

Emergency Care Triage Scales in Developing Countries
A protocol for a Systematic Review of Outcomes, Evidence and Quality

By

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REGISTRATIONS:

1)**PROSPERO** (International Prospective Register of Ongoing Systematic Reviews, <http://www.crd.york.ac.uk/prospero>) This review will be registered with PROSPERO, an international, open access, free, online registration system that follows the guidelines set forth by PRISMA and Cochrane reviews (1).

2)University of North Carolina at Chapel Hill

Institutional Review Board

This review will also be submitted for IRB approval/waiver to the University of North Carolina at Chapel Hill.

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ABSTRACT

Background: Emergency Department triage scales can play a key role in the development of emergency care capacity for developing countries. Numerous studies exist on the reliability and validity of these systems in High Income Countries. However, little is known about the efficacy of these systems in developing countries. This systematic review protocol aims to prepare a team of international experts to investigate published literature on triage system implementation outcomes in Low and Middle Income Countries (LMICs). Questions that will be addressed include:

- 1) Has the application of a formal triage system reduced mortality within the Emergency Department or survival to hospital discharge?
- 2) What is the inter-rater and intra-rater reliability of health care workers performing triage?
- 3) What is the measured validity in predicting discharge, admission, or death in the ED?
- 4) What other outcomes were assessed such as wait times, length of stays, patient satisfaction or resource utilization and their supporting evidence?

Methods: A systematic search will be completed from published literature, without language or date restrictions, in the following databases: EMBASE, Web of Science, Pubmed, Scopus, CINAHL, and Global Health. The search strategy for all databases include these terms: (Emergency) AND (triage). Other search terms were included, as well as a novel search string to limit to LMICs. A-priori roles, definitions, timeline and strategies are explicitly stated for this systematic review. Study protocol will be submitted to PROSPERO and the University of North Carolina Institutional Review Board. Data Abstraction forms and Quality of Evidence tables will be piloted on preliminary included studies. Study team members will review protocol for completeness.

Results: Initial search using the specified PICOTTS criteria revealed 3150 abstracts for review. Consensus from two independent reviewers will reveal full text articles to assess for eligibility.

Conclusions: After final editing by review team, submission to PROSPERO, and approval by UNC IRB, this systematic review will resume with review of full text articles for eligibility. The manuscript will be then be prepared for submission for publication.

“The ultimate goal of triage is to preserve and protect endangered human lives as much as possible by assigning priority to patients with an immediate need for life-sustaining treatment.”

Aacharya et al, 2011(2)

INTRODUCTION

THE BURDEN OF ACUTE, EPISODIC ILLNESS and INJURY

The recent Global Burden of Disease Study, 2010, has highlighted the plight of developing countries, which are experiencing an increasing incidence of non-communicable diseases (NCD) along with the continued prevalence of communicable diseases (CD). Worldwide, ischemic heart disease has become the number one cause of global years of life lost. NCD's

such as cerebrovascular disease, diabetes, lung

cancer and road traffic injuries are increasing

against a backdrop of continued malaria, HIV,

pulmonary infections, diarrhea, and

tuberculosis which are also leading causes of

global years of life lost (3)(**Figure 1**). This

burden overwhelms health systems in

countries with limited resources, as evidenced

by corollary health statistics such as increased

under 5 mortality with low concentrations of health workers in Low and Middle Income

Countries (LMIC)(4). Patients with NCD and CD related health conditions present for

medical assistance in all stages of their illness. A percentage of these will be of high

acuity/severity requiring time-sensitive treatment or stabilization(5).



FIGURE 1: Top 13 Causes of Global Years of Life Lost (GBD 2010)

These patients will present to whatever healthcare or system is available, if it exists at all, for evaluation of their acute or emergent conditions. However, specialized emergency medicine (EM) and acute care systems are considered underdeveloped in most LMICs (6).

In a systematic review of EM training programs in LMICs, Nowacki et al 2013, states that:

“Further increasing the burden on weak EM services in these health-care settings is the frequent lack of access to primary care, leading many patients to seek delayed treatment, often in an acute or critical state. As a result, resource-limited settings experience a significant mis-match of needs and services: high rates of critically ill patients and constrained or underdeveloped EM systems.” (7)

This “mis-match of needs and services” further compounds the stress a triple burden **(Figure 2)** of disease places on health care and delivery systems. Fortunately, the World Health Assembly recognizes the vital contribution of Emergency Care services within the total health system in addressing acute illness and injury. Evidence of this is found within their recent adoption of *Resolution 60.22, Health Systems: Emergency care systems*, which states:

“Recognizing that improved organization and planning for provision of trauma and emergency care is an essential part of integrated health-care delivery, plays an important role in preparedness for, and response to, mass-casualty incidents, and can lower mortality, reduce disability and prevent other adverse health outcomes arising from the burden of every day injuries.”(6)

Preparation for this burden of disease will require development of triage systems.

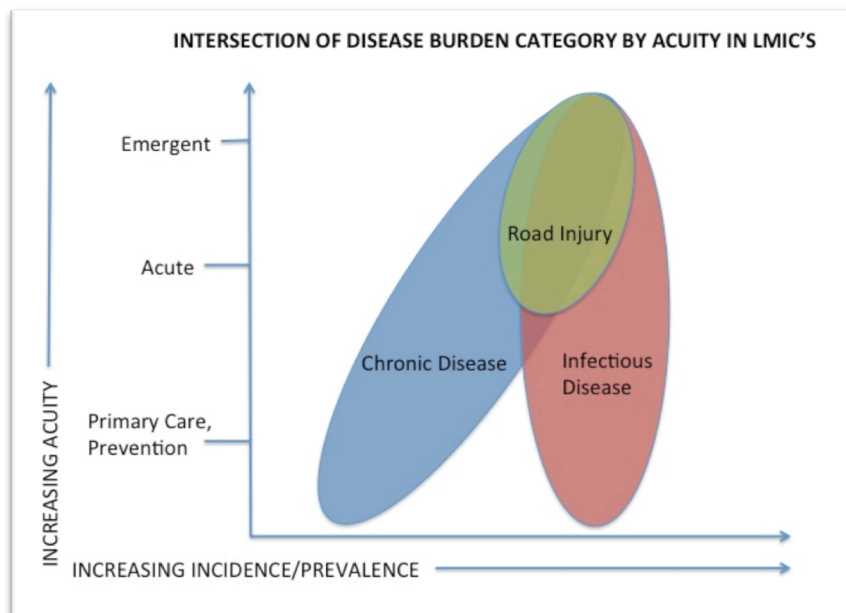


Figure 2: “Triple Burden” of Disease in LMIC’s

[Adapted from Kaji et al, from the NIH rountable on Medical and Surgical Emergencies(8)]

STATE OF EMERGENCY CARE TRIAGE IN DEVELOPING COUNTRIES

Triage is a cornerstone in the development of modern emergency care (9). The acute and emergency presentations of the disease burden described (**Figure 2**) converge onto the health system at its most utilized entry point: the emergency department (10). This first point of contact requires triage, a process of sorting patients based on acuity and allocating the intensity of limited healthcare resources to effectively treat the patient’s time sensitive injury or illness (9). Triage practices are specialized based on available resources, social situations, assessment of the individual patient, and pre-defined triage criteria. The principal settings for medical triage are in Emergency Departments, intensive care units, multi (mass)-casualty Incidents (MCI), battlefield, localized disasters, and in widespread disasters (i.e. weapons of mass destruction-WMD) (11).

In the developing world, triage is underutilized. Patients may wait “next in line”, as they await stabilization of their acute illness via admission to the hospital or after an evaluation by a consultant (possibly the following day)(12,13). This is in contrast to

mature EM systems, where patients are triaged according to acuity level and stabilization begins immediately (**Figure 3**)(9). In order to properly assess for time sensitive illness or injury among a high volume of patient arrivals, a formal triage plan must be in place a priori. Implementation of modern formal triage systems has standardized the approach to patient care in the ED, allowing for monitoring and evaluation of the triage process (14,15).

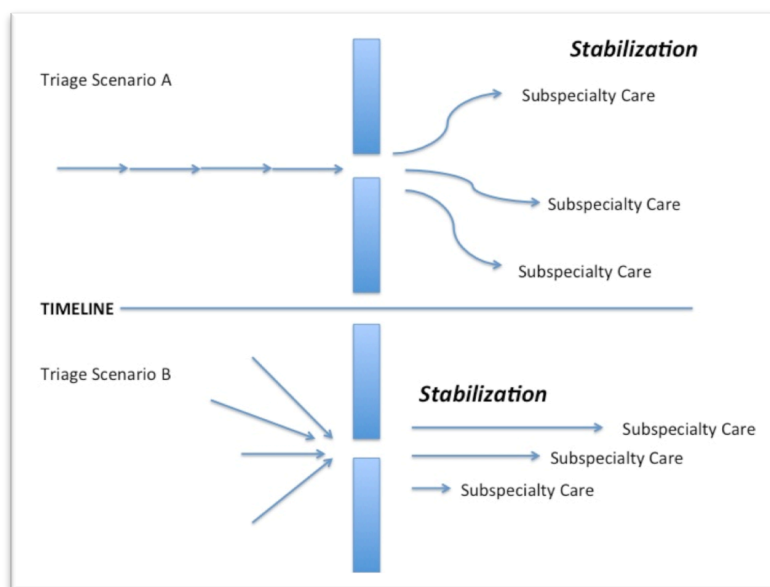


Figure 3: Triage Scenario A represents no formal system, Triage Scenario B represents a formal system in place.

