The Guideline for Essential Trauma Care facilitated targeted recommendations for specific training and low-cost, life-saving equipment (60).

In other studies using this tool, its results were also able to inform specific recommendations (61). Through the administration of this tool, personnel shortages in Ghana were discovered to be a product of migration to more urban environments or foreign countries. Thus, focused solutions were suggested including more robust local incentives and regulation of foreign recruitment (61). The survey was also able to show that delays in equipment access were frequently due to poor organisation and inadequate facility planning (61). It also had the capability of shedding light on deficits in essential low-cost items in different places it was utilised, which led to recommendations for equipment monitoring and registries (61). The WHO Guideline for Essential Trauma Care has been cited as the most realistic mechanism to assess for the minimum, internationally-accepted, essential trauma care standards (61). However, despite this description, the conclusions that can be drawn from the tool are limited to trauma rather than the broad spectrum of emergency. Moreover, there has never been any kind of quality study reinforcing its claim of realism and effectiveness. There are currently no validation studies using this tool.

2.3.3 Other current tools

There have been several studies performed using both WHO and non-WHO tools. Currently, none of these instruments assess emergency care, but universally, they have shown the benefits of collecting baseline data to ultimately target areas for improvement. Despite their limitations, these studies have preliminarily demonstrated the potential impact of data from a simple survey. For example, the Harvard Humanitarian Tool could characterise the lack of trained physicians in surgery in Ethiopia, and in response, the government increased the number of training initiatives in the country (47). This tool, like so many others, has a documented usefulness, but because it has never been tested for reliability or validity, the strength of its conclusions as well as its widespread use is more susceptible to scepticism.

Plainly, the surveys that exist encompass a wide variety of approaches and a diversity of focus on subject matter, however, there is still a need for a standardised survey for emergency care that is comprehensive, highly usable, and easy to administer. It should provide accurate and meaningful information based on

consensus criteria with translatable data analysis. Each of the surveys discussed had marked advantages and limitations, but there are still none that address all emergency conditions with an in-depth investigation of capacity in service provision. And significantly, the great majority of the tools have not been tested for reliability or validity. A strong tool containing the above qualities with the additional attribute of validation would be an extraordinarily important apparatus in emergency care development in Africa.

2.4 AFEM Emergency Care Assessment Tool

2.4.1 Signal functions and sentinel conditions

Key to effective emergency care is the initial stabilisation and management of the patient, starting with the recognition of acute life threatening syndromes, followed by timely, accurate diagnoses. By categorising the limited set of clinical syndromes ill patients can experience, the evaluation and assessment of emergency care delivery can be achieved. With these goals in mind, in 2009, WHO developed an important reference tool targeting the specific clinical syndromes for obstetric emergencies in EmOC (46). These obstetric and newborn emergencies include haemorrhage, sepsis, unsafe abortion, pre-eclampsia, eclampsia, and prolonged obstructed labour (46). By using a set of clinical syndromes, deemed “sentinel conditions”, the EmOC generates a framework for critical interventions in obstetric emergencies. Each of these sentinel conditions has one or more associated life-saving interventions called “signal functions”. These signal functions can be used to assess a facility’s ability to manage obstetric and newborn emergencies as they elucidate the capability to manage a sentinel condition and thus provide commentary on the overall function and capacity of emergency obstetric care at that facility (46). EmOC uses “signal functions” to assess a facility’s capacity to deliver specific life-saving interventions to manage these emergencies (46).

Signal functions are life-saving services that are based on the overall ability to perform a service rather than the individual components of the intervention (46). For example, the ability to administer antibiotics intravenously is a signal function that at once assesses knowledge, intervention, and supplies. Signal functions places the focus on the practical capacity and delivery of a service, which is advantageous compared to the potentially ambiguous data checklists give about the presence or absence of specific supplies and equipment. Furthermore, the sensitivity of signal

functions still allow for the detection of serious flaws at a facility level (46).

Using such functions, EmOC is also able to designate a health facility that provides obstetric care as “Basic” or “Comprehensive” based upon compliance with parameters defined by the tool (46). Compared to conventional impact indicators such as mortality ratios, these outcome indicators provide more meaningful information, better reflect the actual ability of a facility to manage obstetric emergencies, and can directly translate into informing and modifying health policies and programmes (46).

EmOC’s signal functions were developed from specific clinical syndromes that occur for obstetrical emergencies. Analogously, emergency conditions also have specific clinical syndromes of various aetiology that occur before death. These have been named “sentinel conditions”, a term which will be employed throughout this dissertation.

2.4.2 Origins of ECAT

At the 2013 AFEM Consensus Conference, a workgroup was tasked with assigning signal functions required to successfully care for the six sentinel conditions previously identified by the WHO Integrated Management of Adolescent and Adult Illness. The sentinel conditions are:

- Respiratory failure
- Shock states
- Altered mental status
- Dangerous fever
- Severe pain, and
- Trauma

It was agreed that regardless of resources, setting, or facility level, all healthcare facilities had to be able to recognise and manage these six sentinel conditions in order to provide effective emergency care (1). As a result, the AFEM Emergency Care Assessment Tool was developed by using the signal functions agreed upon at the Consensus Conference to capture and describe a facility’s abilities in the appropriate delivery of emergency health services for the sentinel conditions. It is designed to answer the critical question of whether life-saving services are being effectively delivered at a given facility level. Existing tools categorise facilities using

language such as “Basic”, “Intermediate”, or “Advanced”. Others are designed as checklists, essentially functioning as an equipment or resource audit. However, ECAT is intended to perform neither such a categorisation nor to undertake an equipment or resource review (37,46,61). It is only intended to assess a facility’s ability to perform signal functions. ECAT builds upon the groundwork that EmOC assembled, but while EmOC monitors and evaluates a facility’s ability to provide emergency obstetrical care specifically, ECAT captures a facility’s ability to manage and provide quality care for basic emergencies (46).

In addition, it is important for there to be an assessment on the frequency and nature of the barriers to emergency care delivery that occur most in a given facility. This information would improve service provision via increased targeted and effective interventions. For example, if inadequate training is identified as a barrier to service provision, this could be remedied with the introduction of more specific skills based training or continued learning programmes. On the other hand, if the reason behind suboptimal service provision is revealed to be a lack of supplies or equipment, the approach and intervention would alternatively target equipment and supply ordering, hiring of equipment specialists for repairs, improved supply chain management, or potential budget changes. Determining a more detailed understanding of the barriers to care delivery provides additional information which will allow for targeted, specific improvements.

To address this issue, EmOC surveys and organises why a signal function cannot be performed under broad categories including “training issues”, “supplies, equipment, and drugs issue”, “management issue”, “policy issues”, and “no indication” (46). Following suit, ECAT also includes similar categories called “barriers to delivery”.

2.4.3 Previous ECAT Cameroon results

A previous study pertaining to the ECAT in Cameroon was conducted in 2014, approximately one year prior to the one being discussed currently (28). The focus of that study was the development of the ECAT so that it could accurately assess a facility’s management of emergency conditions. The study additionally took a preliminary look at how the ECAT functioned in an attempt to ensure that the information collected at each facility was pertinent, informative, and applicable. This process was informally done since the primary aim of study was development rather than actual assessment of either the ECAT or the performance of facilities. The

obtained data were not particularly rigorous but it demonstrated the potential of ECAT, hinted at the possible future conclusions that it could elucidate, and served as a launch point for the present study.

During this first ECAT study in Cameroon, data were collected to assess for inter- and intra-rater reliability. Due to a limited sample size, the conformance reflected by the kappa values and confidence intervals was unsurprisingly poor. Thus, it was concluded that an appropriate assessment of reliability was overly limited by small sample sizes which were unable to generate meaningful kappa values (28).

Perhaps more interestingly for this current research being described, the preliminary study in Cameroon did comment on the fact that uniformly, the most indicated barrier to care delivery across the three facility levels fell under the two categories: “Health care worker training” and “Supplies, equipment, and medication” (28). Similarly, the least indicated barrier for all three facility levels were “Human resources” and then “Policies” (28). Furthermore, at district level, regional level, and national level facilities in Cameroon, the sentinel condition Respiratory failure had the most signal functions marked as being unattainable (28). At all facility levels, Maternal health had the most signal functions marked as attainable (28).

2.4.4 Final form of ECAT

The early versions of ECAT had major issues with its format, but made progressive steps toward simplification while preserving thoroughness to better determine if a facility could provide adequate, essential emergency care services. In the final version, the tool achieved both concision and efficiency by using only vetted and optimised signal functions that could collectively assess ability and inform intervention (28).

The early versions of ECAT evaluated signal functions against availability parameters, however these were removed in the version ultimately used in Cameroon. A stricter definition of an “essential” signal function was taken meaning that the availability of a signal function would be binary; either it was “always available” or it was not. If a facility was unable to perform an essential signal function at all times, then it was marked as unattainable. This approach was slightly softened during this validation study in Cameroon and instead incorporated a 10% tolerance level. The binary was thus altered to “>90% available” versus “not available”.

In earlier version of ECAT, barriers to delivery were originally termed "categories of failure". However, plainly, the language and scope transformed through various iterations of the tool. Distinct definitions and examples of the barriers to delivery were developed for clarity:

- Policies: lack of policies and process that facilitate optimal patient care (e.g. triage system, timely patient movement to definitive care, automatic financial provision for emergent patient)
- Human resources: insufficient number of authorised cadre of health care workers to perform the desired function
- Health care worker training: authorised cadre is available but not trained, or there is a lack of confidence in providers' skills
- Supplies, equipment, medication: supplies and equipment are not available, not functional or broken, or needed drugs are unavailable
- Infrastructure: critical facility based infrastructure, such as electricity, lab, blood bank, X-ray, CT scan, intensive care unit, are not available or not functional
- No indication: no client needing this procedure comes to this facility
- Other/Comments (28)

ECAT is intended to determine the current capacity of a facility. Therefore, based on the conclusion of previous studies on ECAT, it was decided to be most appropriate to ask questions prospectively in the format: "You have a patient coming in with [sentinel condition], can you perform [signal function]". For each signal function, there would then be an ensuing section for comments and clarification. The time frame of the signal function items was specified as "today".

Throughout the development of the ECAT, sentinel condition categories were also significantly changed. The version used in Cameroon, unlike the early versions of ECAT, examined maternal health conditions.

Finally, in concert with the findings from previous ECAT research, a formal protocol to administer the ECAT survey was adopted. To standardise administration of the tool, the completion of a brief training session supplemented by a detailed document entitled "Instructions to administer ECAT" was required of each ECAT researcher and emergency medicine specialist (Appendix C). Interviewees were

asked to complete a simple form providing background information about the person undertaking the assessment, including position and skill level at the facility. This form also collected basic facility data in order to confirm the health care facility level (Appendix D). Next, informed consent was obtained, additional questions were addressed, and the ECAT researcher explained the barriers to delivery (Appendix E,F). Use of the guiding information contained within the consent form was encouraged.

CHAPTER 3
Methodology

3.1 Study design

This was an observational validation study of the ECAT tool at five health facilities in Cameroon, using on-site administration of the ECAT as well as direct observation of emergency care capacity.

The study was conducted at five health facilities across two regions of Cameroon. Included in the study were an emergency unit at the national level, the emergency facility at a regional hospital, and the designated emergency care units of three district level hospitals. Three district hospital emergency facilities were observed rather than one because hospitals at the district level represent the majority of hospital facilities in Cameroon. All hospitals evaluated were public, state funded institutions, as these represent the establishments at which the vast majority of the Cameroonian population seeks acute medical attention.

A variety of shifts during the day, night, and weekend were worked in order to maximise the diversity of presentations observed.

3.2 Study setting

Cameroon is a Central African nation with a population of roughly 22.7 million a life-expectancy of 55 years in 2013, and a 95 per 1000 live births mortality rate for those under age 5 (62). Like many lower-middle income countries, the physician density in Cameroon is very low, estimated by the World Health Organization to be as few as one doctor for every 5,000 people. Furthermore, WHO estimates that Cameroon has an annual mortality rate of 101.8 per 1,000 population due to trauma and an annual burden of disease due to injury of 4,430 Disability Adjusted Life Years (DALYs) per 100,000 population (63,64). When considering the additional morbidity and mortality experienced by the population due to burdens of disease such as malaria or HIV/AIDS as well as non-communicable diseases, the fact that emergency care in Cameroon is still largely rudimentary is concerning. In addition, currently, the Ministry of Health does not recognise emergency medicine as a distinct field, and there is therefore an absence of specialist emergency medicine training programmes. In 2002, it was estimated that approximately one emergency ward existed for every 1.25 million people in Cameroon; a situation exacerbated by the fact that the majority of resources

and skilled providers are concentrated at major referral centres (65).

However, recent developments have created a source of optimism. The AFEM is in close contact with Cameroon Ministry of Health officials who are driving emergency care development in the country. They as well as various foreign partners have identified emergency care as a significant priority for intervention and have made a long-term commitment to funding and promoting development of this healthcare domain. There are also a number of overseas emergency medicine specialists who are embedded in Cameroon for medium to long term periods, providing training and direction, but also with an understanding of the health landscape from an emergency care perspective.

If the conditions and state of emergency care in Cameroon are to continue to improve and be made sustainable, it is critical to use a standardised and accurate assessment tool to guide both emergency care implementation and systems. The ECAT endeavours to fill this role by providing targeted data that will determine if basic, quality emergency care is delivered and ultimately inform the improvement of services, infrastructures, and policy. However, before it is fully capable of functioning in this capacity, the ECAT must take the necessary step of validity testing.

3.3 Study population

Data were collected by employing the ECAT at five different health facilities: three district, one regional, and one central hospital (in order to be representative of all levels of hospital facility in Cameroon). Local representatives (emergency care specialists) in Cameroon facilitated the selection of health facilities. This process was a convenience sampling, incorporating practical considerations such as site diversity, locale, accessibility, time, and safety. This study was intended to externally validate the instrument, not the facility or the healthcare personnel. Thus, the important sample size was the number of signal functions observed at each hospital. The facility sample size was therefore related to the number of signal functions witnessed rather than the number of facilities visited.

In order to examine the validity of ECAT at the level of the emergency care sphere, and not at the level of each individual provider, we administered the tool with the Head of Emergency at each facility (as they were the most knowledgeable about what was happening in their emergency intake area).

Direct observation of the signal functions was conducted on any cadre of staff

who was attempting to perform the skill and not limited to emergency medicine specialists. This included other physicians, nurses, technicians, and therapists.

3.4 Inclusion and exclusion

Inclusion: Government hospital facilities at the district, regional, and national levels with emergency units staffed full time - 24 hours a day, 7 days a week. These facilities were all ensured to be recognised and approved by the Cameroonian Ministry of Health. Sites were identified within the focused catchment area of the researcher by local representatives (emergency care specialists) who facilitated the process. This selection was therefore a convenience sampling, incorporating practical considerations such as accessibility, time and safety

Exclusion: Non-government hospital facilities, facilities below the district level, facilities without dedicated emergency units, facilities that were not recognised and approved by the Ministry of Health, and facilities that were not staffed full time were excluded from the study.

