Validating a Chief Compliant List for Low Resource Settings: A Methodologic Case Study

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Abstract

Background:

The chief or presenting complaint is the reason for seeking health care, often in the patient's own words. In limited resource settings, a diagnosis-based approach to quantifying burden of disease is not possible, partly due to limited availability of an established lexicon or coding system. Collaboration with World Health Organization colleagues resulted in the creation of a pilot symptom list representing an attempt to standardize undifferentiated chief complaints in emergency and acute care settings. A validated universal chief complaint list would profoundly benefit clinicians, researchers, and policymakers world-wide by allowing the communication and development of system-level priorities based around the signs and symptoms most often experienced by the patients being served.

Methods:

This study was incorporated as a part of a larger prospective observational study on human immunodeficiency virus testing in Emergency Departments in South Africa. The pilot symptom list was used for chief complaint coding in three Emergency Departments. Data was collected on 3,357 patients using paper case report forms. Chief complaint terms were reviewed by two study team members to determine the frequency of concordance between the coded chief complaint term and the selected symptom(s) from the pilot symptom list.

Results:

Overall, 3,537 patients' chief complaints were reviewed, of which 640 were identified as 'potential mis-matches'. When considering the 191 confirmed mis-matches (29.8%), the Delphi process identified 6 (3.1%) false mismatches and 185 (96.9%) true mismatches. Significant chief-complaint clustering was identified with 9 sets of complaints frequently selected together for the same patient. "Pain" was used 2,076 times for 58.7% of all patients. Testing for validity and functionality of the initial draft dataset via user feedback and expert-panel modified Delphi analysis resulted in several substantial changes to the pilot symptom list.

Conclusions:

This study found that the pilot symptom list with aforementioned modifications could be applied to a low resource emergency system. Recommendations for additions, modifications, and/or deletions from the draft chief complaint list will improve validity and functionality of the list in low resource environments. Selecting a patient's chief complaint from a validated list offers a vital tool to help triage patients, streamline emergency care delivery, and improve patient outcomes.

Introduction

The chief or presenting complaint is the reason for seeking health care, often in the patient's own words. While the utility of recording and analyzing chief complaints is well accepted in resource-rich and highly developed emergency care systems, diagnosis-based research has remained the predominant standard when evaluating/quantifying burden of disease (BOD) in most health care settings.[1] In limited resource settings, a standard approach to quantifying BOD is not possible, partly due to both limited availability of an established lexicon or coding system and more limited diagnostics than in resource-rich settings.[2] Furthermore, diagnosis-based research strategies fail to capture an essential element of emergency care: the sorting of patients with undifferentiated symptom-based chief complaints into diagnostic categories and levels of acuity, which in turn guides decision-making on behalf of these patients based on limited symptom-based information and diagnostics.

The patient's chief complaint is a key piece of information that helps direct this process. Additionally, the chief complaint can further be stratified based on acuity and those complaints designated as 'high acuity' have been found to independently predict mortality; enhanced attention and increased resources being made available to those with high risk chief complaints can improve patient health outcomes, and is the standard of care in many resource-rich settings.[3] This inherent value of the chief complaint has led to the development of ontologies of emergency care presenting complaints of varying degrees of sophistication; these have been predominantly derived in wealthy settings, and not validated through most of the world.[4–6] One intrinsic barrier to researchers' use of chief complaints, rather than diagnoses, has lain in the absence of standardization of chief-complaint nomenclature, terminology and taxonomy for the recording, translating and cataloguing of complaints among emergency patients presenting to care in these global settings.[7] The few efforts in this direction that do exist lack the imprimatur and validation standards of an international body.[8] Our group worked with colleagues from the World Health Organization (WHO) to create a pilot symptom list for use in low resource settings, representing an attempt by an international criterion-setting body in emergency care to standardize this type of collection of undifferentiated chief complaints in the emergency and acute care setting.