RISKS/BENEFITS OF STANDARDIZED TRIAGE PRACTICES AND PROTOCOLS

Implementation of standardized triage practices can have the desired effect of improving patient safety and quality of care (16), reducing death in the A & E (13), establishing a method for monitoring and evaluation (14), prediction of resource utilization (17), decreased patient waiting times (18,19), and greater patient satisfaction (20). Since a formal system standardizes the prioritization of patients, it removes harmful subjective biases and can improve communication among healthcare workers (16). The few known published studies in developing countries have demonstrated a reduction in pediatric

mortality, such as the Emergency Triage and Assessment(ETAT)(21) in Malawi(13,22), as well as reliability and validity of formal systems in resource-constrained settings(23–28)

However, variations in evidence make it difficult to predict which triage system is the “best” one, especially for LMIC’s. Triage in the developing world faces unique challenges due to lack of resources, inadequate supervision and incomplete training (13) Limited triage training, “gestalt” decision making, and lack of formal triage systems produces inconsistency in triage decisions (29)which can jeopardize patients with time-sensitive illnesses. However, triage standardization may create further challenges. Fernandes et al (2005) describe the risks of triage standardization to include 1)implementation costs, 2)difficulty in implementing standards and 3)the need for updates (16).

Widely recognized standardized triage scales, such as the Emergency Severity Index(ESI), Manchester Triage System(MTS), Canadian Triage Acuity Scale(CTAS), and the Australasian Triage Score(ATS) have been utilized in Emergency Departments in developed countries for many years, and their reliabilities and/or validities have been demonstrated to varying degrees(16,30–33). A systematic review by Farrohknia et al in 2011 evaluated the scientific support for published adult ED triage scales and also reported varying degrees of validity, reliability and outcomes(34). In addition, these studies were conducted in high income countries, further inhibiting the translation to resource limited settings.

THE IDEAL TRIAGE SYSTEM: DEFINITIONS

An ideal triage system demonstrates reliability, validity, utility and relevance(16), while upholding the values of human life, human health, efficient use of resources and fairness (35).

Reliability in this context is defined as “the reproducibility in measurements made on a subject by multiple observers (inter-rater reliability) or by one observer at multiple time points (intrarater reliability).”(36) As these authors point out, inter-rater variability can lead to variability in patient care which can be harmful. It is therefore necessary to assess if this triage system is guiding reliable (non-variable) triage decisions in this health care setting.

Validity can be defined as “a test that appears to measure what it purports to measure(37)” or “describes the ability of the measure to accurately predict outcomes(14)”. It is vitally important to assess whether a new intervention, such as triage system is actually “testing” what it is purporting to, in this case, categorizing patients into appropriate acuity levels which predict the expected outcome (admission, discharge or death).

Utility in triage is a philosophical approach that can be defined as the “greatest good for the greatest number”(38). In the context of a modern emergency department, this could be interpreted as, “achieving the greatest good possible for every possible patient”.

Relevance can also be philosophical in nature, taking into account practical issues, such as whether the triage system “works” in the context it is applied, given the available resources(39). The true relevance is left to the reader to determine based on their context and the available evidence(40).

TESTING FOR RELIABILITY AND VALIDITY IN TRIAGE

Reliability

Reliability (or precision), the degree of agreement, is conventionally measured as the ability of health care workers to agree on a patient acuity level, based on the clinical

presentation and chief complaint. The Kappa statistic and “percentage of agreement” are traditional measurements. Inter-rater reliability can be calculated via the quadratically weighted kappa (QWK) statistic or intraclass coefficient (ICC). The QWK has been described for ordinal data assessment (41) and in similar triage reliability research by Twomey, et al (27). Hallgren (2012) cites Norman and Streiner (2008) who show that “quadratic weights for ordinal scales is identical to a two-way mixed, single-measures, consistency ICC, and the two may be substituted interchangeably(42).”

The QWK and ICC produce a value between 0 and 1. Landis and Koch (43) described a method for “benchmarking” interpretation of these value in relation to actual interobserver agreement as follows:

Kappa (or ICC) statistic	Strength of Agreement
<0.00	Poor
0.00-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost Perfect

(Landis and Koch, Biometrics, 1977)

However, in clinical practice, these arbitrary definitions may be difficult to communicate. Individual interpretation between “fair” vs “moderate” may be negligible. Further, a “slight” agreement may still be indistinguishable from “poor” in the context of a triage decision. Alternatively, Cicchetti and Sparrow proposed a scale for more clinical relevance in 1981(44), cited in (45).

Kappa (or ICC) statistic	Strength of Agreement
<0.40	Poor
0.40-0.59	Fair
0.60-0.74	Good
0.75-1.00	Excellent

(Cicchetti and Sparrow, 1981)

To remain the most consistent across the triage literature, however, we will interpret the Kappa statistic from the scale of Landis and Koch(43).

Validity

The capability of utilizing a triage scale to predict a specific patient disposition outcome has been used as a measure of validity (28,32). While several studies have proposed criterion for judging the validity of randomized clinical trials(40), assessing triage validity can be problematic. Of the different types of validities, construct validity has been proposed by Twomey et al 2007, as an acceptable measure of triage scales in the developing world(46). As Sechrest, 1985 states, “construct validation is a gradual incremental process as evidence builds towards a coherent and persuasive case for linking the measure and the construct”(37). Twomey et al 2013, presents evidence for the use of a modified Delphi (expert consensus process) for creating the evidence for a validity construct in triage(47) In the case of triage, the most common linkage is the triage acuity level with the outcome of admission to the hospital or death. Validity is reported as decreased when significant levels of under or over triage exist.

Acceptable overtriage rates in trauma of 25-30% and 1-5% for undertriage has been suggested by the American College of Surgeons, Committee on Trauma(ACSCOT)(48). These rates, published in the *Resources for optimal care of the injured patient*, 2014, represent more stringent standards than previously cited in their 1998 publication(cited in(28), not in press) of 50% and 10% respectively. While the ACSCOT definitions for overtriage and undertriage have been used as a benchmark in triage studies, it should be noted that there are several limitations to using these as the gold standard in EC triage. First, these norms for trauma triage were established in the context of US trauma systems,

which have high material and workforce resources. Second, these are non-evidence based guidelines proposed for pre-hospital (EMS) trauma patients, being referred to a trauma center, rather than the diverse medical and trauma casemix found in EC's. However, as there no other current acceptable norms for over and undertriage per acuity level for the diverse casemix of EC's(49), the ACSOT remain a benchmark.

Acceptable mis-triage rates (for EC's specifically) should be a carefully calculated equipoise, influenced by local resources, and remains an area for further research(50). Indeed, over-triaging increases the burden on the health system, indirectly increasing wait times, and subsequently increases the overall risk for patients in the ED. Undertriage leads to an increased wait time for patients with a potentially deteriorating condition and possibly death(48). However, in an effort to reduce undertriage, the net trade-off may equal more overtriage. In a resource limited setting, the inappropriate allocation of resources can be life threatening for another patient requiring those services (49).

RATIONALE FOR A SYSTEMATIC REVIEW

UNKNOWN BODY of EVIDENCE for TRIAGE SYSTEMS in LMIC's

As interest and the awareness of the need for emergency care and triage system development in LMIC's increases(51), important questions are raised:

- What triage systems are available for use?
- How reliable or valid are these systems when deployed in the developing world?
- Is there an evidence based process for implementation in this context?

Further practical questions could be raised by hospital and ED supervisors such as:

- Where and how do I access these systems?
- What materials and format are required for training triage staff?
- How do I measure, evaluate and audit training and implementation?