3.5 Data collection

3.5.1 Administration of ECAT

The ECAT researcher sent to Cameroon (PK) is bilingual. After obtaining consent (Appendix E,F), the tool was administered to each respective facility's Head of Emergency in a face to face meeting. Each survey administration lasted about 45 minutes. The researcher was on hand to answer any questions as the Head of Emergency completed the form on paper, in either English or French.

Since ECAT is a prospective tool, the Head of Emergency was given the opportunity to provide detail with each signal function. For example, the researcher would ask, “If a patient with (sentinel condition) entered your health facility right now, would you be able to (signal function) at least 90% of the time.” If the answer was “No” the respondent would be asked why, and the results classified under “Barriers to delivery”. Any further details were collected under the “Comments” section.

3.5.2 Survey procedures

First, interviewees read information about the study and the interviewer gave them the opportunity to ask questions. After clarification, the interviewees signed the consent form (Appendix E,F). They also completed a form collecting background

information on their facility's capacity and on the interviewee's position and skill level at the facility (Appendix D). They were then explicitly encouraged to ask questions and provide comments during the survey. The interviewer explained and provided examples for each barrier to delivery and allowed time for additional questions. Within the consent form, they were also given standardised information with definitions and examples to reference throughout the administration of the survey.

The ECAT interview is a series of yes/no questions with possible follow up questions based on the response. It was made clear that answering "yes" to a question was stating that the signal function was available at least 90% of the time, 24 hours a day, and 7 days a week. ECAT was administered using appropriate language explained in the previous section (i.e. "If a patient with (sentinel condition) entered your health facility right now, would you be able to (signal function) at least 90% of the time.") A "No" response would then be followed by clarifying questions classified under "Barriers to delivery". It was important that the interviewer stressed that ECAT was assessing the capability of the health facility and not the knowledge base of the interviewees.

3.5.3 Validation protocol

Comparing the ECAT against the external reference or gold standard of a directly observed, correctly performed signal function was chosen as the validation process as it is already a vital component of assessment across all medical specialties, it provides real-time data on performance with actual patients, and there are multiple publications suggesting the validity of numerous similar direct observation tools (66). Retrospective global or summative assessment, although a commonplace method, was decided against due to its potential introduction of recall bias and its inadequate insight into the performance of signal functions (67).

AFEM identified emergency medicine specialists working locally with whom the ECAT researcher directly observed the performance of signal functions in the emergency intake areas of each facility. It was essential to have the specialist present for every witnessed signal functions to appropriately determine if it had been performed correctly or not.

The sample size of observation was up to 50 iterations of each signal function at each facility, but as many as possible if the opportunity arose. The survey is binary and measures whether a signal function can be performed correctly at least 90% of

the time (i.e. a 10% tolerance level). A 10% tolerance level means that each signal function would need to be seen performed correctly around 50 times before it could be said that said signal function could be performed correctly “all the time”. Without being judgmental and while accepting the reality of the current healthcare situation in developing countries, low resource African emergency systems are largely rudimentary at this point. For many signal functions, we expected to see an incident of inability to correctly perform the skill before witnessing 50 correct procedures.

Each signal function was therefore observed as much as possible by the researcher and emergency specialists; all shifts at the facility were captured multiple times over one week; and both correct and incorrect procedures were documented.

If a signal function was not seen 50 times, we still stood to gain very useful data. Initially, it was suggested that each signal function could be measured for validity at a particular range of confidence for a given sample size, but further discussion with statisticians indicated that with the type of data being collected, it would not be possible to determine a p-value for each individual signal function on their own. It was pointed out that the data were not independent, being repeated measures on the same facility (both the ECAT completed by the Head of Emergency and the ECAT signal functions being directly observed were being performed on the same emergency facility). Thus, it was necessary to apply a paired proportions comparison; it was revealed that the data were geared to compare two binary variables expressed in a paired data layout, otherwise known as a McNemar test (68,69). Via the McNemar test, a statistical study could be run where the null hypothesis for the study was that there was no difference between what the Heads of Emergency completing the ECAT said they could do and what observation showed they could actually do. A p-value <0.05, would be a significant conclusion – that there is a statistically significant difference between what the Heads using the ECAT said their hospitals could do and what was actually observed.

Some signal functions were performed very rarely and would have been impractical to measure to a significant sample size (e.g. surgical airway). The tool was still administered with those items included and reported on them when they arose, but it was not expected that they would create significant data points. Those signal functions that were expected to be rare and for which it was difficult to achieve a practical sample size were highlighted in CAPS on the ECAT (Appendix A,B). These rare signal functions were agreed upon by the consensus of emergency medicine

specialists.

As many patients often had multiple signal functions executed on them during a single visit or encounter, data were collected in parallel (e.g. if a sick patient received oxygen and IV fluids, on the assessment form, they were marked as meeting: oxygen administration, peripheral percutaneous intravenous access, and administration of isotonic IV fluids in each sentinel condition where they appear).

Direct observation of the signal functions was on any cadre of staff who was attempting to perform the skill and not limited to emergency medicine specialists.

3.6 Data analysis and management

3.6.1 McNemar test

After extensive statistician input to this study and considering the nature of the information collected, we ultimately settled on performing McNemar tests on the data. This test allows for a broad comparison of the directly observed signal functions with the completed ECATs filled out by the Heads of Emergency at each study facility. In this way, a more specific and quantitative sense of how accurately the tool reflects what the institutions/Heads of emergency said they were able to perform could be obtained.

Direct Chi-square testing was determined to be less appropriate than McNemar testing as the aim was not to test for independence. The application of importance in this scenario was rather to test for consistency between two variables, a critical feature of the McNemar test. In this case, the null hypothesis was that the occurrence of the outcomes for the two groups (direct observation of ECAT signal functions at a 10% tolerance level versus ECAT completed by a Head of emergency) was equal. That is, there was no difference between what the Heads using the ECAT said they could do and what observation showed they could actually do. Correspondingly, the alternative hypothesis was that there was a difference between what the Heads using the ECAT said their hospitals could do and what was actually observed. Because the data were derived from the same tool and facility (*i.e.*, the data were paired), the data could be organised into a 2x2 table and the McNemar test was the most appropriate statistical analysis.

There was question as to whether a more traditional exact binomial test should be employed because as the sample size becomes small, the traditional advice has previously been to forgo the McNemar test in favour of a binomial test (67). More

specifically, it has been noted that in the test's 2x2 table,

	+	-
+	a	b
-	c	d

when the sum b + c is small, the statistical power of the McNemar test can be low despite a large a + b + c + d (70). However, because recent simulations have shown that when b + c in the 2x2 table become sufficiently small, the exact binomial test and the McNemar test with continuity correction become similar, the McNemar statistical analysis was deemed appropriate (70).

It was then necessary to determine which specific McNemar analysis to run. The original exact conditional McNemar test is powerful, but has been found to be excessively liberal in disproving the null hypotheses. The mid-P version is also useful, but ultimately has been found to be less strong than the asymptotic McNemar test (70). For these reasons, an asymptotic McNemar test with continuity correction was used to analyse the data.

The research coordinator (PK) used Microsoft Excel to record answers to the survey. Each signal function was entered as 'yes' or 'no', for each survey and data points were frequently rechecked for accuracy. To assess for validity, only the yes/no response component of the surveys were used. McNemar tests were used to determine whether there was a statistically significant difference between the ECAT completed by the Head of Emergency versus the direct observation of the ECAT signal functions by the ECAT researcher and emergency specialists. These tests were additionally used to evaluate more specifically for differences between directly observed and Head of Emergency reported sentinel conditions. This gave information on the validity of the assessment tool as a whole at each facility.

Responses from "barriers to delivery" were not analysed using quantitative statistics due to their qualitative nature. They have been analysed using simple descriptive statistics to determine how often a given barrier occurred for a signal function.

3.6.2 Data organisation

Before McNemar tests could be run on the data in Microsoft Excel, the data had to first be organised into a format that could easily and logically be reduced into a 2x2 table. Thus, the raw information from the direct observations as well as the ECATs completed by the Heads of emergency were transformed into binary data that would be amenable for statistical comparison to evaluate for a difference between the paired data.

For each signal function, regardless of the number of times it was witnessed being performed, if it was observed being conducted correctly at a 90% or greater rate, the signal function was marked as a 1. If the signal function could not meet this criterion, it was marked as a 0.

Similarly, the results from the ECATs administered to the Heads of emergency at each facility were converted into a binary format. If the Head stated that their facility was capable of performing a particular signal function correctly at a 90% or greater rate, this response was designated with a 1. If they responded that their facility was incapable of performing a given signal function at that frequency of correctness, a 0 was assigned.

In this way, two columns were constructed, one tabulating a facility's reported ability to perform signal functions and the other tabulating what the researcher and specialists observed to be the facility's capability to perform signal functions. These two columns could then be directly compared. Clarifying data were also collected in two additional columns. These columns detailed the number of times each signal function was observed by direct observation as well as the number of times it was observed being performed correctly. These latter data were also presented in percentage form.

3.6.3 Data management

Surveys were collected from five different facilities of varying levels, across two regions, with five different interviewees. The surveys were collected and kept by the ECAT researcher and were later used for analysis.

All administered tools and direct observation tools used to compare were collected and kept on a password protected work computer by the researcher. Collected data were compiled and handled by the researchers only. Only study investigators have access to the completed toolkits and results. Specific health facility

results were made known to the health facility manager only.

The results did not contain any identifying information of the tool participant or the providers being directly observed. The information was not and will not be sold or used for any commercial purpose.

Microsoft Excel was used for recording answers to the survey by the research coordinator.

3.7 Ethics

3.7.1 Ethics approvals

Ethical approval was obtained from the University of Cape Town's Human Research Ethics Committee (HREC/REF number 842/2015) (Appendix G). Local ethics approval was also obtained from all sites in Cameroon via each health facility's director. (Appendix I).

Ethics approval in Cameroon was obtained from Le Comité National d'Ethique de la Recherche pour la Santé Humaine (Appendix H).

The healthcare workers completing the ECAT signed informed consent (Appendix E,F).

3.7.2 Risk and benefits to interviewees

Potential risks to interviewees included discomfort, which was avoided using non-judgmental, culturally appropriate language. Great emphasis was placed on a clear communication that this was not an assessment of the interviewee's knowledge base nor a comprehensive regional analysis of health facilities, but rather a study to determine the validity of the ECAT.

There were not any overt benefits to the interviewees via participation in the study. They did not receive compensation or gifts for their time.

3.7.3 Informed consent

Participation in the assessment was voluntary, and the participants, both the Head of Emergency completing ECAT and the providers being directly observed, were given the option to decline involvement. If the participants agreed, they signed consent (Appendix E,F).

Patient consent was not required as care for the patient was unchanged. The practitioners were being observed rather than the patients, and no patient data were

being collected.

All information collected remained strictly confidential and the results did not include any identifying information on the interviewees or the providers.

3.7.4 Language

The ECAT as well as all the consent documents were translated to French. These were checked with Cameroonian counterparts for comprehensibility, cultural appropriateness, and appropriate language. They were not back translated. Both the researcher (PK) and local emergency specialists are fully bilingual and have extensive experience in the Cameroonian healthcare system.

3.7.5 Administrative reimbursement

This study required two locally based emergency medicine specialists to help collect validity data. One of the two specialists always accompanied the ECAT researcher during data collection. Travel, food, and accommodation costs were entirely covered for these individuals during working and travel hours over the five weeks of data collection. Each of these specialists was offered a small monetary compensation for their assistance.

CHAPTER 4
Results

4.1 Overall Trends

In general, the higher the level of facility, the greater the number of signal functions that could be performed correctly and consistently, and hence the greater the emergency care capacity.

Across the five health facilities visited, the country wide data collected consists of 2839 total signal functions observed and all but 13 of the signal functions listed in ECAT were directly observed by the ECAT researcher and the emergency specialists collecting the data. By a large margin, the most observed signal functions were generally small procedural items such as obtaining peripheral IV access, starting initial appropriate wound care, and performing a urine dipstick. Significantly, one of the most observed signal functions that was not procedural was the administration of intravenous antimalarials /antibiotics.

Table 1 summarises the available information on each emergency care facility:

Facility level	Emergency unit beds	Doctors	Emergency unit volume (patients per day)	ICU beds
National	43	23	25	3
Regional	12	Data unavailable	10-15	0
Urban District	3	Data unavailable	5	0
Suburban District	5	Data unavailable	7	0
Rural District	7	Data unavailable	5-10	0

Table 1: Emergency facility statistics

4.1.1 National level

From the data sheet that was administered to the national level emergency facility, it was self-reported that there are currently 23 doctors working at the facility in total with 13 of those having some form of emergency care training. The facility has 43 beds total, including a three bed intensive care unit. Although variable, the unit reported an average of 25 patients a day.

At the national emergency unit 56 of the 71 (78.9%) signal function types were successfully directly observed, occurring on 1508 separate occasions. The most observed signal function was obtaining IV access (n=127). Out of the 15 signal functions that were unable to be observed, nine were previously identified as being rare interventions. A further three signal functions that were unable to be witnessed fell under the Maternal Health sentinel condition and did not fall under the emergency unit's purview at this site.

4.1.2 Regional level

The regional level emergency facility declined to self-report on the total number of health staff working at the unit, but they did report that there are two physicians attending the facility during the day and one during the night. The unit has 12 beds total, but no intensive care unit. An average of 10-15 patients per day was reported.

At the regional emergency facility, 46 of the 71 (64.9%) signal functions were observed a total of 427 times. Here, interventions such as obtaining IV access (n=30), performing a urine dipstick (n=36), and initial appropriate wound care (n=33) were the most observed signal functions. Those signal functions previously flagged as rare were unable to be witnessed at this facility, including those in the maternal health domain which did not comprise part of the EUs scope of practice.

4.1.3 District level

Three district hospital emergency facilities were observed rather than one because hospitals at the district level represent the majority of hospital facilities in Cameroon Across the three district hospitals, 48 of 71 (67.6%) signal functions were observed 904 times.

The urban district level hospital in our sample is a facility that exists within the capital city of Yaoundé. They self-reported that there is always one physician and 3-4 nurses working the facility at any given time, however, none of the staff is trained

specifically in emergency care. The emergency facility has three beds total and an average of five patients are seen per day. At this facility, 37 of the 71 (52.1%) signal functions were observed a total of 294 times. The most directly observed signal function was the administration of antimalarial medication (n=31).

The suburban district level hospital in our sample was a facility that exists within a densely populated area right outside the confines of a larger city. They self-reported that there is always one physician and 2 nurses staffing the facility at any given time, however, none of the staff are trained specifically in emergency care. The emergency facility has five beds total and an average of seven patients are seen per day. At this facility, 39 of the 71 (54.9%) signal functions were observed a total of 288 times.

The rural district level hospital is a facility that serves the residents of a small town, as well as the health zone's primarily rural population. They self-reported that there is always one physician and three nurses staffing the facility at any given time. None of the staff are trained specifically in emergency care. The emergency facility has seven beds total and an average of 5-10 patients are seen per day. At this facility, 44 of the 71 (62.0%) signal functions were observed a total of 322 times.