The challenge of translating free-text chief complaints to support syndromic surveillance, operational needs and research work has been extensively addressed in high-income settings.[4,9,10] However, and as noted, lists derived in resource-rich settings often have not been validated across national boundaries, nor in health care systems characterized by substantially different patterns of care-seeking, resource-availability and degrees of development of emergency care. In addition, while chief complaints do not perfectly map to disease burden, a standardized language for recording and analyzing chief complaints allows actors across the spectrum of acute and emergency care, including community, pre-hospital and hospital-based health-care providers, to effectively communicate and develop system-level priorities based around the signs and symptoms most often experienced by the patients they serve. A straightforward and universal chief complaint list, tested and validated in a global setting, would be of profound benefit to clinicians, researchers and policymakers world-wide as it would allow for the use of chief complaint data in the quantification, analysis and evidence-based planning that emergency care in low-resource settings is urgently in need of.

This paper presents methodological strategy that can be exported to other settings to refine a local chief complaint list. The authors piloted a draft symptom list, against traditional free-text chief compliant recording and thereby sought to thus test the validity and functionality of the pilot symptom list while developing a strategy for further refinement within an exemplar emergency system in South Africa.

Methods

Overview

Incorporated as a part of a larger study on human immunodeficiency virus (HIV) testing in Emergency Departments in South Africa, the pilot symptom list (Appendix 1) was used for chief complaint coding in a large multi-center Emergency Department (ED) based observational study in South Africa wherein study staff (predominantly HIV counsellors or nurses, with research training), collected both free text chief complaints and then made a good-faith effort to match chief complaints to one of the pre-determined symptoms from the pilot symptom list.[11]

The original prospective observational study, conducted between June 2017 and July 2018, was embedded in the larger Walter Sisulu Infectious Diseases Screening in Emergency Departments (WISE) Study that implemented point-of-care HIV testing in the ED and collected extensive demographic data on ED patients. This study collected data across three EDs in the Eastern Cape Province, South Africa, where each of the three EDs was sampled for a period of six weeks. Data was collected on 3,357 patients across these three hospitals using paper case report forms (CRFs).

For the purposes of this analysis, the free-text chief complaints were then coded using the Medical Dictionary for Regulatory Activities (MedDRA©) nomenclature. Free-text chief complaints were then compared to those identified by study staff using the pilot symptom list and analyzed for clustering using factor analysis. The primary outcome of interest was to assess appropriateness and sufficiency of the pilot symptom list in capturing and reflecting patients' presenting complaints. The secondary outcome of interest was to assess redundancy in the pilot symptom list by observing categories that were never selected or selected significantly frequently. A modified Delphi methodology was used to review the outcomes and observations using these to make recommendations for modifications and amendments to the pilot symptom list.

Setting

The WISE study was conducted in the Eastern Cape Province in three hospital-based Emergency Departments. Nelson Mandela Academic Hospital (NMAH) and Mthatha Regional Hospital (MRH) are located in the rural town of Mthatha, and Livingstone Hospital (LH) is in the city of Port Elizabeth. NMAH and LH are both tertiary care centers, they receive referred patients from regional and district hospitals in addition to providing 24-hour trauma care. MRH provides 24-hour services for walk-in patients and ambulances, while trauma cases are transferred to NMAH. All hospitals maintain 20–50 beds in the ED, and are staffed by 1–2 doctors, but are not staffed by physicians or other providers specializing in

Emergency Medicine. Patients are seen on a first-come-first-serve basis unless determined to be critically ill or requiring immediate care. Handwritten logbooks and paper medical files are used to track all patients.

Recruitment and Enrolment

Patients presenting for care to the hospital ED during the study period, aged 18 years and older, fully conscious, and clinically stable were eligible for enrollment in the study. Patients who met the inclusion criteria were approached by trained HCT staff as soon as they completed the triage process and were informed of the ongoing study and offered a point-of-care HIV test. Data was also collected on patient demographics, presenting complaint, presenting symptoms, past medical history, as well as reasons for accepting or declining the HIV test. Written informed consent was sought for all patients. Patients were enrolled 24-hours a day, throughout the duration of the study.