Prior systematic reviews evaluating triage systems have included studies in High Income Countries(HIC's) by Farrohknia et al in 2005 (34,52), for mass-casualty settings (53), pre-hospital specific (54), or limited to pediatric patients only (55)(abstract only available 12/14/14). Intensive searching of literature databases is required to find studies of triage systems in LMIC's. However, no known published systematic reviews are available on adult triage systems in developing countries. **There is a need for this Systematic review to answer the previous questions raised and to fill the information gap in the literature.**

TRIAGE SYSTEMS for HEALTH SYSTEMS

Hospitals, health systems and subsequently, the health of the public in developing settings stand to benefit from a review that will identify triage systems that improve triage capacity. The act of triaging (or sorting or choosing) patients in a healthcare setting involves pre-determined choices guided by ethical principles of “distributive justice” or of “equal chances”. It has been recommended that, “health care system leaders, including public health officials, health care system administrators, and ED directors engage in careful planning for triage in all of its settings, from the daily routine of the hospital ED to a massive earthquake or infectious disease pandemic.(11)” It has been advocated that in addition to the biomedical ethical principles of respect for autonomy, beneficence, nonmaleficence and justice, a “care ethics perspective” should be considered in triage

planning(2). The care ethics perspective emphasizes that medical care holds important value in individual lives as well as educational arenas and social policy(2).

Health system strengthening in LMIC's would benefit from quality improvement processes(56). The implementation of a formal triage systems can be a healthcare quality improvement initiative. The goal of quality improvement is to seek care that is safe, effective, patient-centered, timely, efficient, and equitable(57). Quality improvement processes, especially in LMIC's, support and enhance the World Health Organization (WHO)'s health system framework. The six building blocks of this model include service delivery, health workforce, information, medical products/technology, financing, and leadership/governance(56). Specific examples of how formal triage systems may contribute to quality of care is found in Fernandez et al's (2005) discussion of alternative uses (other than for medical sorting of patients) of triage systems:

- (1) retrospective review for quality assurance
- (2) mechanisms to examine costs of delivery of emergency health care
- (3) efforts by government agencies to analyze the alleged inappropriateness of care delivered by emergency departments (16)

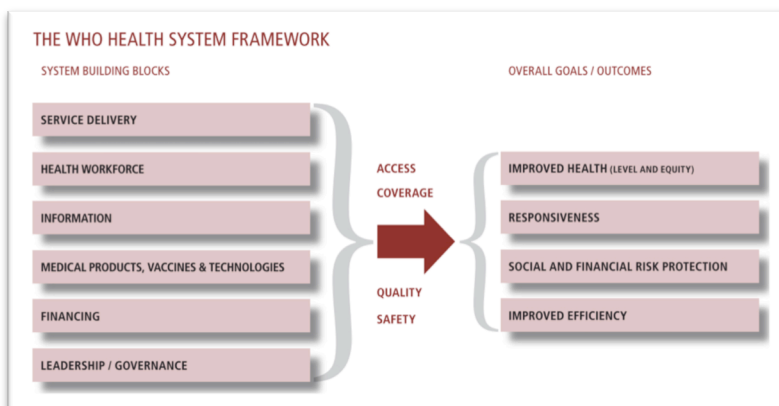


Figure 4: The WHO health system framework (reprinted from World Health Organization 2007)(58)

However, to ensure sustainability of quality triage practices, ongoing QI efforts should be continued through regular audits and training. It is recognized that for quality improvement to occur, triage planning must occur in conjunction with all other health care process improvements, especially given the current state of Emergency Care.

The US Institute of Medicine, in its 2007 report, “Hospital Based Emergency Care: At the breaking point” details the multi-factorial pressures causing strain on Emergency Care centers in the US. These pressures include patient financial barriers, limited availability of alternative sources of care, patient preference for convenience, and non-urgent visits – all of which overwhelm the emergency care access point (59). In addition, inefficient use of inpatient services increases overcrowding, waiting times, ambulance diversions and “patient boarding” in the emergency department. The net result leaves Emergency HCW’s caring for a higher volume of critically ill patients while simultaneously assessing and stabilizing incoming patients (59). These difficulties are universal and world-wide. Emergency Centers in developing settings face similar challenges but with arguably further resource constraints (60). Even with the most efficient use of resources that results from triage planning, the external pressures leading to the described “breaking point” cannot be solved in isolation.

More sustainable solutions must come from comprehensive strengthening of health systems, vis-à-vis improving preventive services and care, primary health care, reducing acute health crises, developing highly integrated emergency medical systems, and managing the public’s expectations of “emergency care”. In addition, “improved coordination, expanded regionalization, and increased transparency and accountability” has been advocated for 21st century emergency care systems(59). It is with this vision in

mind that we seek to elucidate the availability and quality of triage system evidence through the following objectives.

OBJECTIVES

This systematic review will specifically seek to assess which triage systems have been applied in Emergency Departments in resource limited settings, their evidence, outcomes and quality. We aim to answer the following questions, adapted from Farroknia et al's 2005 review of ED Triage Scales:

- 1) In LMIC's, has the application of a formal triage system reduced mortality in the Emergency Department or survival to hospital discharge?
- 2) In LMIC's utilizing triage systems, what is the reliability of (level of agreement between) HCW's performing triage and/or compared to an expert defined "standard".
- 3) In LMIC's adhering to triage systems, what is the measured validity in predicting discharge, admission, or death in the ED (as defined by over/undertriage)?
- 4) In LMIC's, what other outcomes have been studied about a formal triage system relationship to wait times, length of stays, patient satisfaction or resource utilization and their supporting evidence?
- 5) What is the quality of these selected studies, according to internationally accepted GRADE guidelines?

METHODS

Methodology for this review was developed in accordance with Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) and Preferred Reporting Items for Systematic Reviews and Meta Analysis protocols (PRISMA-P) guidelines (40,61,62).

Eligibility Criteria

We will systematically search published literature on the available reliabilities, validities, and outcomes of formal triage systems utilized in Emergency Departments in the developing world. A PICOTTS table(40) will be used to guide the search, and was refined using a modified Delphi method by the review committee for the following eligibility criteria:

Inclusion Criteria:

- Developing country based on world bank classification of LMIC and/or an *underdeveloped* status by the United Nations
- Emergency Department care (or any hospital/clinic facility offering acute or emergent care).
- Triage assessing the patient's initial point of contact with the emergency department.
- All patients presenting for acute care regardless of diagnosis

Exclusion Criteria

- Pediatric focused studies or triage systems
- High Income Countries
- In-hospital patient re-evaluation after initial triage

- Trauma, Pre-hospital, or Mass-Casualty specific triage scales/systems
(unless deployed in an emergency department setting)

The following PICOTTS table (last amended April 8th, 2015) will be used to screen abstracts and full text articles for inclusion:

	INCLUSION	EXCLUSION
<u>Population</u>	<ul style="list-style-type: none"> · Emergency Department/Acute Care Clinic Based · Initial Point of Contact for this visit · Developing Countries based on World Bank Classification of LMIC and/or developing by UN · All adult patients presenting for Emergency or Acute Care 	<ul style="list-style-type: none"> · Inpatient assessment only · Pediatric only · HIC's only · No ED/hospital Re-assessment Methods/Criteria
<u>Intervention</u>	<ul style="list-style-type: none"> · <u>Triage Scale or Triage Systems</u> for Acute or Emergency Care including/but not limited to: <ul style="list-style-type: none"> · Triage Early Warning System (TEWS), · Manchester Triage System (MTS) · Canadian Triage and Acuity Scale(CTAS), · Australian Triage Scale(ATS), · Emergency Severity Index(ESI), · South African Triage Scale (SATS), · Cape Triage Score(CTS), · Australasian Triage Scale(ATS), · Taiwan Triage System(TTS) <p>System: defined set of indicators used to assess patient at Triage Miram Webster def of Triage: "the sorting of patients (as in an emergency room) according to the urgency of their need for care"</p>	<ul style="list-style-type: none"> · Trauma "Specific" Triage Scales · Prehospital Specific · Mass Casualty Triage Systems (Unless utilized within the ED hospital setting)
<u>Comparator</u>	Locale specific traditional Triage methods (ie: "next in line", "time based triage"), original standard of care, prior triage system	No comparisons made
<u>Outcomes</u>	<ul style="list-style-type: none"> • <u>Reliability:</u> HCW Inter-rater Reliability HCW Intra-rater Reliability • <u>Validity:</u> Urgency level as prediction of Admission, ICU admission, Discharge, death in ED, In-Hospital Mortality. (also used to determine Undertriage and Overtriage Rates) • Overall Mortality Reduction in A & E or Improved Survival to Hospital Discharge 	

	<ul style="list-style-type: none"> The relationship of triage system to wait times, length of stay, patient satisfaction or resource utilization 	
Time allowed for outcomes to appear	Discharge from Hospital	After Discharge from Hospital
Previous Time for lit search	All dates	
Study designs allowed	Prospective, observational, RCT's, NRCT's, reviews.	Case Reports

Information Sources

The search will not be limited by language or dates. We will search the following databases: MEDLINE, EMBASE, Web of Science, Global Health, Scopus, and CINAHL. We will also include relevant studies found through hand searching references of eligible full text articles. Grey literature or unpublished literature will not be assessed.