The signal function data are summarised in the following table:

Emergency Facility	**Number of signal function types observed (Out of 71)**	**Number of total signal functions observed**
National	56 (78.9%)	1508
Regional	46 (64.9%)	427
District 1 (Urban)	37 (52.1%)	294
District 2 (Suburban)	39 (54.9%)	288
District 3 (Rural)	44 (62.0%)	322

Table 2: Signal functions at health facilities in Cameroon

4.2 McNemar tests of ECAT

4.2.1 National emergency facility

The data for the national level emergency unit were organised into a 2x2 table (Table 3) for analysis. 52 of the total 56 signal functions that were observed showed correlation between what was reported by the Head of emergency as attainable at a >90% rate and what was directly observed to be correctly performed at a >90% rate. Two signal functions demonstrated correlation. One signal function was reported as being unattainable, but was observed to be correctly performed by the researchers. Oppositely, one signal function was reported as being capable of being correctly performed but was observed to be unable to reach that threshold in practice.

		Signal functions marked as:	
		Capable of being correctly performed at >90%	Not capable of correctly being performed at >90%
Reference Standard (Directly Observed at >90% correct performance)	Yes	52	1
	No	1	2

Table 3: McNemar 2x2 for national emergency unit

The McNemar test for the national level unit produced a two-tailed p-value of 1.000. The alpha for the analysis was set at 0.05. The null hypothesis was that the two treatments were identical i.e. the direct observations correlated with what the Heads of emergency reported that their facility was capable of performing. The alternative hypothesis was that there was a statistically significant difference between signal functions able to be observed at a >90% rate and the signal functions that the Head of emergency indicated could be performed at this rate. The computed p-value was greater than the significance level of alpha = 0.05, thus one was not able to reject the null hypothesis.

4.2.2 Regional emergency facility

For the regional level emergency unit, 24 of the total 46 signal functions that were observed showed correlation between what was reported by the Head of

emergency as attainable and what was directly observed to be correctly performed. Ten signal functions demonstrated correlation between what was reported by the Head of emergency as being unable to be correctly performed and what the researchers observed to be unable to be correctly performed. Ten signal functions were reported as being unable to be correctly performed, but were actually observed to be correctly performed by the researchers. Oppositely, two signal functions were reported as being capable of being correctly performed, but were observed to be unable to reach that threshold in practice.

		Signal functions marked as:	
		Capable of being performed at >90%	Not capable of being performed at >90%
Reference Standard (Directly Observed at >90%)	Yes	24	10
	No	2	10

Table 4: McNemar 2x2 for regional emergency unit

The McNemar test for the regional level unit produced a p-value of 0.0433; a significant result with the alpha set at 0.05. Thus one should reject the null hypothesis and accept the alternative hypothesis.

4.2.3 Urban district emergency facility

For the urban district hospital emergency facility, 24 of the total 37 signal functions that were observed showed correlation between what was reported by the Head of emergency as being attainable and what was directly observed to be correctly performed. Three signal functions demonstrated correlation between what was reported by the Head of emergency as being unable to be correctly performed and what the researchers observed to be unable to be correctly performed. One signal function was reported as being unable to be correctly performed, but was actually observed to be correctly performed. Oppositely, nine signal functions were reported as being capable of being correctly performed but were observed to be unable to reach that threshold in practice.

		Signal functions marked as:	
		Capable of being performed at >90%	Not capable of being performed at >90%
Reference Standard (Directly Observed at >90%)	Yes	24	1
	No	9	3

Table 5: McNemar 2x2 for urban district emergency unit

The McNemar test for the urban district level unit produced a p-value of 0.0269. The alpha for the analysis was set at 0.05. As the computed p-value was lower than the significance level of alpha = 0.05, one should reject the null hypothesis and accept the alternative hypothesis.

4.2.4 Suburban district emergency facility

For the suburban district hospital emergency facility, 29 of the total 39 signal functions that were observed showed correlation between what was reported by the Head of emergency as being able to be correctly performed and what was directly observed to be correctly performed. Four signal functions demonstrated correlation between what was reported by the Head of emergency as being unable to be correctly performed and what the researchers observed to be unable to be correctly performed. Two signal functions were reported as being unable to be correctly performed, but were observed to be correctly performed by the researchers. Oppositely, four signal functions were reported as being capable of being correctly performed, but were observed to be unable to reach that threshold in practice.

		Signal functions marked as:	
		Capable of being performed at >90%	Not capable of being performed at >90%
Reference Standard (Directly Observed at >90%)	Yes	29	2
	No	4	4

Table 6: McNemar 2x2 for suburban district emergency unit

The McNemar test for the suburban district level unit produced a p-value of 0.6831. The alpha for the analysis was set at 0.05. As the computed p-value was greater than the significance level of alpha = 0.05, one could not reject the null hypothesis.

4.2.5 Rural district emergency facility

For the rural district hospital emergency facility, 27 of the total 44 signal functions that were observed showed correlation between what was reported by the Head of emergency as being attainable and what was directly observed to be correctly performed. Three signal functions demonstrated correlation between what was reported by the Head of emergency as being unable to be correctly performed and what was observed to be unable to be correctly performed. Ten signal functions were reported as being unable to be correctly performed, but were actually observed to be correctly performed by the researchers. Oppositely, four signal functions were reported as being capable of being correctly performed but were observed to be unable to reach that threshold in practice.

		Signal functions marked as:	
		Capable of being performed at >90%	Not capable of being performed at >90%
Reference Standard (Directly Observed at >90%)	Yes	27	10
	No	4	3

Table 7: McNemar 2x2 for rural district emergency unit

The McNemar test for the rural district level unit produced a p-value of 0.1814. The alpha for the analysis was set at 0.05. As the computed p-value was greater than the significance level of alpha = 0.05, one could not reject the null hypothesis.

4.3 Sentinel conditions

4.3.1 Sentinel conditions as reported by facility heads of emergency

The previous ECAT development study conducted in Cameroon suggested that at all levels of facility the sentinel condition Respiratory failure had the most signal functions marked as unattainable. Maternal health had the most signal functions marked as attainable (28).

In this study, a similar result was found. Respiratory failure was the sentinel condition with signal functions marked most frequently as being incapable of being performed correctly >90% of the time. Signal functions within this sentinel condition were indicated as being unattainable 38 times across all the facilities in this research.

Aside from Respiratory failure, Table 8 indicates that the Heads of emergency at the five facilities appeared to have less confidence in their ability to perform the signal functions in the sentinel conditions Shock and Trauma. The regional hospital emergency facility reported the largest percentage of signal functions that are unattainable at the defined threshold, with 41 of 71 (57.7%).

	National	Regional	District (Urban)	District (Suburban)	District (Rural)
Respiratory Failure	2/14 = 14.3%	78.6%	57.1%	57.1%	64.3%
Shock	4/17 = 23.5%	58.8%	41.2%	41.2%	47.1%
AMS	1/10 = 10%	30%	10%	20%	20%
Severe Pain	0/9 = 0%	33.3%	11.1%	22.2%	11.1%
Trauma	3/17 = 17.6%	58.8%	29.4%	52.9%	47.1%
Maternal Health	1/4 = 25%	100%	0%	25%	25%

Table 8: Percentage of signal functions unable to be performed - reported

Table 9 reflects the percentages of signal functions per sentinel condition which could be performed correctly at the defined threshold, as reported by the Heads of emergency. This study found that Maternal health had a proportionally high number of signal functions that were reported to be attainable. However, Severe pain and Altered mental status were indicated as having many signal functions that could be performed correctly. The national level emergency unit had the largest number of signal functions in each sentinel condition that they felt they could perform consistently, and the regional had the lowest.

	National	Regional	District (Urban)	District (Suburban)	District (Rural)
Respiratory Failure	85.7%	17.6%	42.9%	42.9%	35.7%
Shock	76.5%	41.2%	58.8%	58.8%	52.9%
AMS	90%	70%	100%	80%	80%
Severe Pain	100%	66.7%	88.9%	77.8%	88.9%
Trauma	82.4%	100%	70.6%	47.1%	52.9%
Maternal Health	75%	0%	100%	75%	75%

Table 9: Percentage of signal functions able to be performed - reported

4.3.2 Sentinel conditions as directly observed by ECAT research team

Information on the directly observed signal functions and sentinel conditions is summarised in Table 10. Respiratory failure and Altered mental status were overall the sentinel conditions that had both the greatest number and percentages of signal functions that were observed to be unable to be performed correctly. Proportionally, Altered mental status demonstrates a greater rate of signal functions that could not attain the defined threshold (10 signal functions in that sentinel condition versus 14 for respiratory failure). The regional and urban district emergency units tied for the number

of signal functions in total that were directly observed to be unable to be performed correctly. Notably, the percentages in Table 10 do not discount signal functions that were not directly observed, i.e. the percentages reflect signal functions that were unable to be performed in the context of all the signal functions in each sentinel condition.

	National	Regional	District (Urban)	District (Suburban)	District (Rural)
Respiratory Failure	0%	28.9%	21.4%	14.3%	14.3%
Shock	11.8%	6.9%	6.9%	6.9%	0%
AMS	10%	20%	40%	20%	20%
Severe Pain	0%	33.3%	11.1%	11.1%	11.1%
Trauma	0%	11.8%	17.6%	11.8%	11.8%
Maternal Health	0%	0%	0%	0%	0%

Table 10: Percentage of signal functions unable to be performed - observation

Shock was the sentinel condition that had the greatest number of signal functions that were observed to be able to be performed correctly . However, proportionally, Severe pain demonstrated the greatest percentage of signal functions performed correctly (nine signal functions in Severe pain versus 17 for Shock). The national level unit had both the greatest number and percentage of signal functions and sentinel conditions that could be addressed correctly. However, the facility that had the next best total was the rural district hospital with 37. Notably, the percentages in Table 11 do not discount signal functions that were not directly observed, i.e. the percentages reflect signal functions that were unable to be performed in the context of all the signal functions in each sentinel condition.

	National	Regional	District (Urban)	District (Suburban)	District (Rural)
Respiratory Failure	78.6%	42.9%	14.3%	28.6%	57.1%
Shock	70.6%	58.9%	35.3%	41.2%	52.9%
AMS	80%	60%	30%	60%	50%
Severe Pain	100%	55.6%	77.8%	66.7%	77.8%
Trauma	70.6%	35.3%	35.3%	35.3%	41.2%
Maternal Health	25%	25%	25%	50%	25%

Table 11: Percentage of signal functions able to be performed - observation

4.3.3 McNemar analysis of sentinel conditions

To gain insight into the sentinel conditions, McNemar tests were also run on the data for each of the sentinel conditions. The existing binary signal function data was condensed into smaller 2x2 tables organised by sentinel condition. An asymptotic McNemar test with continuity correction was used to analyse the data. The resultant p-values from each 2x2 table for each separate sentinel condition per facility follow:

	National	Regional	District (Urban)	District (Suburban)	District (Rural)
Respiratory Failure	1.000	0.134	0.480	1.000	0.289
Shock	1.000	0.134	1.000	1.000	0.248
AMS	1.000	1.000	0.248	1.000	1.000
Severe Pain	1.000	1.000	1.000	1.000	1.000
Trauma	1.000	1.000	0.480	1.000	1.000
Maternal Health	1.000	1.000	1.000	1.000	1.000

Table 12: McNemar test p-values for sentinel conditions at emergency facilities

As the alpha for each analysis was set to the standard 0.05, all the computed p-values were greater than the significance level of alpha = 0.05, which does not allow the rejection of the null hypothesis. Thus, if evaluating for sentinel conditions on their own, one cannot conclude that there is a statistical difference between what was directly observed by the ECAT researcher and the emergency specialists and what was reported on the ECAT administered to the Heads of emergency for any of the sentinel conditions at any of the emergency facilities sampled.

4.4 Barriers to delivery

Data on barriers to care delivery were also collected in this study. Heads of emergency expounded upon those barriers whenever they marked that a signal function was unable to be performed correctly >90% of the time. Multiple barriers could be indicated for a single signal function so the number of barriers do not necessarily correlate with the number of signal functions marked as unattainable. Table 13 summarises the number of times each barrier to delivery was identified for the signal functions at each health facility.

	National	Regional	District Urban	District Suburban	District Rural	Total
Policies	0	0	1	0	0	**1**
Human resources	1	3	0	0	3	**7**
HCW training	7	3	10	6	13	**39**
Supplies, equipment, medication	7	22	5	20	15	**69**
Infrastructure	0	9	0	18	1	**28**
No indication	0	0	2	2	1	**5**
Total	**15**	**37**	**18**	**46**	**33**	

Table 13: Reported barriers to delivery of signal functions

The largest barriers to care fall under the categories “Supplies, equipment, and medication” and “Health care worker training” - occurring 69 and 39 times respectively. The least indicated barrier was “Policies”; it was only identified as the issue on one occasion (at the urban district hospital). Overall the suburban district hospital reported the greatest number of barriers to care delivery and the national emergency unit reported the least. At the regional hospital and the suburban district hospital, infrastructure was denoted as a significant barrier with nine and 18 notations respectively.

During direct observation of the signal functions, qualitative data were also collected describing the barriers to care delivery that the ECAT researchers and emergency specialist consultants visually identified. However, it became quickly apparent that for the timeframe of this study, there was not enough time allotted to investigate the barrier to care delivery every time a signal function was performed incorrectly. Therefore, general qualitative trends were detailed as much as possible

for the observed signal functions at each of the five facilities at which this study was taking place. Overall, the direct observations corroborated the reported barriers. “Supplies, equipment, and medication” and “Health care worker training” were the barriers to delivery that were universally perceived at every facility that was part of this study in Cameroon. The former, in particular, was often very obviously apparent at the district hospital emergency units even before any signal functions were witnessed. A striking barrier that the research team often identified at each facility but that was frequently conspicuously absent on the ECAT completed by the Heads of emergency was “Policies”. These findings will be further discussed in the Discussion chapter.

CHAPTER 5
Discussion

The national, suburban district, and rural district hospital emergency facilities data suggest that ECAT is a valid tool. However, the regional and urban district hospitals' data were contradictory. Thus, there was mixed evidence regarding the ability of the self-reported ECAT tool to accurately reflect actual emergency care provision.

The general trend in this study was that the level of facility study correlated with the ability to perform an increasing number of signal functions. The higher the level of facility, the greater the number of signal functions that could be performed correctly and consistently, and hence the greater the emergency care capacity. These trends, the barriers to care delivery that contributed at the different site locations, and the nuances in the validity findings will be further explored in this chapter.

5.1 Statistical Interpretation

5.1.1 National emergency facility

At the national facility, there was no statistical difference between reported and observed ability to perform signal functions. This suggests that, at this facility, ECAT is a valid representation of emergency care delivery ability.