Search Strategy

A search strategy was adapted from a novel search method, that can be found online by the University of North Carolina's Health Sciences Library(63) which targets countries categorized as Low or Middle Income (LMIC) by the World Bank(64) or considered "developing" by the United Nations Statistics Division(65). An iterative and a modified Delphi approach was undertaken to refine the search string to attempt to capture relevant studies to meet our study questions and objectives. After all full texts for inclusion have been identified, the reference lists will be scanned for any further relevant articles. In addition, our final full text list will be compared with the systematic review team's personal

files list to make all known relevant articles have been included. The following search string represents the key words included in all databases:

(trriage OR “modified early warning score” OR “Triage early warning score” OR “manchester triage system” OR “emergency severity index” OR “Canadian Triage” OR “Canadian Triage Acuity Scale” OR “South African Triage Scale” OR “Cape Triage Score” OR “Australasian Triage Scale” OR “Taiwan Triage System” OR “Soterion Rapid Triage System”) AND (Reliability OR reliable OR agreement OR concordance OR consistency OR precision OR valid OR validity OR validation OR accuracy OR admission OR admissions OR discharge OR discharges OR mortality OR death OR implement OR implementation OR efficacy OR effectiveness OR efficiency OR predict OR predicts OR prediction OR “patient outcomes” OR feasibility OR satisfaction OR wait OR waiting OR "length of stay" OR LOS OR "time to evaluation" OR “interventions given”)

AND

These are added to the word “Emergency” or “Emergencies” then combined with a list of all the LMIC World Bank countries (<http://data.worldbank.org/about/country-and-lending-groups>) or countries considered “developing” according to the UN

(<http://hdr.undp.org/en/countries> and

<http://unstats.un.org/unsd/methods/m49/m49regin.htm#developed>), including terms

and synonyms related to “developing” and “resource-limited”. The full search terms are attached for the PUBMED database (APPENDIX II).

Study Records

Data Management

Search records will be exported into Endnote X7(66)(Figure 5). Duplicates were removed within Endnote. The full list of Abstracts (3150) have been uploaded into an online data abstraction tool, Covidence (67)(Figure 6). This is a free online software that allows multiple reviewers to assess each abstract, full text document and customizable data abstraction tool. Two reviewers (Myers and Wangara) will access Covidence for review and inclusion/exclusion of articles. Data abstracted from full text included articles will be exported into an excel file, for preparation for developing comparison tables and into an online software program called Gradepro (68) (Figure 7) for grading quality of evidence as advocated by the GRADE working group(69).

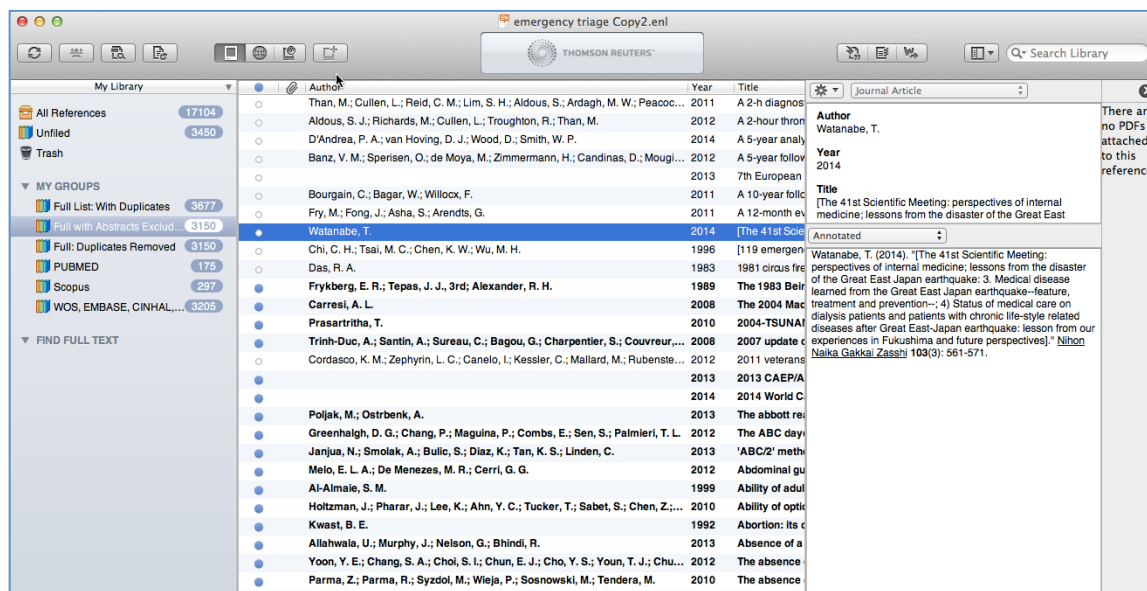


Figure 5: Screenshot of Endnote X7 (©1988-2014 Thompson-Reuters)(66)

The screenshot shows the Covidence interface for a systematic review protocol. The title is "Emergency Care Triage Scales in Developing Countries A protocol for a Systematic Review of Outcomes, Evidence and Quality". The user is Justin Myers. The search bar is empty. The navigation menu shows the following counts: Import, Screen (0), Full text review (1), Included (1), Excluded (0), Irrelevant (0), Export, and Settings. The table below shows the status of studies at each stage:

Stage	Count
Studies	2
New	0
Screen	2
Full text review	2
Include	1
Exclude	0
Irrelevant	0

The search schedule section shows "Last searched: NA" and "Next search in: NA", with a "Search now" button.

Figure 6: Screenshot of Covidence (© 2013 covidence)(67)

Selection Process

Two independent reviewers (Myers and Wangara) will screen title and abstracts from the initial search and full text articles will be obtained for eligibility review. Consensus will be attempted through discussion between reviewers, however, if consensus is unobtainable, either original study authors may be contacted for additional information or a 3rd reviewer will make the final determination. Next, full text articles will be assessed for eligibility for inclusion by two reviewers (Myers and Wangara) and a 3rd reviewer will be utilized if consensus cannot be achieved through discussion. At the full text review stage, reasons for exclusion will be reported.

Data Collection Process

Full text articles that meet inclusion criteria will undergo data abstraction. Prior to starting the full text review, we will be pilot the data abstraction form (in Covidence) to assess for reliability of abstraction between reviewers and make needed adjustments. Reviewers will review these same pilot studies and then a conference call will be employed to discuss our results and any necessary changes required for the data abstraction tool. Data abstraction will include demographics, methodology, interventions and reported outcomes from triage scale implementation. Two pairs of authors will complete data abstraction independently and in duplicate for the included studies. The first pair will consist of Myers and Travers. Myers will complete the initial extraction and Travers will review for accuracy and completeness. The second pair will consist of Wangara and Twomey. Wangara will complete the initial extraction and Twomey will review for accuracy and completeness. This method of reviewing independently, and in duplicate reduces biases and improves data entry accuracy (62). Disagreements will be resolved by discussion and when consensus cannot be achieved a 5th committee member(Waller), will make the final determination. These data will be summarized in our data tables and the information will be imported into Gradepro for assessment of quality and strength of evidence. Travers and Twomey will assess each of the studies utilizing Gradepro's features and Waller/Myers will review and make a final decision if consensus cannot be achieved. If any additional information is needed to resolve uncertainties, authors of the original study may be contacted.

Data Items

The following table is an outline of the data items to be extracted from included studies:

Author	Study Design	Intervention(Type of Triage System and components)	Number of Excluded Patients/Charts/HCW's
Year	Participant Characteristics (dispersion of ages, sex)	Control (Comparator, prior triage practice or system components)	Number of Patients/Charts/HCW's remained for analysis
Country	Study Setting (A&E, annual census, urban/rural, number of beds, total staff and type of staff)	Number of Patients/Charts /HCW's enrolled for assessment	Missing Data

Outcomes and Prioritization

There are a variety of studied patient outcomes in triage research. Most of these are proxies for patient health outcomes(70). Admission, discharge from the A & E or Death in the A & E have been reported (71). These outcomes are defined as a calculated “overtriage” or “undertriage”(71). Door to doctor (the interval of time in which a patient arrives to the A & E and is evaluated personally by a physician), patient waiting times, length of stay(19) and resource utilization(17,72) have also been described. If the study tests the reliability of the implemented system, then inter or intra-observer agreement of patient acuity levels may be the primary outcome. There are also studies which evaluate specific outcomes related to a triage tool, such as the Manchester Triage Scale's ability to detect and predict outcomes in febrile illnesses or acute myocardial infarctions, described in a systematic review by Azeredo et al (2014)(73). Given this wide variability in outcomes tested, we will prioritize the following outcomes as outlined in our PICOTTs table. We will specifically

describe whether each study reported each of the 4 categories in summary tables. If another primary outcome was studied, it will be listed under an “other” category.

Outcomes	<ol style="list-style-type: none"> 1. <u>Reliability</u>: <ol style="list-style-type: none"> a. HCW Inter-rater Reliability b. HCW Intra-rater Reliability 2. <u>Validity</u>: <ol style="list-style-type: none"> a. Urgency level as prediction: <ol style="list-style-type: none"> i. Admission, ii. ICU admission, iii. Discharge, iv. death in ED, b. In-Hospital Mortality c. Undertriage and Overtriage rates 3. Overall Mortality Reduction in A & E or Improved Survival to Hospital Discharge 4. The relationship of triage system to <ol style="list-style-type: none"> a. wait times b. length of stay c. patient satisfaction d. resource utilization
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Risk of Bias in Individual Studies

Limitations of each study will be assessed in the stage of review when our quality tables will be generated. Assessment of the risk of bias, inconsistency, indirectness and imprecision will be scaled as “not serious, serious, and very serious” according to the GRADE handbook and supporting literature(74–78). These judgments will be made independently by two reviewers (Twomey, Travers) utilizing GRADE Handbook guidelines and disagreements or uncertainties will be resolved by a 3rd reviewer (Waller) or by obtaining additional information from the original study’s author.

Data Synthesis

Heterogeneity in study populations, interventions, and outcomes of triage studies will make it implausible to conduct a meta-analysis of study results(62). Therefore, a narrative synthesis will be utilized for our results(79). We will provide a systematic narrative synthesis of each study characteristics in table format, comparing outcomes across studies.

Meta-Biases

Meta-Biases of our selected publications will not be assessed for this review.

Confidence in cumulative/narrative evidence (Strength of Evidence: GRADE)

Quality of evidence will be utilized using the GradeProGDT online software program(68). This is the software used to create Summary of Finding(SoF) tables for Cochrane Reviews. All team members will have access to this site to allow for project collaboration. Further information can be found at: <http://tech.cochrane.org/revman/gradepr>.

Information extracted from summary/question tables will be entered into the GradePro software. Studies will be grouped according to the specific Triage Scale or System. For example, a possible table would be “The Validity of the South African Triage Scale compared to Prior Triage Practice in Low and Middle Income Countries” as shown in **Figure 7**.

BDT **GRADE** Emergency Care Triage Scales in Developing Countries justin_myers@med.unc.edu

Should Australian Triage Scale vs. Prior Triage Practice be used in Low and Middle Income Countries? Explanations Help

Australian Triage Scale compared to Prior Triage Practice in Low and Middle Income Countries

Nº of studies	Study design	Quality assessment					Summary of findings				Quality	Importance
		Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Nº of patients		Effect			
							Australian Triage Scale	Prior Triage Practice	Relative (95% CI)	Absolute (95% CI)		
Reliability of Triage (assessed with: Quadratically Weighted Kappa)												
1	observational studies	not serious	not serious	not serious	not serious		15/-	15/-	not estimable	not estimable		IMPORTANT
Validity of Scale (assessed with: Prediction of Admission, Discharge or Death in A & E)												
1	observational studies	not serious	not serious	not serious	not serious	publication bias strongly suspected ¹	2000/-	2000/-	not estimable	not estimable		IMPORTANT
Add outcome												

Tasks Team Scope Document Sections Comparisons Outcomes Searching Screening Data Extraction Risk of Bias Analyses Evidence Table Recommendations Dissemination

Figure 7: Gradepro screenshot(© 2015, McMaster University and Evidence Prime Inc.)(68)

RESULTS

According to PROSPERO's guidelines, an initial search is allowable prior to full registration. An initial search by Myers and Lackey was completed of the aforementioned databases on 3/21/15, which produced 5,176 total abstracts. 2,026 duplicates were removed, leaving 3150 abstracts for review. These will be subsequently screened using the PICOTTS table by two reviewers, Myers and Wangara, and the combined unique abstracts selected for full text review for eligibility totaled = xxx. See planned Prisma-style flow diagram below:

Prisma Flow Diagram

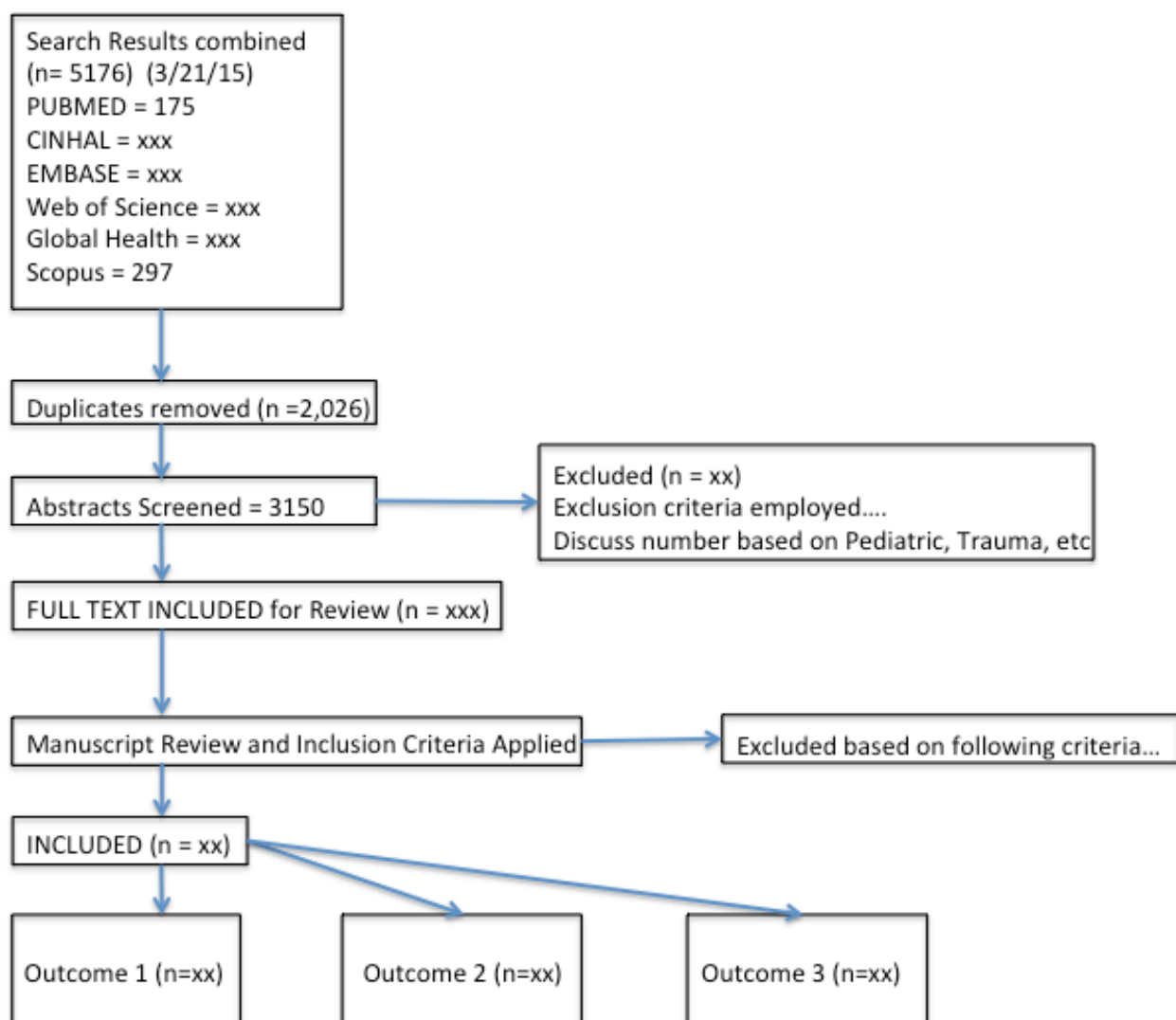


Table structures similar to the following will be utilized for presentation of data from the review and as narrative summary to the initial study questions and objectives.

Summary of Included Studies reporting Reliabilities, Validities, and Outcomes related to Triage Implementation in Developing Countries							
Author, Year, Reference Country	Study Design	Patient Characteristics/Study Setting/ Inclusion Criteria	Intervention (type of triage system)	Control or Comparison	Primary Outcome	Missing Data %	Study Quality and Relevance
Mullan, 2014, Botswana	Retrospective Observational, cohort. "before and after"	All patients and all ages presenting to the A & E. A&E is an urban tertiary gov facility with 30,000 annual volume. 21 total beds. N = 14,706 (pre-implementation) 25,243 (post-implementation)	Modified South African Triage Scale "PMH A&E Triage Scale (PATS)" 4 level system: Red(Immediate)/Orange(Very Urgent)/Yellow(Urgent)/Green(Routine)	3 level triage system: I:Life Threatening II:Potentially Life Threatening III:Non-life threatening	Overtriage and Undertriage Rates (defined via levels of acuity in predicting admission/death/discharge)	12% (pre-implementation) 5%(post-implementation)	

Question 1: Has the application of a formal triage system demonstrated a reduction in mortality rates in the A & E or improved survival to hospital discharge?				
Author, Year, Reference Country	Reported? (yes or no)	Measurement	Statistical Analysis	Quality of Analysis and/or Limitations
Mullan, 2014, Botswana	Yes	% Death in A&E Pre/Post Intervention	Pre-PATS Died in A & E = 0.19% (CI:0.12 to 0.26) Post-PATS Died in A & E = 0.19% (CI: 0.13 to 0.24) p value = 0.93	Non-significant change in mortality in the A & E. No improvement in A & E mortality. Unknown survival to hospital discharge.