5.1.2 Regional emergency facility

A statistically significant difference was detected between what was independently observed and what was reported at the regional facility. While this discrepancy may seem to detract from the argument for validity, it is important to realise that this finding may be confounded by issues of reliability. The statistics may not necessarily be a reflection of the tool but rather an indication that a sole reporter and the true capacity of the facility did not correlate for this particular facility. The regional facility reported less capacity than was observed by the ECAT researchers. The reasons for this are not completely clear, but the regional facility had reportedly been functioning far under its expected capabilities for more than a year due to unaddressed equipment malfunctions, such as a broken CT scanner, and unreliable supply delivery. Under-reporting capacity on the ECAT may have served as a statement to highlight or accentuate existing and chronic problems at the facility.

These findings suggest that further reliability studies should be conducted on ECAT and that employing ECAT with a greater number of individuals at each facility may yield more valid answers.

5.1.3 Urban district emergency facility

A statistically significant difference was detected between what was directly observed and what was reported at the urban district facility. Similar to the regional level emergency facility, while this discrepancy may seem to detract from the argument for validity, the finding actually serves to highlight an interesting issue of reporter reliability. Again, the statistics may not necessarily reflect the tool but rather an indication that a single reporter and the true capacity of the facility did not correlate for this particular facility. Here too, the urban district facility reported less capacity than was observed. The reasons for this finding may be similar to those postulated earlier as the urban district facility also endorsed chronic supply shortages, but more significantly, several of the nurses reported discontent over the fact that they had not received their salary from the government in over six months. Under reporting capacity on the ECAT may have served as a statement to highlight or accentuate existing and chronic problems at the facility. These findings further suggest that reliability studies should be a future priority for ECAT and that employing ECAT with a greater number of individuals at each facility may yield more valid answers.

5.1.4 Suburban district emergency facility

The suburban district hospital was a surprisingly well maintained and equipped facility that exists within a densely-populated area directly outside the confines of the capital city but without easy access to the resources present in the city. At this facility, there was no statistical difference between reported and observed ability to perform signal functions. This suggests that, at this facility, ECAT is a valid representation of emergency care delivery ability. The fact that ECAT was shown to be valid at various locations and service levels is an important finding as it gives support to the breadth of the ECAT's potential validity in diverse settings.

5.1.5 Rural district emergency facility

The rural district level hospital is a facility that serves both the residents of a small town and the health zone's primarily rural population. A statistically significant difference could not be detected between direct observation and reported ability to perform signal functions. This suggests that, at this facility, ECAT is a valid representation of emergency care delivery ability. Combined with the findings from the national and suburban district hospitals, this gives further credence to the scope of the ECAT's validity and widespread practicality across diverse settings and diverse emergency facility levels.

Location	Catchment	ECAT reported by Head valid?	Explanation
National	Capital city	Yes	Report showed correlation with observation
Regional	Regional capital city	No	Potential reliability issue. Discrepancy between Head report and observation
Urban	High population zone of capital city	No	Potential reliability issue. Discrepancy between Head report and observation
Suburban	Densely populated zone directly outside the capital	Yes	Report showed correlation with observation
Rural	Small rural town and its health zone	Yes	Report showed correlation with observation

Table 14: Validity findings at emergency facilities

5.2 Signal functions

Across the five health facilities, the country wide data collected consisted of 2839 total signal functions observed. All but 13 of the signal functions listed in ECAT were directly observed. By a large margin, the most frequently observed signal functions were generally small procedural items such as obtaining peripheral IV access, starting initial appropriate wound care, and performing a urine dipstick. One of the most observed signal functions that was not procedural was the administration of intravenous antimalarials/antibiotics, which indicates the frequency of presumed infectious presentations within emergency units in Cameroon. The data suggest that quality initiatives within facilities may prioritise the appropriateness of antimalarial and antibiotic administration.

The regional hospital reported the largest number of signal functions that were unattainable. They marked 41 of the signal functions in this manner. The reasons for this are not completely clear. The ECAT procedures were explicitly and clearly described, and the Head of emergency at the regional level facility demonstrated understanding of the survey to a similar degree as the other Heads at other facilities. However, despite being at a unit that was more fully equipped, had more access to resources and testing, and even had their own freestanding emergency care structure, the way the regional Head responded was decidedly more pessimistic than how his counterparts at lower level establishments responded. It was also noticeably more pessimistic than what observation indicated the regional facility could perform on a consistent basis. Definite explanations to why this occurred currently lacks concrete evidence, but it is important to note that the regional emergency unit had reportedly been functioning far under its expected capabilities for a considerable time due to unaddressed equipment malfunctions and supply shortages. Under reporting capacity on the ECAT may have been an alternative means to highlight or accentuate an existing and chronic problem at the facility.

This discrepancy between how the regional facility completed the tool and what was observed contributed to the McNemar tests showing a statistical difference between the two. However, this is more a reflection of the potential subjective nature of the reporting. The Head of emergency as sole reporter may not possess the required reliability and a greater number of individuals surveyed at each facility may give even greater insight into validity. Even though the aims, objectives, character, and procedure of the ECAT were made abundantly clear to the Heads of emergency

in charge of filling out the survey, it is still possible that personal perceptions, judgements, or confidence of one individual could have influenced the way the surveys were completed and hence the measure of the ECAT's validity. The results and experiences from the regional emergency facility hint at the future need for robust reliability studies. This must be performed with an appropriate sample size to determine inter- and intra-rater reliability to identify specific areas where conformance was good or poor and possible reasons why.

5.2.1 Rare signal functions

Signal functions whose observations were expected to be rare were indicated on the ECAT. The identification of these rare signal functions was based on a consensus of emergency specialists experienced in low resource settings. This was ultimately an astute action as these were consistently signal functions that were unable to be observed regardless of region or facility level. This is not to say that some of these were not observed. Most of the rare signal functions that were witnessed being performed occurred at the national emergency unit, and were usually observed being performed correctly. However, this is potentially skewed by the fact that many of the providers performing these skills at the national level facility were emergency care specialists that had significant clinical experience and training from international hospitals, universities, and institutions in South Africa, France, and South Korea. The Head of emergency at the national emergency facility marked most of the rare signal functions as being unattainable.

5.3 Sentinel conditions

5.3.1 Head of emergency report

In this study, Respiratory failure was the sentinel condition with signal functions reported most frequently as being incapable of being performed correctly. It was indicated as such 38 times across all of the Cameroonian emergency facilities in this research. However, this should be interpreted with the knowledge that Respiratory failure is a sentinel condition within which there is a larger number of signal functions. The fact that this was felt to be the worst managed sentinel condition across Cameroon may be an indication of not only the burden of disease in the country, but also the need to focus training and resources to better manage this condition. This is also particularly pertinent because a patient presenting with a respiratory failure signal function often

will not have the time to be transferred to higher levels of care. It is therefore an absolute necessity for this sentinel condition to be well managed starting at lower level facilities.

Shock and Trauma were the two other sentinel conditions in which the Heads of emergency at the five facilities had less confidence in their ability to perform the relevant signal functions. This correlates with the well-documented high burden of disease and imperative need for improved management of trauma across Africa (37,38,42,46). This study is novel as it is a primary report from the field that suggests a limited capacity to deal with this increasing burden in Cameroon. The first-hand acquisition of information from the Heads of emergency as well as the subsequent objective observation of a wide variety of emergent conditions in order to validate ECAT is a unique step being taken by this study. A valid assessment tool that can accurately elucidate health burdens and areas of improvement via a primary report would have far reaching policy and health implications.

Additionally, this study found that the sentinel condition of Maternal health had a proportionally high number of signal functions that were reported to be attainable. This was a somewhat perplexing finding as generally, conditions pertaining to maternal health did not fall under the purview of most of the emergency facilities. In fact, only the national level facility had a dedicated area in which to handle these conditions, but even there, obstetrical emergencies were generally routed to the Obstetrics and Gynaecology service of the hospital. The reason for this finding is most likely the marked global health funding stemming from the Millennium Development Goals that highlighted obstetrical emergencies (46). This large global policy move and the funding that ensued created opportunities for education and avenues for assessment such as EmOC. The renewed focus on this issue is likely the reason why these signal functions can be completed and reported on with such confidence.

The signal functions for the sentinel conditions Severe pain and Altered mental were consistently reported as attainable. This may reflect both more thorough training in these conditions as well as more consistent resources and equipment to handle these signal functions; a notable consideration given that country-wide, “Supplies, equipment, and medication” and “Health care worker training” were the two most cited barriers to delivery.

5.3.2 ECAT research team observations

Observation indicated that Respiratory failure and Altered mental status were overall the sentinel conditions that had the greatest number of signal functions that were unable to be performed correctly. However, proportionally, Altered mental status demonstrated a greater rate of signal functions that could not attain the defined threshold as there are ten signal functions in that sentinel condition versus 14 for Respiratory failure. In general, the regional emergency unit and urban district emergency unit had the greatest number of signal functions in total that were directly observed to be unattainable.

Shock was the sentinel condition that had the greatest number of signal functions that were observed to be attainable across all facilities. However, proportionally, the sentinel condition of Severe pain demonstrated a greater percentage of signal functions that were attainable. This is partially because there are nine signal functions in that sentinel condition versus 17 signal functions for Shock. However, it may also be since the signal functions within Severe pain are not especially technically challenging nor are they particularly rare. For example, the signal functions “Urine dipstick”, “HCG testing”, or “Oral hydration” are procedures that are performed very frequently and do not require a high level of technical experience or training. The national level facility had the greatest number of signal functions and therefore sentinel conditions that were observed to be performed correctly. Interestingly, the facility that had the next best numerical total was the rural district hospital with 37 signal functions. Perhaps due to diminishing resources as a facility becomes more rural, providers are encouraged by their surrounding resources and conditions to become more efficient and competent in their techniques.

5.3.3 Interpretation of sentinel condition statistics

In the Results chapter, it was described how McNemar tests were run on the data for each of the sentinel conditions. It has also been described in the Methodology chapter that the evaluation of small sample sizes via McNemar analysis is less robust because the test becomes increasingly conservative and less statistically powerful as the “b + c” measure decreases. This clearly became relevant when the sentinel conditions were being examined. Despite conditions being optimised via an asymptotic McNemar test with continuity correction, the results of these tests demonstrated a considerable diminishment of power.

None of the p-values of the sentinel condition McNemar tests allowed for the rejection of the null hypothesis. Thus, evaluating for sentinel conditions on their own, one would not be able to conclude that there were any statistical differences between what was observed and what was reported for any of the sentinel conditions at any of the emergency units. As enticing as this looks towards favouring an argument for the validity of the ECAT, the trap is interpreting these statistical results as such. It is clearly inconsistent with the fact that when the ECAT was evaluated as a holistic composite of the sentinel conditions, both the regional and urban district hospital emergency facilities demonstrated a statistical difference.

If one re-examines the table that lists the p-values of the McNemar tests on the sentinel conditions, one will notice that there are conspicuous number of outputs of 1.000. This fact combined with the discrepancies between the McNemar tests of the sentinel conditions and the holistic ECAT McNemar tests, strongly suggests that when analysing the sentinel conditions, the limitations of the McNemar tests were encountered. That is, the number of signal functions observed for each sentinel conditions was sufficiently small and the b + c was sufficiently minute such that the test became prohibitively weak and conservative. Therefore, although much qualitative information can be gleaned from the sentinel conditions, satisfactory quantitative statistical data were not achieved for them. An analysable change let alone adequate sample sizes or statistically significant values were unable to be detected, and quantitative arguments could not be advanced for or against validity of the ECAT via the sentinel conditions on their own.

5.4 Overall validity of ECAT

By taking a closer look at the validity of the ECAT, this study attempted to make a data driven observation and statement about the quality of the tool with a single reporter – the Head of emergency. Previous studies made preliminary informal evaluations into the reliability of ECAT, but the sample sizes used were insignificant and underpowered, and the data collected were not rigorous enough to allow for sound conclusions. More definitive studies on reliability are still pending. This project was able to assess for validity of the tool at a holistic level at a number of facility levels in diverse locations across Cameroon.

Overall, the national hospital emergency unit, suburban district hospital emergency unit, and rural district hospital emergency unit yielded data supporting the

validity of the ECAT at those respective institutions. The regional hospital emergency unit and urban district hospital emergency unit output data that did not support the validity of the ECAT. However, as explained previously, given the context in which the regional and urban district facility data were collected, these findings may be a greater reflection of the reliability of a sole reporter than they are of the validity of the tool. Thus, although the mixed nature of these overall data does not necessarily allow for an immediate robust and definitive statement about the validity of the tool, the fact that statistical analyses showed that a correlation existed at different levels of emergency units, in drastically different settings, and at the majority of facilities sampled, is a very encouraging argument for the validity of ECAT.

5.5 Barriers to delivery

The data collected over two years of sampling in Cameroon, including the previous ECAT development research conducted before the present study, appears to be consistent in its findings and with each other. This study showed that the largest and most reported barriers to care at the five facilities fell under the categories “Supplies, equipment, and medication” and “Health care worker training”. Conversely, the least indicated barrier reported was “Policies”. “Supplies, equipment, and medication” and “Health care worker training” were also the most significant observed barriers to care. This hints at a systemic issue because these two barriers were implicated regardless of facility level. As training and a distinct lack of knowledge on emergency conditions were often reported, it could be recommended to the government in Cameroon to prioritise country-wide interventions in improving emergency condition-specific training for all providers who perform any of the signal functions in their scope of practice, including doctors, nurses, and clinical officers. This could be partially accomplished via the implementation of AFEM vetted curricula which have been developed for similar contexts. To target supply and equipment issues, facilities could also be directed to undertake a more detailed checklist survey to determine the exact resource insufficiencies in facilities across the country.

The fact that “Policies” was reported to be the least indicated barrier to delivery is an interesting finding because it was observed to be a barrier on multiple occasions. Yet, it was identified as a barrier on only one occasion for a single signal function at the urban district hospital emergency unit. Furthermore, "Infrastructure” was a

recurrent barrier to delivery noted during observation. These will be further discussed at length.

5.5.1 Infrastructure: resource and equipment location

A common issue of clarification that the Heads of emergency required concerned what constituted the ability to correctly perform a signal function from an infrastructure standpoint. They often sought greater explanation in situations where it was relevant to take into consideration not only if the signal function could be performed but also where it could be performed. On multiple occasions, it was important to specify that the tool was meant to be framed within the dedicated emergency area because of their contention that the knowledge and materials were available, just not necessarily in the emergency unit. For example, at two of the district hospitals, the personnel were properly trained and able to administer emergency oxygen, but the tanks of oxygen were located in the surgical suites. If oxygen was necessary, the established procedure was to transport the patient to surgery in order to administer it. By the standards of the ECAT this would be categorised as an inability to correctly perform the signal function since it is not efficient, time-sensitive, or readily available. Furthermore, the implicit understanding was that the services provided should be located in an emergency unit. The contention that the knowledge was present and that it was simply the location of a resource that was a limiting factor is understood, however, at this stage in emergency care development in Cameroon, the single emergency model is considered standard and truly, a patient in need of emergent oxygen application should not routinely require transportation to a surgical suite.

These experiential observations point to two things: first, there is a broad and general infrastructure issue both geographically and between facility level in Cameroon where personnel, training, and knowledge can be available for a given signal function in the emergency unit, but the equipment and supplies are located elsewhere in the hospital. This is an inefficiency that could potentially cost precious time and lives especially in acute presentations. Secondly, the ECAT functioned much more effectively both in terms of reliability and enhanced understanding of the tool when administered in person by the ECAT researcher. Answering ECAT independent of a surveyor was more likely to promote confusion and errors in the answers. The process of administering the ECAT was always smooth and uncomplicated when time

was taken to sit and navigate it with both the researcher and Head of emergency together. In future administration of the ECAT, this study would advocate for the continuation of this approach as it provides a richer, more reliable, and less obscure interpretation of the signal functions, leading to better overall data. This recommendation which was put forward in the ECAT development study is seconded in this study with full understanding that it is more time and resource dependent. However, if large scale public health and policy changes are one day to be based off of these data, it would behove all involved parties to have access to the best, most accurate and precise data possible.

5.5.2 Infrastructure: maternal health

At the five health facilities visited across the country, 2839 total signal functions and all but 13 of the signal functions listed in ECAT were directly observed. An interesting pattern that arose was that the signal functions under the Maternal health sentinel condition were frequently unable to be witnessed due to the fact that they often did not fall under the emergency unit's purview. Particularly for obstetric emergencies, all of the hospitals visited had a pre-existing, established way of dealing with such conditions; and in general, those emergencies went directly to the Obstetrics and Gynaecology service. Consequently, almost none of those emergencies showed up at the emergency unit. This is reflected in the data as there is a paucity of information surrounding this sentinel function due to the inability to witness its signal functions and whether they could be consistently performed correctly or not.

This focus and distribution of obstetric emergency to a specific unit based on initial presentation is a known systems issue. However, it is also important to understand where patients are primarily presenting in the first place. In other words, either the existence of or lack of contact with certain signal functions or sentinel conditions is in itself an interesting piece of information. As future steps are taken with the ECAT and as its use becomes increasingly widespread and accepted, it will be very important to continue to capture this information as it will assist in elucidating how certain health establishments direct the flow and management of their maternal health emergencies. Global policy and hence funding has tended to highlight obstetric emergency and has allowed for maternal health to become a global priority without emphasising emergency care across the life cycle. ECAT will serve to bridge those gaps by collecting important data that can address the need for a more far-reaching

and holistic development of emergency care.

5.5.3 Policies: pre-payment

A significant and difficult barrier to delivery that was too often encountered was the barrier of the payment before service policy that exists in Cameroon. There were a concerning number of times that a signal function had to be marked as unable to be performed correctly not because of a lack of skill, but because the signal function needed to be performed but was either abandoned or not initiated due to a purely monetary issue. As all hospitals in Cameroon use the fee-for-service model (71), if the money ran out or if a service could not be afforded by the patient's family even though it was clearly necessary, care for that patient could be abruptly deserted. Speaking very frankly, this was extremely upsetting to watch on multiple occasions. This issue is so important that the policy barrier of payment before service should be explicitly captured in the ECAT rather than codified under the barrier heading of "Policies". Conversations about further work has included qualitative documentation with retrospective coding that would likely capture this type of information as well as information about access and affordability. Cameroon has provisions for emergency care in its laws, however too frequently, compliance to these policies is being superseded by payment (71). The recommendation must be for strengthening of and absolute adherence to these codes. Lives are being lost even in facilities where care is available due to an inability to pay; an access to care issue that must be addressed at the legislative level.

5.6 ECAT administration

The ECAT functioned much more effectively both in terms of reliability and enhanced understanding of the tool when administered in person by the ECAT researcher to the Head of emergency. This is on top of the written resources that were given to each Head of emergency to facilitate understanding of the study and completion of the ECAT. Because of the results and recommendations of the previous ECAT development study, an in-person approach was used as much as possible when employing the ECAT. However, at two of the facilities, the Heads of emergency initially insisted upon sitting down and filling out the survey without the ECAT researcher being directly on hand to assist, clarify, and administer the tool. Ultimately, this approach was unsuccessful as the Heads of emergency at both of these sites required

clarification and had additional enquiries about the tool which necessitated an in-person consultation. The issues were quickly resolved once the ECAT was administered in the recommended manner.

During this validation study, the entire survey as well as accompanying documents and instructions had to be translated into French. However, the additional layer was that this study was conducted in Francophone Cameroon, which possesses a novel set of vernacular and cultural idiosyncrasies that have the potential to confound and confuse the administration of the ECAT. The translation thus required multiple iterations and checks for correctness, consistency, and appropriateness. It will be necessary for the ECAT to undergo rigorous cultural testing to ensure that appropriate, context-specific terms, definitions, and translations are used in each unique environment where ECAT is employed.

Future research should also include qualitative interviews in order to formally assess the administration and usability of the tool. These can ensure that the tool is comprehensive, that its signal function, sentinel condition, and barriers to delivery components are clear, and that the tool is rapid and easy to complete. Using the assumption that signal functions are available >90% of the time must be verified to be an understandable and realistic way to view signal function ability. More robust confirmation that the “barriers to delivery” category is comprehensive will give better insight into why certain signal functions have been marked in particular ways and also provide additional information and education if a misunderstanding or personal bias arises.

5.7 ECAT in context of existing tools

There are many existing tools that are already in use, however, ECAT aims to provide a much-needed role that other tools have not been able to fulfill. In addition, ECAT could potentially be employed in conjunction with some of the existing tools in order to supplement the details absent in each respective tool.

ECAT was based on and constructed using the successes of EmOC’s innovative signal functions. Signal functions proved to be useful in not only assessing management of maternal health as with EmOC, but also in determining capacity in the emergency care setting. However, the scope had to be expanded. For all intents and purposes, being a maternal health specific tool, EmOC evaluates the management of a healthy person in a single acute event, at a specific time point, for a condition that is

not actually a disease. In contrast, emergency care deals with additional complexities due to the required ability to recognise and intervene on syndromes and toxidromes of multiple specific diseases; what this dissertation has been calling sentinel conditions. Although ECAT draws upon the signal functions and format of EmOC, it was tailored to reflect this key difference.

Now with this validation study, an additional level of rigour is being applied to the level of quality and applicability of the tool. Most existing tools have not undergone studies assessing either validity or reliability. The reliability study of TSAAEESC in Ghana being the exception (57). However the scope, approach, and capability of TSAAEESC is much more limited than ECAT. The findings of this research are encouraging for the validity of the tool and motivating for further future validity and reliability studies.

The future scope of the ECAT is far reaching. Ultimately, one of the ideas for the tool's future role is to be able to designate facilities as "basic", "intermediate", and "advanced" based on distinct capacity criteria. This is considered to be an essential point as it further differentiates the ECAT from the WHO Trauma checklist, which attempts to evaluate facilities based on ostensible predetermined designations (42). In contrast, ECAT aims to actually bestow meaningful, useful, and appropriate designations rather than critiquing a facility's supposed current level. There are questions that need to be addressed in order for this designation function to occur. For example, it is not yet clear what the proper calibration for the tool should be; if it is too vigorous or strict, potentially too many African facilities would not meet the criteria for even a "basic" level. It is also unclear if the most beneficial and targeted approach to designating a facility level is to give one designation per facility or if designations should be stratified by sentinel conditions. After ensuring tool reliability and validity, future studies on ECAT should address making decisions regarding how to assign facility designations.

ECAT was developed to serve as a broad, general assessment, to quickly determine flaws or areas for improvement in the emergency care system via signal functions. It was designed to quickly determine whether a particular signal function could be performed correctly >90% of the time; yes or no. The question is blunt; the ECAT was not meant to nor designed to collect nuanced answers. However, greater detail can be collected by elucidating the barriers to care delivery. Furthermore, ECAT has the potential to be reinforced by one of the many existing equipment checklists

after a “first-pass” with the ECAT tool.

For example, for a facility that demonstrates a poor ability to perform signal functions from the “trauma” sentinel condition, they could then be directed towards using the WHO Trauma checklist to refine the nature of their difficulty. Similarly, for a facility that identifies areas for improvement in the maternal health sentinel condition via the ECAT, they could then take an analogous course of action by completing the WHO EmOC tool. In addition, since the ECAT does not include any specifics regarding medication, it could easily be supplemented with existing WHO essential medication checklists that are context-appropriate and approved (72). This could capture the necessary details of specific medication gaps especially for facilities that indicate medication availability as a barrier to care delivery on the ECAT.

5.8 Value and utility of ECAT

The intention of ECAT is to serve as a sensitive predictor of emergency system function in situations where morbidity and mortality would be affected by appropriate management (7). Emergency scenarios generally do not require a trained specialist for definitive care, but are rather syndromes where early intervention by any appropriate cadre of staff would make significant impacts on outcomes (22). The ECAT was designed to specifically reflect those syndromes and diagnoses in a simple, comprehensive, and informative manner. Signal functions were developed as the ideal way to capture the broad sentinel condition categories while at the same time retaining a hint of the detail present in facility equipment lists. ECAT’s signal functions were to serve as a diagnostic tool to establish facility shortcomings. They are a simple way of indicating when a part of a facility’s basic emergency care capacity is not met. In this way, these shortcomings can help to inform and prioritise targeted interventions. ECAT makes it possible to determine the areas requiring improvement in different facilities at different levels, as well as broader geographical level data and trends such as how many times certain barriers to delivery occurred in certain countries.

In its present form, ECAT is an individual facility assessment. However, with modifications and increasingly widespread use, it has the potential to be used as a broader community assessment tool. By evaluating patterns in data revealed by ECAT against reported barriers to delivery, signal functions were hypothesised to be a sensitive predictor of both larger scale emergency system function as well as epidemiologic data (46). Furthermore, a method has already been demonstrated as

EmOC has previously used indicators such as geography and the ratio of number of facilities to population size in conjunction with signal functions to assess capacity at a regional scale (46). If employed at a large enough sample of facilities in a region, similar use of ECAT could help determine and describe areas of improvement in a system and country. ECAT could serve as an objective adjunct in advocating for increased capacity and population-level emergency health systems development.

5.9 Limitations of study

There were several limitations to this study, although it is important to remember that the focus of this phase of the study was the validation of the tool, not collecting quantitative data.

The nature of the McNemar tests do not necessarily allow for the statistical evaluation of some the nuances present in the data. Because the statistical approach employed is necessarily confined to a 2x2 table and can only effectively generate information about the ECAT as a whole, consideration of details such as the number of times each signal function was observed is noticeably absent. For example, at the national facility, the signal function “Peripheral percutaneous intravenous access” was observed 127 times and was correctly performed 100% of the time, which was above the >90% threshold. This meant that when the data were reorganised into a binary format, this signal function was designated as a “1”. However, the signal function “Needle decompression of tension pneumothorax” was observed just one time at the same facility, and was judged to be correctly performed that one time. This was also a 100% correctly performed rate, also above the threshold, and thus also designated as a “1”. Clearly, the difference between 127 observations and one observation cannot be effectively captured. Weighting of signal functions or placing thresholds for certain common procedures based on the ED volume has been proposed to adjust for frequency. These measures could potentially address the asymmetry in data, and may be considered as a future direction for ECAT. However, it is important to note that ECAT was developed to serve as a broad, general assessment, to quickly determine flaws or areas for improvement in the emergency care system via the signal functions. It was not meant to or designed to collect nuanced answers that take into consideration the relative prevalence of one signal function versus another.

This study used only convenience sampling of the facilities included in the study rather than a random sample. The time constraints and accessibility of certain regions

and hospitals in Cameroon was not conducive to random sampling. Furthermore, since it was the validity of the ECAT and its signal functions that were being studied and not the individual facilities, it was more important to have a random sampling of signal functions at each emergency unit, which was achieved.

ECAT is intended for any emergency facility, however, in this study, only public government hospitals were assessed. This is where the clear majority of the Cameroonian population receives emergency care, since most people do not have access to private facilities. The tool will ultimately be able to be applied to any facility, however, the public facilities were chosen for depth and breadth of emergency cases. This may limit external validity.

An important consideration in the study is that the national emergency unit is the one facility that was not purely funded and operational due to state resources; it is a relatively new entity (opened in 2015) and is largely equipped and staffed through funding of both the South Korean government (through the Korean Agency for International Cooperation (KOICA)) and the United States (via the Global Health Security Agenda) (73). This aid is not only funding, but also modern equipment and medical workers: emergency physicians, nurses, and technicians. Because of this additional support structure, there is clearly a significant difference between what the national emergency unit can offer and what can be offered and performed even one level down at the regional level. The national emergency unit does not necessarily characterise the emergency care situation and quality experienced by the rest of the country.

Additionally, the results and experiences from the regional emergency facility hinted at the fact that the validity of the ECAT may be subject to user dependence and reliability. Even though the aims, objectives, character, and procedure of the ECAT were made abundantly clear to the Heads of emergency in charge of filling out the survey, it is possible that personal perceptions, judgements, or confidence could have influenced the way the surveys were completed and hence the accuracy of the tools as well as the measure of the validity of the ECAT. Further intra- and inter-reliability studies must be performed.

CHAPTER 6
Conclusions

To date, there has not been a single evaluatory tool that is able to assess the capacity of emergency care services at the facility level and that is applicable to LMICs. This study suggests that the Emergency Care Assessment Tool is able to establish emergency capacity via evaluation of signal functions at various levels of facility. The success of this study suggests that larger regional or national studies would provide concrete information on current emergency capacity to policy-makers and could have profound implications on clarifying a clear and targeted approach to improvement based on the barriers to delivery. In addition, mapping facility capacity could have marked implications for emergency care system planning such as identifying patterns in barriers of delivery, matching facility capacity to population and disease burden or appropriation of resources based on a facilities stated needs to enhance health care delivery.

Several future steps will be required to finalise ECAT. These include further validity studies to ensure that self-reported capabilities of interviewees are providing accurate self-assessments, as well as inter- and intra-rater reliability studies.

6.1 Recommendations

6.1.1 Reliability and validity studies

The findings of this study are very encouraging for not only the validity of the tool but the data it can help elucidate. However, continued validity studies are necessary, both in different countries and with a greater number of signal functions observed.

Inter- and intra-rater reliability studies are needed to determine if different people within the same facility give the same information and if the tool is able to provide reproducible results.

6.1.2 Cultural appropriateness

Language testing and cultural refinement should be made to the ECAT in every country in which it is administered.

6.1.3 ECAT administration and usability

Future research should include qualitative assessments in order to formally determine the administration and usability of the tool. These can ensure that the tool is comprehensive, that its signal function, sentinel condition, and barriers to delivery components are clear, and that the tool is rapid, easy to complete, and yields quality data.

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Appendix A - Emergency Care Assessment Tool (English)

Facility Name_____ Date _____
Location_____

The interview time will only take no more than 45 minutes.
Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with AFEM. If you decide to take part, you are free to withdraw at any time.