Question 2: For studies measuring reliability, what is the reliability of (level of agreement between) HCW's performing triage and/or compared to an expert defined "standard".

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Question 3: For studies measuring validity, how is validity measured for predicting discharge, admission, or death in the ED?

Author, Year, Reference Country	Measure of Validity (Unit of Assessment)	Statistical Analysis Utilized	Pre-Implementation	Post-Implementation	Measured Statistical Significance	Quality of analysis
Mullan, 2014, Botswana	OverTriage and Undertriage rates	Two Sample tests of proportions (p value < 0.05 considered statistically significant)	Overtriage (all ages) = 52.5% (95% CI: 45.6 to 59.4) Undertriage (all ages) = 46.9% (95% CI: 45.4 to 48.3)	Overtriage (all ages) = 38.3% (95% CI: 37.5 to 39.3) Undertriage (all ages) = 16.0% (95% CI: 14.6-17.4)	P value < 0.001 P value < 0.001	

Question 4: What other outcomes were studied such as wait times, length of stays, patient satisfaction or resource utilization and their supporting evidence?

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Question 5: What is the Quality of Evidence according to GRADE guidelines?

DISCUSSION

After we have assessed the reviewed studies, we will complete a discussion section that incorporates the following recommendations for systematic reviews from the “Joanna Briggs Institute Reviewers' Manual: 2014 Edition” (80)

This section should discuss the results of the synthesis as well as any limitations of the primary studies included in the review and of the review itself (i.e. language, access, timeframe, study design, etc.). The results should be discussed in the context of current literature, practice and policy. Areas that may be addressed include:

- *A summary of the major findings of the review.*
- *Issues related to the quality of the research within the area of interest (such as poor indexing).*
- *Other issues of relevance.*
- *Implications for practice and research, including recommendations for the future.*
- *Potential limitations of the systematic review (such as a narrow timeframe or other restrictions).*
- *The discussion does not bring in new literature or findings that have not been reported in the results section but does seek to establish a line of argument based on the findings regarding the phenomenon*

Additional desired topics related to the above and their respective contributors include:

- **Choice and Feasibility for Implementation (Myers/Ali)**

- Quality for Emergency Medicine Practice, including Resource Utilization
(Myers/Martin)
- Public Health and Policy Significance within Health Systems **(Myers/Steffen)**

CONCLUSION

We will complete a conclusion section that incorporates the following recommendations for systematic reviews from the Joanna Briggs Institute Reviewers' Manual: 2014 Edition,

This section should begin with an overall conclusion based on the results. The conclusions drawn should match with the review objective/question. (80)

IMPLICATIONS FOR PRACTICE

This section to be led by 1 reviewer with editorial input from the entire systematic review team.

IMPLICATIONS FOR RESEARCH

This section to be led by 1 reviewer with editorial input from the entire systematic review team.

- **Future Directions for Triage Studies in LMIC's (Debbie/Michele)**

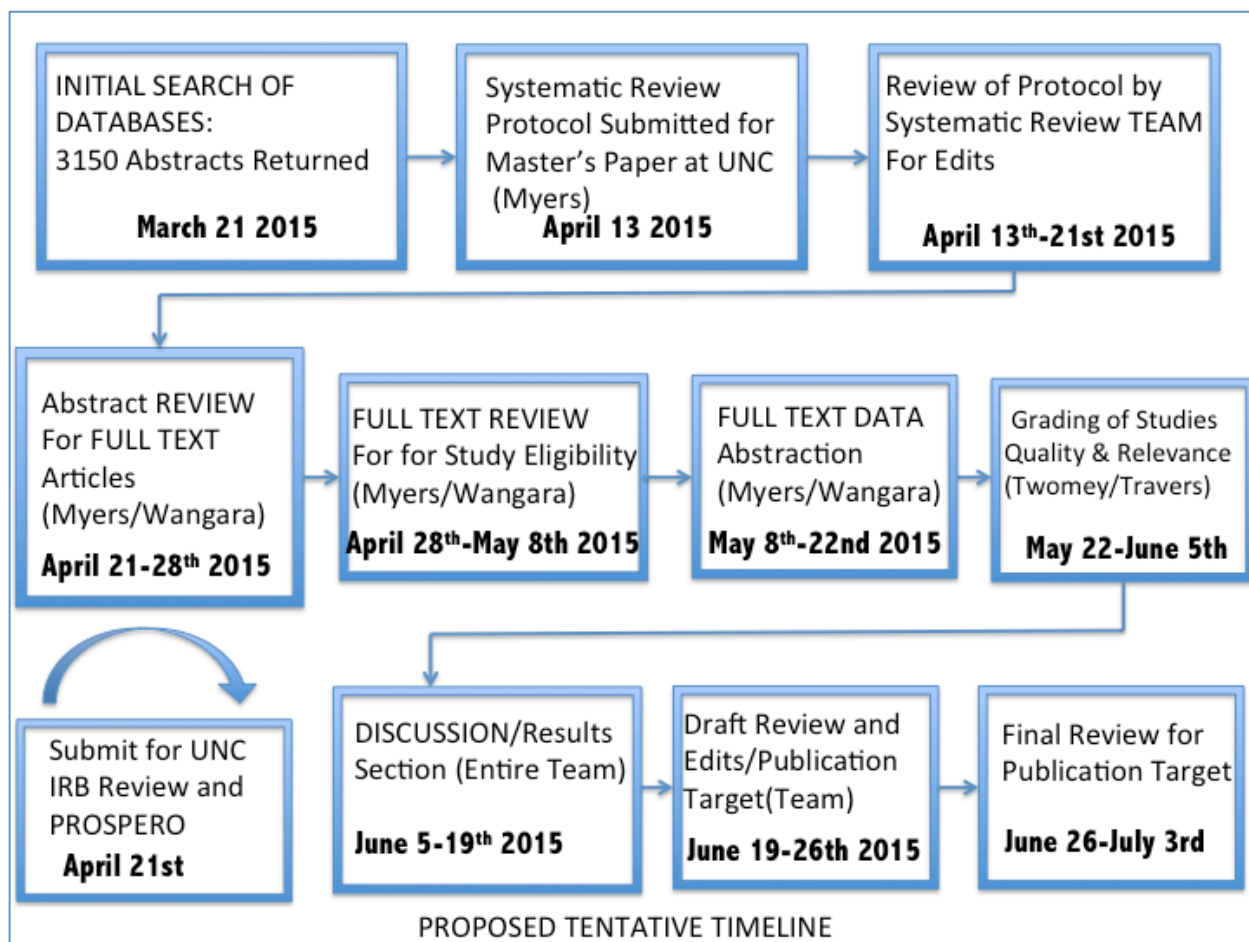
This section should include clear, specific recommendations for future research based on gaps in knowledge identified from the results of the review.(80)

POTENTIAL CONFLICTS OF INTEREST

We will report and register any potential conflicts of interests.