Emergency Care Assessment Tool- Foundation Signal Functions

Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Respiratory Failure									
I. Obstructed airway									
Manual manoeuvres[1]	☐ Yes ☐ No								
Relief of obstruction[2]	☐ Yes ☐ No								
Use of suction	☐ Yes ☐ No								
SURGICAL AIRWAY	☐ Yes ☐ No								
II. Respiratory Distress									

[1] Includes head tilt, chin lift, jaw thrust
[2] Includes abdominal thrusts if conscious, CPR if unconscious, chest thrusts and back blows for infant

Rescue breathing	☐ Yes ☐ No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Three-way dressing	☐ Yes ☐ No								
Insertion of oral airway	☐ Yes ☐ No								
Bag valve mask ventilation	☐ Yes ☐ No								
SUPRAGLOTTIC DEVICE PLACEMENT	☐ Yes ☐ No								
Administer critical therapeutics for reactive airway disease[3]	☐ Yes ☐ No								
Oxygen administration	☐ Yes ☐ No								
Endotracheal intubation	☐ Yes ☐ No								
CRICOTHYROTOMY	☐ Yes ☐ No								
Non-invasive mechanical ventilation	☐ Yes ☐ No								
Invasive mechanical ventilation	☐ Yes ☐ No								
Shock									

[3] E.g. any bronchodilators, adrenaline, steroids

I. Haemorrhagic Shock									
Physical manoeuvers for control of haemorrhage[4]	☐ Yes ☐ No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
ARTERIAL TOURNIQUET	☐ Yes ☐ No								
PELVIC WRAPPING	☐ Yes ☐ No								
Packing and suturing for control of haemorrhage	☐ Yes ☐ No								
Peripheral percutaneous intravenous access	☐ Yes ☐ No								
Intraosseus access	☐ Yes ☐ No								
VENOUS CUTDOWN	☐ Yes ☐ No								
Pathogen screened blood transfusion	☐ Yes ☐ No								
CENTRAL VENOUS ACCESS	☐ Yes ☐ No								
II. Other Shock									
ECG interpretation	☐ Yes ☐ No								

[4] Direct pressure, pressure bandage, pressure points

External defibrillation	☐ Yes ☐ No								
Needle decompressio of tension pneumothorax	☐ Yes ☐ No								
Administration of adrenaline (for anaphylactic shock)	☐ Yes *- If yes, circle:* *IM IV* ☐ No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Administration of IV medications that require advance monitoring[5]	☐ Yes *- If yes, circle:* *IM IV* ☐ No								
Cardioversion	☐ Yes ☐ No								
PERICARDIOCENTESIS	☐ Yes ☐ No								
III. Severe Sepsis/Septic Shock									
Administration of isotonic IV fluids	☐ Yes ☐ No								
Administration of IV antibiotics and/or antimalarials	☐ Yes *- If yes, circle:* *PO IM IV* ☐ No								
Altered Mental Status									

[5] E.g. vasopressors, thrombolytics

I. Unconscious Patient									
Protect from secondary injury[6]	☐ Yes ☐ No								
Check and/or administer glucose if required.	☐ Yes ☐ No								
Administer insulin for hyperglycemia	☐ Yes ☐ No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Perform head CT	☐ Yes ☐ No								
Perform lumbar puncture	☐ Yes ☐ No								
II. Seizure									
Administer benzodiazepine	☐ Yes *- If yes, circle:* *PO IM* *IV Rectal* ☐ No								
Administration of parenteral magnesium sulphate for pregnant patient	☐ Yes ☐ No								

[6] Specifically, is there adequate personnel/infrastructure to monitor blood pressure and avoid hypotension, avoid hyperthermia and cooling if necessary, avoidance of hypoxia, NGT to reduce aspiration risk)

Administer locally appropriate antidote for toxic cause[7]	☐ Yes ☐ No								
III. Other	.								
Administer mental status examination	☐ Yes ☐ No								
Management of extremes of temperature	☐ Yes ☐ No								
Severe Pain									
I. General Severe Pain-	.								
Administer opiate based analgesia	☐ Yes ☐ No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
II. Abdominal Pain									
Urine dipstick	☐ Yes ☐ No								
HCG testing	☐ Yes ☐ No								
Oral hydration	☐ Yes ☐ No								
Placement of Foley catheter for urinary outlet obstruction	☐ Yes ☐ No								

[7] E.g. antivenom

Therapeutic paracentesis	☐ Yes ☐ No								
Ultrasound	☐ Yes ☐ No								
III. Chest Pain									
Administration of aspirin if ACS likely	☐ Yes ☐ No								
Chest x-ray	☐ Yes ☐ No								
Trauma									
I. General Trauma									
Trauma protocol implementation	☐ Yes ☐ No								
Initial appropriate wound care[8]	☐ Yes ☐ No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Basic immobilization for fracture	☐ Yes ☐ No								
Reduction of fracture	☐ Yes ☐ No								
Cervical spine immobilization	☐ Yes ☐ No								
Tetanus vaccine & IVIG as indicated	☐ Yes ☐ No								

[8] irrigate with potable water or sterile solution, surgically close clean acute wounds, dress, infection control as needed

Antibiotics for open fracture (PO/IM vs IV)	☐ Yes *- If yes, circle:* *PO IM IV* ☐ No								
FASCIOTOMY FOR COMPARTMENT SYNDROME	☐ Yes ☐ No								
RABIES IVIG/ VACCINATION AS APPROPRIATE	☐ Yes ☐ No								
Access to general definitive surgical services	☐ Yes ☐ No								
Access to orthopaedic surgical services	☐ Yes ☐ No								
Access to neurosurgical services	☐ Yes ☐ No								
Chest tube insertion	☐ Yes ☐ No								
THORACOTOMY	☐ Yes ☐ No								
AUTOTRANSFUSION FROM CHEST TUBES	☐ Yes ☐ No								
II. Burns	.								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Cooling care	☐ Yes ☐ No								
ESCHARATOMY	☐ Yes ☐ No								

Maternal Health									
I. Obstructive Labour	.								
Administer uterotonic drugs (i.e. parenteral oxytocin)	☐ Yes ☐ No								
Perform assisted vaginal delivery	☐ Yes *- If yes, circle: Routine; Vacuum extraction; Forceps* ☐ No								
Perform newborn resuscitation (e.g. with bag and mask)	☐ Yes ☐ No								
Access to surgical services (e.g. caesarean section)	☐ Yes ☐ No								

Appendix B - Emergency Care Assessment Tool (French)

Facilité_____ Date _____
Endroit_____

Cette enquête durera 45 minutes environ
Participer à cette étude est totalement volontaire. Vous êtes libre de refuser de répondre à une question. Votre relation avec l'AFEM ne sera en aucune circonstance détériorée au cas où vous refuserez de participer ou vous sauterez une question sans répondre.

Outil d'Evaluation du Soin d'Urgence - Fonctions Signales

Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
Insuffisance Respiratoire									
I. Voie Respiratoire Obstruée									
Manœuvres manuelles[9]	☐ Oui ☐ Non								
Déblocage de l'obstruction[10]	☐ Oui ☐ Non								

[9] Incluant inclinaison de la tête, élévation du menton, subluxation mandibulaire
[10] Incluant compressions abdominales si conscient, RCP si sans connaissance, compressions thoraciques et claques dans le dos pour nourrisson

Utilisation d'aspiration	☐ Oui ☐ Non								
LIBÉRATION CHIRURGICALE/CRICO-THYROÏDOTOMIE	☐ Oui ☐ Non								
II. Détresse Respiratoire									
Respiration artificielle	☐ Oui ☐ Non								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
Pansement fermé sur trois côtés	☐ Oui ☐ Non								
Insertion d'une canule oropharyngée	☐ Oui ☐ Non								
Ventilation avec ballon-masque	☐ Oui ☐ Non								
POSITIONNEMENT DE DISPOSITIF SUPRAGLOTTIQUE	☐ Oui ☐ Non								
Administrer thérapeutiques critiques pour syndrome de Brooks[11]	☐ Oui ☐ Non								
Administration d'oxygène	☐ Oui ☐ Non								
Intubation endotrachéale	☐ Oui ☐ Non								

[11] Ex. tous bronchodilatateurs, adrénaline, stéroïdes

LIBÉRATION CHIRURGICALE/CRICO-THYROÏDOTOMIE	☐ Oui ☐ Non								
Ventilation mécanique non-invasive	☐ Oui ☐ Non								
Ventilation mécanique invasive	☐ Oui ☐ Non								
Choc									
I. Choc Hémorragique									
Manœuvres physiques pour maîtriser l'hémorragie [12]	☐ Oui ☐ Non								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
GARROT ARTÉRIEL	☐ Oui ☐ Non								
EMBALLAGE PELVIENNE	☐ Oui ☐ Non								
Remplissage et suture pour maîtriser l'hémorragie	☐ Oui ☐ Non								
Accès intraveineux percutané périphérique	☐ Oui ☐ Non								
Accès intraosseux	☐ Oui ☐ Non								

[12] Pression directe, pansement compressif, points de pression

DÉNUDATION VEINEUSE	☐ Oui ☐ Non								
Transfusion de sang testé pour pathogènes	☐ Oui ☐ Non								
ACCÈS VEINEUX CENTRAL	☐ Oui ☐ Non								
II. Autre Choc									
Interprétation de l'ECG	☐ Oui ☐ Non								
Défibrillation externe	☐ Oui ☐ Non								
Décompression à l'aiguille de pneumothorax sous tension	☐ Oui ☐ Non								
Administration de l'adrénaline (pour choc anaphylactique)	☐ Oui *- Si oui, encerclez:* *IM IV* ☐ Non								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
Administration IV des médicaments qui exigent un suivi avancé[13]	☐ Oui *- Si oui, encerclez:* *IM IV* ☐ Non								
Cardioversion	☐ Oui								

[13] Ex: vasopresseurs, thrombolytiques

	☐ Non								
PÉRICARDIOCENTÈSE	☐ Oui ☐ Non								
III. Sepsis Sévère/Choc Septique									
Administration IV des liquides isotoniques	☐ Oui ☐ Non								
Administration IV des antibiotiques et/ou antipaludiques	☐ Oui *- Si oui, encerclez:* *PO IM IV* ☐ Non								
Altération de l'État Mental									
I. Patient Inconscient									
Protéger de blessures secondaires[14]	☐ Oui ☐ Non								
Vérifier et/ou administrer glucose, le cas échéant.	☐ Oui ☐ Non								
Administrer insuline pour hyperglycémie	☐ Oui ☐ Non								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires

[14] Plus précisément, est-ce qu'il y a un personnel/une infrastructure acceptable afin de surveiller la tension artérielle et éviter l'hypotension, éviter l'hyperthermie et refroidissement si nécessaire, éviter l'hypoxie, sonde nasogastrique pour diminuer risque d'aspiration?

TDM de la tête	☐ Oui ☐ Non								
Ponction lombaire	☐ Oui ☐ Non								
II. Convulsion									
Administrer benzodiazépine	☐ Oui *- Si oui, encerclez:* *PO IM* *IV Rectale* ☐ Non								
Administration parentérale de sulfate de magnésium pour patient enceinte	☐ Oui ☐ Non								
Administrer antidote localement approprié pour la cause toxique[15]	☐ Oui ☐ Non								
III. Autre	.								
Administrer l'examen de l'état mental	☐ Oui ☐ Non								
Gestion des températures extrêmes	☐ Oui ☐ Non								
Douleur Intense									
I. Douleur Intense Général	.								

[15] Ex: antivenin

Administrer analgésie opiacée	☐ Oui ☐ Non								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
II. Douleur Abdominale									
Analyse d'urine	☐ Oui ☐ Non								
Test de hCG	☐ Oui ☐ Non								
Hydratation orale	☐ Oui ☐ Non								
Mise en place d'une sonde de Foley pour obstruction urinaire	☐ Oui ☐ Non								
Paracentèse thérapeutique	☐ Oui ☐ Non								
Échographie	☐ Oui ☐ Non								
III. Douleur thoracique									
Administration de l'aspirine si SCA probable	☐ Oui ☐ Non								
Rayon-X pulmonaire	☐ Oui ☐ Non								
Trauma									
I. Trauma Général									

Implémentation de protocole de trauma	☐ Oui ☐ Non								
Soins initiaux appropriés pour les blessures[16]	☐ Oui ☐ Non								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
Immobilisation basique des fractures	☐ Oui ☐ Non								
Réduction de fracture	☐ Oui ☐ Non								
Immobilisation de la colonne cervicale	☐ Oui ☐ Non								
Vaccin antitétanique & IgIV comme indiqué	☐ Oui ☐ Non								
Antibiotiques pour fracture ouverte (PO/IM vs IV)	☐ Oui *- Si oui, encerclez:* *PO IM* *IV* ☐ Non								
FASCIOTOMIE POUR SYNDROME DE LOGE	☐ Oui ☐ Non								
IgIV CONTRE LA RAGE/ VACCINATION, LE CAS ÉCHÉANT	☐ Oui ☐ Non								
Accès aux services chirurgicaux généraux et définitifs	☐ Oui ☐ Non								

[16] Irriguer avec l'eau potable ou solution stérile, fermer chirurgicalement les plaies aiguës et propres, panser, contrôle des infections au besoin

Accès aux services chirurgicaux orthopédiques	☐ Oui ☐ Non								
Accès aux services neurochirurgicaux	☐ Oui ☐ Non								
Insertion d'un drain thoracique	☐ Oui ☐ Non								
THORACOTOMIE	☐ Oui ☐ Non								
AUTOTRANSFUSION DU SANG DE DRAIN THORACIQUE	☐ Oui ☐ Non								
II. Brûlure	.								
Fonction Signale	Disponible au moins 90% du temps?	SI NON, POURQUOI?	Politiques	Ressources humaines	Formation des professionnels de la santé	Fournitures, équipements et médicaments	Infrastructure	Pas d'indication	Autres/Commentaires
Refroidissement	☐ Oui ☐ Non								
ESCARROTOMIE	☐ Oui ☐ Non								
Santé Maternelle									
I. Dystocie	.								
Administrer médicaments utérotonique (ex: ocytocine parentérale)	☐ Oui ☐ Non								
Accouchement assisté par voie basse	☐ Oui *- Si oui, encerclez:*								

	Routinier; Ventouse; Forceps ☐ Non								
Réanimation de nouveau-nés (ex: avec ballon-masque)	☐ Oui ☐ Non								
Accès aux services chirurgicaux (ex: césarienne)	☐ Oui ☐ Non								

Appendix C – Instructions to Administer ECAT

Before Administering ECAT

1. Be sure the interviewee has read the background information, and signed the consent form.
2. Be sure the interviewee has completed "Basic Information" sheet for his/her health facility.
3. Explicitly explain what each "barrier to delivery" means and be sure interviewee has access to these designations (on survey itself) at all times throughout the interview to reference easily.
4. Explicitly explain to the interviewee that if he/she is unsure of an item, to ask for an explanation.
5. Explicitly explain that this is not an assessment of the interviewee's knowledge base or a comprehensive regional analysis of health facilities.

During ECAT

1. Explain to interviewee that questions and comments throughout administering of the survey are encouraged.
2. Explain that answering "yes" is under the assumption that the signal function can be completed at least 90% of the time it is required to be performed.
3. ECAT is a prospective study so please administer the survey with appropriate language.
    a. For example, "If a patient with *(sentinel condition)* entered your health facility right now, would you be able to *(signal function*) at least 90% of the time."
    b. You may provide clarification and explanation regarding a certain item if the interviewee is not sure.
4. If an item is marked "No," be sure to ask why, mark the appropriate box for "barrier to delivery," and document any further details under the "comments" section. The more information collected the better.
5. Note that ECAT is assessing the capability of the health facility and not the knowledge base of the interviewee.

After Administering ECAT

1. Be sure to thank the interviewee for participating
2. Ask if the interviewee would like a copy of the completed ECAT for their reference.
3. Be sure that all of the contact information is correct and complete.

Appendix D - Background Information Questionnaire

Emergency Care Assessment Tool for Health Facilities

Thank you for your participation in the research study, “Emergency Care Assessment Tool (ECAT) for Health Facilities.” The ECAT toolkit was designed in order to determine if health facilities in Sub-Saharan Africa have the capacity to provide critical emergency services. The aim of this study is to validate the ECAT for different levels of health facilities in low and middle income countries in sub-Saharan Africa.

This is NOT an assessment of you or your health facility, rather, a way to determine the validity of this toolkit for future use.

You will be asked a series of questions based on:

- Background questions
- The management of:
    - Respiratory failure
    - Shock
    - Altered mental status
    - Severe pain
    - Trauma
    - Dangerous fever
- Other

Please answer to the best of your ability, providing as much detail and comments as possible. Feel free to ask questions throughout the survey.

All information is strictly confidential and the results will not include any identifying information on the health facility questioned or the interviewee.

If you have any questions about the survey or the study itself, please contact Paul Kim at programs@afem.info. Thank you for your cooperation!

*****For the following survey, please assume that Emergency Unit refers to emergency department, accident & emergency, trauma unit, casualty department, or emergency room*

Investigator: _____ Date: _____

Region: _____ Hospital: _____

Person Undertaking Assessment

Name of person participating in assessment	
Date of assessment	
Title of participant (doctor, nurse, etc.)	
Signature of participant	
Contact Telephone/Cell number	

Background of Health Care Facility

Name of Health Care Facility	
Address of Health Care Facility	
Country	
Region of Country	
Type of Health Care Facility (*Please circle one)*	District Regional University Private Other: _____
Patient population seen in the EC *(Please circle one)*	Adult only Paediatric only Adult and Paediatric
How many patients does your emergency unit see? *(Please circle one)*	_____ per year/month/week/day

Please indicate the number of health staff:	
Doctors	
Specialist Trained EM Providers	
Nurses	
Clinical or Health Officers	
Technicians	
Paramedical Staff	
Other staff	

Please indicate the number of hospital beds:	
In the Emergency Unit	
In the hospital	
In the intensive care unit	

Appendix E – ECAT Consent Form (English)

ECAT Information Sheet and Consent Form
(For Head of Emergency)

Title: Emergency Care Assessment Tool for Health Facilities – A Validity Study in Cameroon

Researcher: Paul Kim
Email: pkimpccam@gmail.com
Candidate for MSc in Emergency Medicine

Principal Investigator: Professor Lee A Wallis
Division of Emergency Medicine
University of Cape Town
Email: lee.wallis@uct.ac.za
UCT Staff Number: 01401390

Co-supervisor: Dr. Emilie Calvello
University of Colorado
MD, MPH
Email: emiliejbc@gmail.com

Invite:
You are being asked to take part in a research study that aims to validate the African Federation for Emergency Medicine (AFEM) Emergency Care Assessment Tool (ECAT). We hope to develop an objective measurement tool for evaluating comprehensive emergency service provision applicable to the African context.

If you agree, we will ask you to complete the following survey, based around a series of questions on the ability of the health care facility in managing specific emergency conditions. We do not anticipate any additional risks to you from participating in this study. Any report generated will NOT include information that will make it possible to identify you.

This study is NOT meant to evaluate you, the emergency care providers at your facility, or your facility as a whole. It is a validation study of the ECAT tool.

Aim of the Study:
The aim of this study is to determine the content, construct, and face validity of the AFEM Emergency Care Assessment Tool in Cameroon.

To achieve this aim, the study has the following objectives:

- Employ the ECAT in different facility levels (district, regional, and central) in different regions of a selected African country
- Use direct observation to determine whether the signal functions defined in ECAT can actually be performed in these facilities
- Compare the categories of failure identified by the ECAT respondent with those identified by direct observation

Period of Study:

2015-2016	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016
Ethics Review	X	X	X							
Data Collection				X	X	X				
Data Compilation and Analysis						X	X	X		
Compilation of Final Report								X	X	
Submission of MSc										X

Study Population
During the initial phase, ECAT will be employed at 5 different health facilities: 3 district, 1 regional, and 1 central hospital (in order to be representative of all levels of hospital in Cameroon). Based on Phase 1 results, it will be decided if a second phase is necessary to collect data at a greater number of facilities. The goal of this study is to validate the instrument, not the facility. The facility sample size is therefore related to the number of signal functions witnessed rather than the number of facilities visited.

AFEM has local representatives (emergency care specialists) in Cameroon who will facilitate the selection of health facilities. This process will be a convenience sampling, incorporating practical considerations such as accessibility, time and safety.

As we are examining the validity of ECAT at the level of the emergency area, and not at the level of each individual provider, we will administer the tool with the Head of Emergency at each facility (as they are the most likely to know what is happening in their emergency intake area).

Process

We, the researchers will explain:

- That ECAT is assessing the capability of the health facility and not the knowledge base of the respondent.
- That this is a tool validation activity and not the actual assessment of the health facility.
- That questions and comments during the survey are encouraged.
- That "yes" answers imply that the signal function can be completed at least 90% of the time it is required to be performed.

Since ECAT is a prospective tool, you, the Head of Emergency, will be asked to provide detail. For example, the we will ask "If a patient with *(sentinel condition)* entered your health facility right now, would you be able to *(signal function*) at least 90% of the time." If the answer is "*No*", you will be asked why, and the results classified under "category of failure" (any further details will be collected under the "comments" section).

We will then observe the work activities of emergency care providers at your facility and will record information on the ability of the health care facility in managing specific emergency conditions. We do not anticipate any additional risks to you from participating in this study. Any report generated will NOT include information that will make it possible to identify you.

The results of this observation will be compared to the ECAT previously completed by you, the Head of emergency. The results of this comparison will be compiled and analysed as a group, and will be used by AFEM for a more expansive roll out throughout the region to aid in providing excellent emergency services.

This study is NOT meant to evaluate you, the emergency care providers at your facility, or your facility as a whole. It is a validation study of the ECAT tool.

Use of Data- Privacy

Collected data will be compiled and handled by the researchers only. Only study investigators will have access to the completed toolkits and results. The results will not contain any identifying information of the participant or the interviewer. The information will not be sold or used for any commercial purpose.

All data will be stored on a password protected work computer. Data will be entered from paper copies and then checked for accuracy by a second investigator; at that time, paper copies will be destroyed.

The results of the study will be made available to AFEM and all participating programs. If the tool proves to be valid, the final product culminating from this study could be used to assess health facilities' capabilities in providing critical emergency services either as a self-assessment or by the ministry of health of any low or middle income country. We hope to publish a paper detailing the results of the study in a peer-reviewed journal.

Consent

Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with your employer or AFEM. If you decide to take part, you are free to withdraw at any time.

Ethical Considerations- Potential Risks and Benefits & Data confidentiality

There are no direct benefits to you by taking this survey and minimal risk for participating. Similarly, there are no direct benefits and minimal risk to your facility by taking part in this study. However the benefits of a finalised and validated of the toolkit could potentially be a standardised way to assess the capabilities of the health facility in handling critical emergency conditions. This would lead to a clearer way of finding areas of improvement for a given health facility, allowing for a more targeted approach in improving better patient care and handling the majority of life threatening conditions most amenable to timely intervention.

Compensation
There is no compensation for participation in this health facility survey.

Contact
If you have any questions about the survey or the study itself, please contact:
The student researcher, Paul Kim at: programs@afem.info or +27 (0)79 631 1701
The principal investigator, Prof Lee Wallis at: lee.wallis@uct.ac.za or +27 (0)21 944 9226

Ethical Bodies
If you have any questions or concerns regarding your rights or welfare as research participants, you may contact the Human Research Ethics Committee with the study reference number 842/ 2015:

University of Cape Town
Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925, South Africa
+27 (0)21 406 6338
sumaya h.ariefdien@uct.ac.za

You may also contact the Cameroon National Ethics Committee for Human Health Research with the study reference number 2015/06/609/CE/CNERSH/SP:

Comité National D'Ethique de la Recherche pour la Santé Humaine au Cameroun (CNERSH)
Hygiène Mobile
Quartier Messa
Yaoundé, Cameroun
00 237 99 87 47 65 / 00 237 99 76 74 27
cnethique_minsante@yahoo.fr

Statement of Consent:
I have read the above information, and have received answers to my questions. I consent to take part in the study.

Your Signature _____ Date _____

Your Name (printed) _____

Appendix F – ECAT Consent Form (French)

Notice d'information et Fiche de consentement de l'Outil d'Evaluation du Soin

d'Urgence (OESU)
(Chef des Urgences)

Titre: Outil d'Evaluation du Soin d'Urgence pour les formations sanitaires – Une étude de validité au Cameroun

Chercheur: Paul Kim
Email: pkimpccam@gmail.com
Candidat de MSc en Médecine d'Urgence

Investigateur principal: Professeur Lee A Wallis
Division de Médecine d'Urgence
Université du Cap
Email: lee.wallis@uct.ac.za

Co-superviseur: Dr. Emilie Calvello
Université de Colorado
MD, MPH
Email: emiliejbc@gmail.com

Invitation:
Ceci est une invitation à participer à une étude qui vise à valider l'Outil d'Evaluation du Soin d'Urgence de la Fédération Africaine de Soins d'Urgence (AFEM). Nous espérons élaborer un outil de mesure objectif pour l'évaluation des services d'urgences compréhensifs dans le contexte africain.

Si vous êtes d'accord, nous vous demanderons de compléter l'enquête suivante, composée d'une série des questions sur la capacité sanitaires en ce qui concerne la gestion des conditions d'urgence. Nous n'attendons pas les risques supplémentaires qui pourraient découler de la participation. Les résultats ne comporteront aucune identification des participants.

Cette enquête est pour la validation de l'outil en lui-même, PAS pour évaluer la connaissance des participants, des autres fournisseurs, ou la formation sanitaire.

But et objectifs de l'étude:
Le but de cette étude est de déterminer la validité de contenu, la validité de l'attribut,

et la validité apparente de l'Outil d'Evaluation du Soin d'Urgence au Cameroun.

Pour atteindre ce but, l'étude a les objectifs suivant:

- Utiliser l'OESU dans différents niveaux de formations sanitaires (base, district, tertiaire/référence) dans différents régions
- En utilisant l'observation directe, déterminer si les fonctions signales définies en OESU pourront être réalisées correctement dans ces formations sanitaires
- Comparer les catégories d'insuffisance identifiées par la personne sondée avec celles identifiées par l'observation directe

Période de l'étude:

2015-2016	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Fev 2016	Mars 2016	Avr 2016	Mai 2016	Juin 2016	Juil 2016	Aout 2016
Revue éthique	X	X	X	X							
Collection des données					X	X	X				
Compilation et analyse des données							X	X	X		
Compilation du résultat final									X	X	
Soumission du MSc											X

Taille de l'échantillon

Au cours de la phase initiale, OESU sera utilisé à 5 différents établissements sanitaires: 3 district, 1 régional, et 1 hôpital centrale (afin de représenter les différents niveaux sanitaires au Cameroun). En fonction des résultats de la Phase 1, il sera décidé si une deuxième phase sera nécessaire afin de recueillir des données à un plus grand nombre des formations sanitaires. Le but de cette étude est de valider l'outil, pas l'établissement. La taille de l'échantillon est donc liée au nombre des fonctions signales observé plutôt que le nombre des formations sanitaires visité.

AFEM a des représentants locaux (spécialistes en soins d'urgence) au Cameroun qui faciliteront la sélection des formations sanitaires. Ce processus sera par échantillonnage de commodité, en tenant compte des considérations pratiques comme l'accessibilité, le temps, et la sécurité.

Puisque nous examinerons la validité d'OESU au niveau de centre des urgences et pas au niveau de chaque professionnel de la santé, nous allons administrer l'outil avec le Chef des Urgences à chaque établissement sanitaire (car ils sont les plus susceptibles de savoir les activités et la capacité du centre des urgences).

Procédure

Le chercheur expliquera:

- L'OESU évalue la capacité de la formation sanitaire, pas les connaissances du participant.
- Cette étude est pour la validation de l'outil, pas pour évaluer la formation sanitaire
- Les questions et encourager les commentaires durant l'interrogatoire.
- La réponse par «oui» signifie que la fonction signale est disponible et réalisée correctement au moins 90% du temps.

Comme l'OESU est une étude prospective, l'enquête sera faite en utilisant un langage approprie ; par exemple, l'investigateur demanderais "si un malade avec un (signe sentinelle) entre dans ta formation sanitaire maintenant, serais tu capable de (fonction signale) au moins 90% du temps". Si une réponse est "non", alors l'investigateur devra demander le pourquoi et cocher la case appropriée pour la "catégorie d'insuffisance" et documenter si besoin dans la section "commentaires".

Puis, l'investigateur observera les activités professionnelles des fournisseurs de soins d'urgence à la formation sanitaire et enregistrera les informations sur la capacité d'établissement de gérer des états d'urgence spécifiques. Nous n'attendons pas les risques supplémentaires qui pourraient découler de la participation. Les résultats ne comporteront aucune identification des participants.

Les résultats de cette observation seront comparés à l'enquête que le Chef des Urgences complète. Les résultats de cette comparaison seront compilés, analysés, et utilisés par AFEM en vue d'avoir un déploiement plus expansif à travers la région afin de fournir les services d'urgence excellents.

Cette enquête est pour la validation de l'outil en lui-même, PAS pour évaluer la connaissance des participants, des autres fournisseurs, ou la formation sanitaire.

Utilisation des données

Toutes les données de l'enquête seront collectées et conservées par l'investigateur et envoyer au coordinateur de l'étude pour analyse. Les données seront compilées et gérées par les chercheurs seulement. Seulement les investigateurs auront accès aux outils complets et les résultats. Les résultats de chaque formation sanitaire les leur seront communiques sur demande. Les résultats ne comporteront aucune identification des participants. Les informations ne seront ni vendues ou utilisées pour un but commercial.

Les données obtenues seront stockées sur ordinateur de manière sécuritaire et protégées avec les mots de passe. Les données seront d'abord collectées à la main, mais seront ensuite saisies et vérifiées par un deuxième investigateur; à ce moment, les formulaires papiers seront détruits.

Les résultats de l'étude seront disponibles à l'AFEM et les programmes participants. Si, en fin de compte, l'outil démontre qu'il est valide, Le produit final pourrait conduire à une façon standardisée d'évaluation des capacités sanitaires en ce qui concerne la gestion des conditions d'urgence soit comme auto-évaluation soit comme évaluation menée par la Ministère de la Santé. Nous prévoyons publié un article détaillant les résultats de l'étude dans une revue à comité de lecture.