ADDITIONAL MATERIAL

APPENDIX I: TIMELINE



APPENDIX II: DATA ABSTRACTION INSTRUMENT

We will create a custom data abstraction tool in which to extract study information in Covidence (©2013) to be modified with pilot studies. We will include the final abstraction instrument (per the format of publishing journal- possibly as a supplement) Shown here is template similar to the items we will include in our Summary Tables (sample study by Mullan 2014 shown):

Emergency Care Triage Scales in Developing Countries: A systematic Review of Outcomes and Evidence	
Full Text Data Abstraction Form	
General Information	
Researcher performing data extraction	Justin Myers
Date of data extraction	3/28/15
Identification features of the study	
Record number	1
Author	Paul Mullan, Susan Torrey, Amit Chandra, Ngilwe Casuso, Andrew Kestler
Article title	Reduced overtriage and undertriage with a new triage system in an urban accident and emergency department in Botswana: a cohort study
Citation	Mullan, P. C., Torrey, S. B., Chandra, A., Casuso, N., & Kestler, A. (2014). Reduced overtriage and undertriage with a new triage system in an urban accident and emergency department in Botswana: a cohort study. <i>Emergency Medicine Journal</i> , 1, EMJ, 31(5), 356-60. doi:10.1136/emmed-2012-201900
Type of publication (e.g. journal article, conference abstract)	Journal Article
Country, City of Origin	Gaborone, Botswana
Location of Study	Princess Marina Hospital Emergency Department
Source of Funding	Programmatic Costs: University of Botswana School of Medicine or PMH under Ministry of Health Authority. Travel Costs: Baylor College of Medicine
Study characteristics	
Aim/objectives of the study	Compare the undertriage and overtriage rates in the PATS/PMH A&E Triage Scale and pre-PATS study periods.
Study design	Retrospective observational cohort study, "before and after" study design
Study inclusion and exclusion criteria	Inclusion: All patients seen in the A&E during either of two study periods and if they had a triage form completed Exclusion: Patients who were not seen in the A&E during either of two study periods and if they had a triage form completed
Recruitment procedures used (e.g. details of randomisation, blinding)	All patients seen during the study period that had a triage form completed were enrolled (retrospectively)
Participants characteristics	All patients and ages included who presented for care. Pediatric age defined as < or = to 12 years.
Characteristics of participants at the beginning of the study (e.g. Gender, Ethnicity, Socio-economic status, Disease characteristics, Co-morbidities)	All patients presenting to ED. No specific ethnicity or SES status, or disease characteristics targeted. Gender: Male/Female Age Categories: <12 years, 13-14 years, 15-19 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49 years, 50-54 years, 55-59 years, 60-64 years, 65-69 years, 70-74 years, 75-79 years, 80-84 years, 85-89 years, 90-94 years, 95-99 years, 100+ years
Number of participants in each characteristic category for intervention and control groups) or mean/median characteristic values (record whether it is the number eligible, enrolled, or randomized that is reported in the study)	PRE-PATS: 14,706 patients reviewed , POST PATS: 25,243 reviewed. Minimum sample size calculated 1204 pre-PATS, 2,408 post-PATS.
Intervention and setting	
Setting in which the Triage intervention delivered	Tertiary referral government hospital Accident and Emergency Department. Annual volume 30,000 patients. Staff: 2 EM specialists, 12 medical officer physicians, 44 nurses, 5 healthcare auxiliaries. Triage performed by 1 nurse. 21 total patient beds.
Description of the Triage intervention(s) and control(s)	South African Triage Scale(S), a four level formal triage scale consisting of 4 levels: Red "Immediate Care", "Orange" "Very Urgent", "Yellow" "Urgent", "Green" "Routine", and Blue (dead on arrival). Minor modifications made and called "PATS". Control group was the prior triage practice or "pre-PATS" era.
Description of co-interventions	None reported
PRIMARY OUTCOMES	
Primary Outcomes Explicitly Stated	Yes
Definition used in study	Comparison of "overtriage" and "undertriage" rates of patients before and after PATS implementation. "Overtriage" occurs when a patient receives a high acuity triage (red or yellow) and is subsequently discharged, while "undertriage" is when a patient receives a green acuity designation and is subsequently admitted. Overtriage patients were those who received triage categories of pre-PATS I (immediate), PATS red, or PATS orange and were discharged from the A & E. Undertriage patients were those with pre-PATS II or PATS-green who were admitted to hospital or died in the A & E.
Measurement tool or method used	PATS (PMH A&E Triage Scale) which uses clinical discriminators and vital sign parameters to place patient in one of 4 categories as above. Data recorded on a single duplicate paper form and entered into a Microsoft Excel/Access Database. The pre-PATS form was modified to capture PATS specific information.
Unit of measurement (if appropriate)	1)Acuity categories "Red", "Orange", "Yellow", or "Green", 2)Demographic Information(gender, age), 3)Disposition Outcomes (admit, discharge, death in A&E)
Length of follow-up, number and/or time of follow-up measurements	Data collected from 5 April 2010 to 1 May 2010 for post-PATS and compared with pre-PATS database 1 October 2009 to 24 March 2010.
For all intervention groups) and control group(s): Number of participants enrolled	PRE PATS: 14,706 patients reviewed , POST PATS: 25,243 reviewed.