Consentement

Participer à cette étude est totalement volontaire. Vous êtes libre de refuser de répondre à une question. Votre relation avec ni AFEM ni votre employeur ne sera en aucune circonstance détériorée au cas où vous refuserez de participer ou vous sauterez une question sans répondre.

Considérations éthiques – Risques potentiels, Bénéfice et confidentialité des données

Vous n'aurez ni un bénéfice ni un risque direct en participant à cette étude. De même, votre établissement sanitaire n'aurez ni un bénéfice ni un risque direct en participant à cette étude. Cependant, les bénéfices après la finalisation de l'outil (après cette étude) conduiront à une façon standardisée d'évaluation des capacités sanitaires en

ce qui concerne la gestion des conditions d'urgence. Ceci conduira à une manière claire à détecter les domaines à améliorer dans une formation sanitaire, permettant ainsi une approche ciblée d'une meilleure prise en charge des patients et une gestion de la majorité des conditions menaçant le pronostic vital.

Compensation
Il n'y a pas de compensation à participer à cette étude.

Contact
Si vous avez des questions sur l'enquête ou l'étude en soit même, veuillez contacter:
Chercheur, Paul Kim à: programs@afem.info ou +27 (0)79 631 1701
Investigateur principal, Prof Lee Wallis à: lee.wallis@uct.ac.za ou +27 (0)21 944 9226

Comités d'éthique
Si vous avez des questions ou préoccupations sur vos droits ou le bien-être des participants, veuillez contacter UCT Human Research Ethics Committee (HREC) avec le numéro de référence de l'étude (842/2015):

University of Cape Town
Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925, South Africa
+27 (0)21 406 6338
sumayah.ariefdien@uct.ac.za

Vous pouvez également contacter la Comité National D'Ethique de la Recherche pour la Santé Humaine au Cameroun (CNERSH) avec le numéro de référence de l'étude (2015/06/609/CE/CNERSH/SP):

Comité National D'Ethique de la Recherche pour la Santé Humaine au Cameroun (CNERSH)
Hygiène Mobile
Quartier Messa
Yaoundé, Cameroun
00 237 99 87 47 65 / 00 237 99 76 74 27

cnethique_minsante@yahoo.fr

Déclaration de consentement:
J'accepte librement de participer à cette étude dans les conditions précisées dans la notice de l'information, c'est-à-dire de répondre aux questions d'enquête.

Fait à _____ le _____

Participant _____

Nom en imprimé_____

Appendix G – University of Cape Town HREC approval

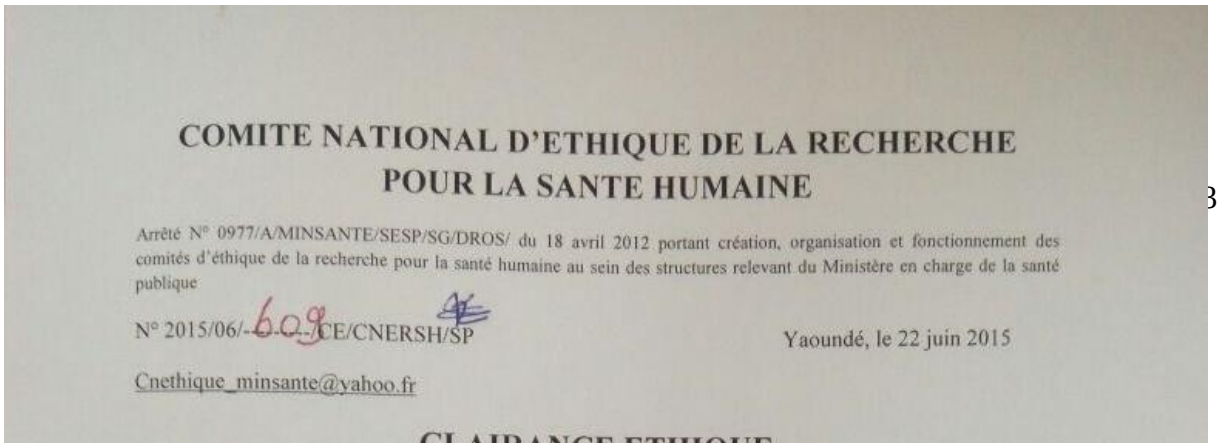
UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
Email: sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

19 January 2016

2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI),and Declaration of Helsinki (2013) guidelines.
The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Ap



COMITE NATIONAL D'ETHIQUE DE LA RECHERCHE POUR LA SANTE HUMAINE

Arrêté N° 0977/A/MINSANTE/SESP/SG/DROS/ du 18 avril 2012 portant création, organisation et fonctionnement des comités d'éthique de la recherche pour la santé humaine au sein des structures relevant du Ministère en charge de la santé publique

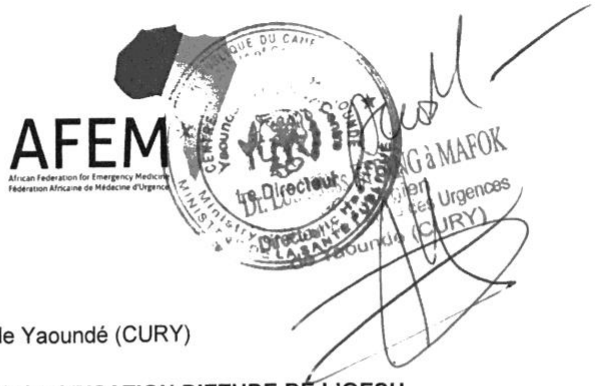
N° 2015/06/-609/CE/CNERSH/SP

Yaoundé, le 22 juin 2015

Cnethique_minsante@yahoo.fr

CLAIRANCE ETHIQUE

Appendix I – Cameroon Facility Approvals



05 Février 2016

Directeur de Centre d'Urgence de Yaoundé (CURY)

DEMANDE D'AUTORISATION D'ETUDE DE L'OESU

Ceci est une demande d'effectuer une étude qui vise à valider l'Outil d'Evaluation du Soin d'Urgence de la Fédération Africaine de Soins d'Urgence (AFEM). Nous espérons élaborer un outil de mesure objectif pour l'évaluation des services d'urgences compréhensifs dans le contexte africain.

Le but de cette étude est de déterminer la validité de contenu, la validité de l'attribut, et la validité apparente de l'Outil d'Evaluation du Soin d'Urgence au Cameroun.

Pour atteindre ce but, l'étude a les objectifs suivant:

- Utiliser l'OESU dans différents niveaux de formations sanitaires (base, district, tertiaire/référence) dans différents régions
- En utilisant l'observation directe, déterminer si les fonctions signales définies en OESU pourront être réalisées correctement dans ces formations sanitaires
- Comparer les catégories d'insuffisance identifiées par la personne sondée avec celles identifiées par l'observation directe

Nous demandons donc votre consentement pour effectuer cette étude à votre établissement. Pour vous aider à prendre votre décision, nous vous présentons également les document suivants:

(a) Une copie de la clairance éthique de CNERSH
(b) Une copie de la clairance éthique de l'Université du Cap

Si vous avez des questions sur l'enquête ou l'étude en soit même, veuillez contacter:

Investigateur principal: Professeur Lee A Wallis
Université du Cap, Université de Stellenbosch; Afrique du Sud
MBChB, MD, DIMCRCSEd, Dip Sport Med, FRCSEd(A&E), FCEM, FCEM(SA), FIFEM, FEMSSA
Division de Médecine d'Urgence
Département de Chirurgie
Email: lee.wallis@uct.ac.za
Tel: +27 (0)21-944-9226

AFEM
African Federation for Emergency Medicine
Fédération Africaine de Médecine d'Urgence

Co-superviseur: Dr Bonaventure G. Hollong
MD, Emergency Physician
PhD Candidate
Université du Cap, Afrique du Sud
Emergency Medicine Teaching Assistant
Faculty of Medicine and Biomedical Sciences
Université de Yaoundé I, Cameroun
Email: holbono@yahoo.com
Tel: 237 699889322

Votre consentement pour effectuer cette étude serait très apprécié.

Je vous prie d'agréer mes salutations distinguées,

Prof. Lee Wallis

Dr. Bonaventure Hollong

REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie

MINISTERE DE LA SANTE PUBLIQUE

SECRETARIAT GENERAL

DELEGATION REGIONALE DU SUD

HOPITAL REGIONAL D'EBOLOWA

REPUBLIC OF CAMEROON
Peace – Work – Fatherland

MINISTRY OF PUBLIC HEALTH

SECRETARY GENERAL'S OFFICE

SOUTH REGIONAL DELEGATION

EBOLOWA REGIONAL HOSPITAL

Ebolowa, le 04 MARS 2016

N° 0445 /L/MINSANTE/SG/DRSPS/HRE

Le Directeur
A
Monsieur le Professeur Lee A WALLIS
Université du CAP, Université de Stellenbosch ;
Afrique du Sud

Objet : demande d'autorisation d'étude de l'OESU du 05 février 2016.

Monsieur,

J'accuse réception de votre lettre dont l'objet est visé à la marge,

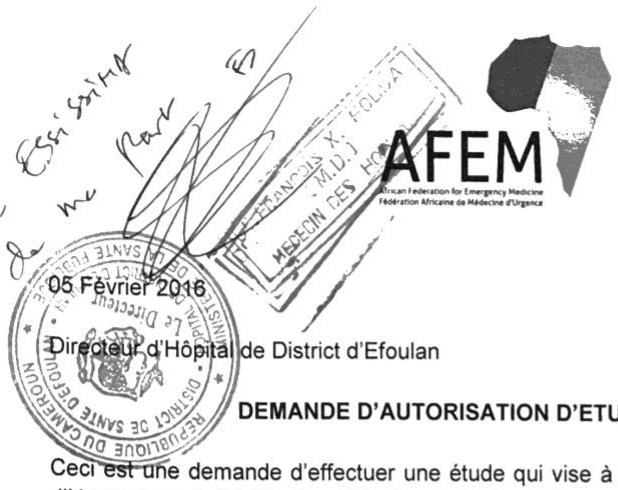
Tout en vous remerciant du choix porté sur l'établissement hospitalier dont nous avons la charge, je vous exprime à travers cette correspondance mon accord et vous assure de notre parfaite collaboration.

Je vous prie d'agréer, Monsieur le Professeur, l'expression de ma parfaite considération.

LE DIRECTEUR

Dr Jean Claude ABOSSOLO

Site web: www.minsante.cm E-mail hopitalregionalebolowa@yahoo.fr



05 Février 2016

Directeur d'Hôpital de District d'Efoulan

DEMANDE D'AUTORISATION D'ETUDE DE L'OESU

Ceci est une demande d'effectuer une étude qui vise à valider l'Outil d'Evaluation du Soin d'Urgence de la Fédération Africaine de Soins d'Urgence (AFEM). Nous espérons élaborer un outil de mesure objectif pour l'évaluation des services d'urgences compréhensifs dans le contexte africain.

Le but de cette étude est de déterminer la validité de contenu, la validité de l'attribut, et la validité apparente de l'Outil d'Evaluation du Soin d'Urgence au Cameroun.

Pour atteindre ce but, l'étude a les objectifs suivant:

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(b) Une copie de la clairance éthique de l'Université du Cap

Si vous avez des questions sur l'enquête ou l'étude en soit même, veuillez contacter:

Investigateur principal: Professeur Lee A Wallis
Université du Cap, Université de Stellenbosch; Afrique du Sud
MBChB, MD, DIMCRCSEd, Dip Sport Med, FRCSEd(A&E), FCEM, FCEM(SA), FIFEM, FEMSSA
Division de Médecine d'Urgence
Département de Chirurgie
Email: lee.wallis@uct.ac.za
Tel: +27 (0)21-944-9226

AFEM
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Fédération Africaine de Médecine d'Urgence

Co-superviseur: Dr Bonaventure G. Hollong
MD, Emergency Physician
PhD Candidate
Université du Cap, Afrique du Sud
Emergency Medicine Teaching Assistant
Faculty of Medicine and Biomedical Sciences
Université de Yaoundé I, Cameroun
Email: holbono@yahoo.com
Tel: 237 699889322

Votre consentement pour effectuer cette étude serait très apprécié.

Je vous prie d'agréer mes salutations distinguées,

Prof. Lee Wallis

Dr. Bonaventure Hollong

REPUBLIQUE DU CAMEROUN
****
Paix – Travail – Patrie
****
MINISTERE DE LA SANTE PUBLIQUE
****
DELEGATION REGIONALE DU CENTRE
****
DISTRICT DE SANTE DE LA CITE VERTE
****
HOPITAL DE DISTRICT DE LA CITE VERTE
****
B.P. : 3604 Messa-Yaoundé
Tél. : 22-22-87-34 / 22-22-12-73

HD
MINSANTE
CITE - VERTE

REPUBLIC OF CAMEROON
****
Peace – Work – Fatherland
****
MINISTRY OF PUBLIC HEALTH
****
REGIONAL CENTER DELEGATION
****
CITE VERTE HEALTH DISTRICT
****
CITE VERTE DISTRICT HOPISTAL
****

N° 020 /L/Minsanté/DRC/DSCV/HDCV

Yaoundé le, 01 MARS 2016

Le Directeur
Aux

Messieurs : - Professeur Lee WALLIS
- Dr Bonaventure G. H.
AFEM

Objet : ***Demande d'autorisation d'étude de l'OSEU.***

Messieurs,

En réponse à votre correspondance dont l'objet est rappelé en marge, j'ai l'honneur de vous faire connaître que je marque mon avis favorable pour cet accès.

Aussi, seriez-vous obligés de respecter le règlement de notre structure pendant la période de votre étude.

Veuillez croire, Messieurs, en l'assurance de ma parfaite considération.

Le Directeur

Pathologiste
Directeur HD-Cité Verte

AFEM
African Federation for Emergency Medicine
Fédération Africaine de Médecine d'Urgence

22/02/16
CN
Par suivi

05 Février 2016

Directeur d'Hôpital de Kribi

DEMANDE D'AUTORISATION D'ETUDE DE L'OESU

Dr Jean Gustave TSIAC...IC...

Ceci est une demande d'effectuer une étude qui vise à valider l'Outil d'Evaluation du Soin d'Urgence de la Fédération Africaine de Soins d'Urgence (AFEM). Nous espérons élaborer un outil de mesure objectif pour l'évaluation des services d'urgences compréhensifs dans le contexte africain.

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Division de Médecine d'Urgence
Département de Chirurgie
Email: lee.wallis@uct.ac.za
Tel: +27 (0)21-944-9226

24/02/2016
Vu ce jour
ole

AFEM
African Federation for Emergency Medicine
Fédération Africaine de Médecine d'Urgence

Co-superviseur: Dr Bonaventure G. Hollong
MD, Emergency Physician
PhD Candidate
Université du Cap, Afrique du Sud
Emergency Medicine Teaching Assistant
Faculty of Medicine and Biomedical Sciences
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Prof. Lee Wallis

Dr. Bonaventure Hollong