Number of participants included in analysis	12,083 pre-PATS and 23,310 PATS patients																																
Number of withdrawals, exclusions, lost to follow-up	2,023 pre-PATS and 1933 PATS excluded, due to: no triage assessment(5 pre-PATS, 480 PATS), no final disposition(1700 pre-PATS, 1130 PATS), and dead on arrival status(228 pre-PATS, 414 PATS). 8 days in PATS period with no data.																																
Summary of primary outcome data(may include figure or table from study)	<p>Table 3 Undertriage and overtriage rates by age</p> <table border="1"> <thead> <tr> <th></th> <th>Pre-PATS period (95% CI)</th> <th>PATS period (95% CI)</th> <th>p Value</th> </tr> </thead> <tbody> <tr> <td>Overtriage: all ages</td> <td>52.0 (46.6 to 57.4)</td> <td>38.6 (35.0 to 42.3)</td> <td><0.001</td> </tr> <tr> <td>Overtriage: adults</td> <td>57.1 (48.9 to 65.3)</td> <td>41.4 (40.3 to 42.5)</td> <td><0.001</td> </tr> <tr> <td>Overtriage: paediatric</td> <td>42.9 (29.3 to 56.7)</td> <td>28.8 (27.1 to 30.6)</td> <td>0.03</td> </tr> <tr> <td>Undertriage: all ages</td> <td>48.0 (45.8 to 50.2)</td> <td>16.0 (14.8 to 17.2)</td> <td><0.001</td> </tr> <tr> <td>Undertriage: adults</td> <td>45.9 (44.3 to 47.6)</td> <td>14.9 (13.4 to 16.5)</td> <td><0.001</td> </tr> <tr> <td>Undertriage: paediatric</td> <td>57.7 (47.8 to 67.5)</td> <td>21.9 (17.8 to 26.0)</td> <td><0.001</td> </tr> </tbody> </table> <p>PMH, Princess Marina Hospital Accident and Emergency Triage Scale.</p>		Pre-PATS period (95% CI)	PATS period (95% CI)	p Value	Overtriage: all ages	52.0 (46.6 to 57.4)	38.6 (35.0 to 42.3)	<0.001	Overtriage: adults	57.1 (48.9 to 65.3)	41.4 (40.3 to 42.5)	<0.001	Overtriage: paediatric	42.9 (29.3 to 56.7)	28.8 (27.1 to 30.6)	0.03	Undertriage: all ages	48.0 (45.8 to 50.2)	16.0 (14.8 to 17.2)	<0.001	Undertriage: adults	45.9 (44.3 to 47.6)	14.9 (13.4 to 16.5)	<0.001	Undertriage: paediatric	57.7 (47.8 to 67.5)	21.9 (17.8 to 26.0)	<0.001				
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Dichotomous: number of events, number of participants	See above data																																
Continuous: mean and standard deviation	N/A																																
Type of analysis used in study (e.g. intention to treat, per protocol)	Appears to be "per protocol" A secondary "intention to treat" analysis was done by including participants with missing information (to determine the hypothetical absolute best minimum undertriage and overtriage rates) but this was explicitly stated.																																
Unit of assessment/analysis/Statistical techniques used	Two sample tests of proportion to compare the two samples. A p value < 0.05 considered statistically significant. An absolute difference of % in overtriage rate between pre-PATS and PATS study periods were considered a significant change for the primary outcome.																																
Statistical Software	STATA V.11.1 (College Station, Texas, USA) and Microsoft Excel 2007 (Seattle, Washington, USA)																																
Dichotomous: odds ratio, risk ratio and confidence intervals, p value Continuous: mean difference, confidence intervals	Dichotomous: see above chart Continuous: N/A																																
Secondary Outcomes and Subgroup Analysis																																	
Additional outcomes	Secondary Outcomes (parameters pre and post implementation): distribution of triage categories, percentage of each triage category with "hospitalized patients"(defined as admitted to the ward or intensive care unit, or died in A & E), proportion of "critical patients"(defined as admitted to ICU or died in A & E) in each triage category and percentage of critical outcomes in the lowest triage categories.																																
Summary of Secondary Outcome Data(may use figure or table from paper)	<p>Figure 1 Proportion of patients admitted to intensive care unit (ICU) or died in A&E by triage category. The figure shows two bar charts. The left chart is for 'Pre-PATS' and the right chart is for 'PATS'. The y-axis represents the percentage of patients (0-100%). The x-axis represents the triage categories: Red, Orange, Yellow, Green, Blue. In the Pre-PATS chart, Red is ~100%, Orange is ~100%, Yellow is ~100%, Green is ~100%, and Blue is ~100%. In the PATS chart, Red is ~100%, Orange is ~100%, Yellow is ~100%, Green is ~100%, and Blue is ~100%.</p> <p>Figure 2 Proportion of each triage category with hospitalised patients (admitted to the ward or intensive care unit, or died in A & E) by triage category. The figure shows two bar charts. The left chart is for 'Pre-PATS' and the right chart is for 'PATS'. The y-axis represents the percentage of patients (0-100%). The x-axis represents the triage categories: Red, Orange, Yellow, Green, Blue. In the Pre-PATS chart, Red is ~100%, Orange is ~100%, Yellow is ~100%, Green is ~100%, and Blue is ~100%. In the PATS chart, Red is ~100%, Orange is ~100%, Yellow is ~100%, Green is ~100%, and Blue is ~100%.</p> <p>Table 2 Final disposition of patients in pre-PATS and PATS study periods</p> <table border="1"> <thead> <tr> <th>Disposition</th> <th>Pre-PATS period (% of 12,083 number)</th> <th>PATS period (% of 23,310 number)</th> <th>p Value</th> </tr> </thead> <tbody> <tr> <td>Admitted to ward or intensive care unit</td> <td>41.8 (37.1 to 46.5)</td> <td>47.1 (45.1 to 49.1)</td> <td><0.05</td> </tr> <tr> <td>Discharge to home or clinic</td> <td>49.8 (45.6 to 54.0)</td> <td>49.6 (48.1 to 51.1)</td> <td><0.05</td> </tr> <tr> <td>Discharge to hospital</td> <td>1.6 (0.8 to 2.5)</td> <td>1.6 (0.8 to 2.5)</td> <td>0.98</td> </tr> <tr> <td>Left without being seen</td> <td>0.0 (0.0 to 0.0)</td> <td>0.0 (0.0 to 0.0)</td> <td><0.05</td> </tr> <tr> <td>Dead in A&E</td> <td>0.0 (0.0 to 0.0)</td> <td>0.0 (0.0 to 0.0)</td> <td><0.05</td> </tr> <tr> <td>Admitted to ICU</td> <td>0.0 (0.0 to 0.0)</td> <td>0.0 (0.0 to 0.0)</td> <td><0.05</td> </tr> <tr> <td>Unknown final disposition</td> <td>0.0 (0.0 to 0.0)</td> <td>0.0 (0.0 to 0.0)</td> <td><0.05</td> </tr> </tbody> </table> <p>ICU, Intensive Care Unit; PATS, Princess Marina Hospital Accident and Emergency Triage Scale.</p>	Disposition	Pre-PATS period (% of 12,083 number)	PATS period (% of 23,310 number)	p Value	Admitted to ward or intensive care unit	41.8 (37.1 to 46.5)	47.1 (45.1 to 49.1)	<0.05	Discharge to home or clinic	49.8 (45.6 to 54.0)	49.6 (48.1 to 51.1)	<0.05	Discharge to hospital	1.6 (0.8 to 2.5)	1.6 (0.8 to 2.5)	0.98	Left without being seen	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)	<0.05	Dead in A&E	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)	<0.05	Admitted to ICU	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)	<0.05	Unknown final disposition	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)	<0.05
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Unknown final disposition	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)	<0.05																														
Record details of any additional relevant outcomes reported	None reported																																
Resource use	The authors acknowledged that resource utilization would be a useful outcome, such as the ESI scale has reported, but did not capture this.																																
Adverse events	None reported																																
Other Notes and Comments																																	
Additional Secondary/Demographic Information from Study table:																																	
<p>Table 1 Pre-PATS and PATS subjects</p> <table border="1"> <thead> <tr> <th></th> <th>Pre-PATS period (% per category) (n)</th> <th>PATS period (% per category) (n)</th> <th>p Value</th> </tr> </thead> <tbody> <tr> <td>Gender: female</td> <td>54% (8046)</td> <td>54% (12 507)</td> <td>0.16</td> </tr> <tr> <td>Age 0-12 months</td> <td>1.5% (210)</td> <td>1.5% (345)</td> <td><0.05</td> </tr> <tr> <td>Age 13 months-12 years</td> <td>15% (2140)</td> <td>17% (3880)</td> <td><0.05</td> </tr> <tr> <td>Age 13-49 years</td> <td>75% (10730)</td> <td>70% (15870)</td> <td><0.05</td> </tr> <tr> <td>Age 50 years and older</td> <td>6% (827)</td> <td>7% (1607)</td> <td><0.05</td> </tr> <tr> <td>Specific age unrecorded</td> <td>6% (826)</td> <td>6% (1360)</td> <td><0.05</td> </tr> <tr> <td>Total patients</td> <td>14 706</td> <td>23 243</td> <td></td> </tr> </tbody> </table> <p>PMH, Princess Marina Hospital Accident and Emergency Triage Scale.</p>			Pre-PATS period (% per category) (n)	PATS period (% per category) (n)	p Value	Gender: female	54% (8046)	54% (12 507)	0.16	Age 0-12 months	1.5% (210)	1.5% (345)	<0.05	Age 13 months-12 years	15% (2140)	17% (3880)	<0.05	Age 13-49 years	75% (10730)	70% (15870)	<0.05	Age 50 years and older	6% (827)	7% (1607)	<0.05	Specific age unrecorded	6% (826)	6% (1360)	<0.05	Total patients	14 706	23 243	
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APPENDIX III: FULL SEARCH STRING: FOR PUBMED DATABASE

(Emergency care[tw] OR Emergency[tiab] OR Emergencies[tiab]) AND ((triage OR "modified early warning score"[tiab] OR "triage early warning score"[tiab] OR "manchester triage system"[tiab] OR "emergency severity index"[tiab] OR "Canadian Triage Acuity Scale"[tiab] OR "South African Triage Scale"[tiab] OR "Cape Triage Score"[tiab] OR "Australasian Triage Scale"[tiab] OR "Taiwan Triage System"[tiab] OR "Soterion Rapid Triage System") AND (Reliability OR reliable OR agreement OR concordance OR consistency OR precision OR valid OR validity OR validation OR accuracy OR admission OR admissions OR discharge OR discharges OR mortality OR death OR implement OR implementation OR efficacy OR effectiveness OR efficiency OR predict OR predicts OR prediction OR "patient outcomes" OR feasibility OR satisfaction OR wait OR waiting OR "length of stay" OR LOS OR "time to evaluation" OR "interventions given") AND (Africa[tw] OR Asia[tw] OR Caribbean[tw] OR West Indies[tw] OR South America[tw] OR Latin America[tw] OR Central America[tw] OR Afghanistan[tw] OR Albania[tw] OR Algeria[tw] OR Angola[tw] OR Antigua[tw] OR Barbuda[tw] OR Argentina[tw] OR Armenia[tw] OR Armenian[tw] OR Aruba[tw] OR Azerbaijan[tw] OR Bahrain[tw] OR Bangladesh[tw] OR Barbados[tw] OR Benin[tw] OR Byelarus[tw] OR Byelorussian[tw] OR Belarus[tw] OR Belorussian[tw] OR Belorussia[tw] OR Belize[tw] OR Bhutan[tw] OR Bolivia[tw] OR Bosnia[tw] OR Herzegovina[tw] OR Hercegovina[tw] OR Botswana[tw] OR Brazil[tw] OR Bulgaria[tw] OR Burkina Faso[tw] OR Burkina Fasso[tw] OR Upper Volta[tw] OR Burundi[tw] OR Urundi[tw] OR Cambodia[tw] OR Khmer Republic[tw] OR Kampuchea[tw] OR Cameroon[tw] OR Cameroons[tw] OR Cameron[tw] OR Cape Verde[tw] OR Cabo Verde[tw] OR Central African Republic[tw] OR Chad[tw] OR Chile[tw] OR China[tw] OR Colombia[tw] OR Comoros[tw] OR Comoro Islands[tw] OR Comores[tw] OR Mayotte[tw] OR Congo[tw] OR Zaire[tw] OR Costa Rica[tw] OR Cote d'Ivoire[tw] OR Ivory Coast[tw] OR Croatia[tw] OR Cuba[tw] OR 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FULL SEARCH STRING: FOR PUBMED DATABASE (continued)

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APPENDIX IV: CRITICAL APPRAISAL INSTRUMENT

See Figure 7 (GradePro)

APPENDIX V: TABLE OF INCLUDED STUDIES

We will place table of all included studies here as recommended by the Joanna Briggs Institute(80).

APPENDIX VI: LIST OF EXCLUDED STUDIES

Additionally, a list of our excluded full text studies will be placed here, per the following recommendations:

At a minimum, a list of studies excluded at the critical appraisal stage must be appended and reasons for exclusion should be provided for each study (these reasons should relate to the methodological quality of the study, not study selection). Studies excluded following examination of the full-text may also be listed along with their reason for exclusion at that stage (i.e. a mismatch with the inclusion criteria). This may be as a separate appendix or itemized in some fashion within the one appendix.(80)

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