Data Collection

Data were recorded using CRFs. Responses to *demographic information*, *past medical history*, and *reasons for accepting or declining the HIV test* were recorded using predetermined categorical options or as free text, *presenting complaint* was recorded as free text and later coded using the Medical Dictionary for Regulatory Activities (MedDRA©, MedDRA MSSO, Virginia). *Chief complaints* were recorded using the symptom list (WHO-SL). CRFs were scanned and entered using intelligent character recognition (ICR) DataFax software (DataFax©, Clinical DataFax Systems Inc., Hamilton, Ontario, Canada) and centrally double-verified by independent data technicians.

Data Analysis and Statistics

Data were analyzed using STATA v.15© (StataCorp, LLC, Texas). The WHO-SL was checked for accuracy against MedDRA-coded chief complaints for each patient. MedDRA-coded chief complaint terms were reviewed by two study team members to determine the frequency of concordance between the MedDRA term and the selected symptom(s) from the pilot symptom list. A ‘match’ was defined as a patient record with a MedDRA term that aligned with the symptom(s) selected on the pilot symptom list. A ‘mismatch’ was defined as a patient record with a MedDRA term that was either not present in the WHO-SL or did not align with the symptom(s) selected on the pilot symptom list. These mismatches were further defined as ‘true mismatches’ (when the appropriate symptom(s) matching the MedDRA term did not exist on the pilot symptom list/needed to be added) and ‘false mismatches’ (when the appropriate symptom(s) matching the MedDRA term was available but not selected from the pilot symptom list).

Modified Delphi Process

Our algorithm for matching the free text chief complaint (coded using MedRA ©) and the boxes ticked on the pilot symptom list identified potential mismatches among the chief complaints. This process is described in Fig. 1.

The initial list of 640 potential mis-matches was then divided amongst six emergency medicine physicians/residents for independent review to determine if these mismatches represented actual taxonomic errors or computer/algorithmic errors as well as if they mandated a modification or addition to the pilot symptom list. From this review, final decisions regarding changes to the list were reached systematically using the modified Delphi Method. Using this method, each reviewer shared reflections from their independent review, in a round robin fashion, which was recorded and reflected on a whiteboard to the entire group, until no new ideas were forthcoming. Thereafter reviewers had the opportunity to discuss and clarify each comment/idea shared until group consensus was reached. Notes were kept on rationale for response to each of the mismatches and a detailed review of each of the mismatches, the supporting discussion and resulting recommendations for changes is provided below.

Results

The intent of this analysis of the pilot symptom list was to address adequacy, validity and functionality of this data set to achieve chief complaint data capture in a real-world resource-constrained emergency medicine setting. Functionality was approached through staff surveys and interviews with the HIV counsellors and nurses who completed the CRFs. These staff reports revealed four key concerns. Firstly, patients and staff struggled with the meaning of some of the terminology used – e.g. “GU” referring to genital or urinary complaints. Second, the pilot symptom list was presented as an unordered list – the absence of an interpretable sequence to the list such as alphabetic or body-system based ordering made it difficult for staff to rapidly find complaints. Third, staff reported they found many of the complaints on the pilot symptom list to be too broad (pain being a primary example) and applied to many patients – this meant that multiple boxes were often ticked. Lastly, staff found it difficult to identify if something was an injury or not, including being unsure, for example, how to classify a patient with an injury two weeks ago now presenting for a wound complication. This final concern was raised nearly universally across staff, and we suggest that a major modification to the pilot symptom list should be that the condition/symptom sections include both medical and traumatic chief complaints, and staff should collect further trauma data if an injury is present. In discussions of this topic, staff also reported that they found it easier to think in an ordered fashion about trauma, addressing first mechanism, then location and then intent for injured patients – for example, as in a fall downstairs, causing head injury, occurring due to an assault.

Validity was approached through addressing adequacy and accuracy of the pilot symptom list to capture the richness of the data present in the free-text chief complaint fields, ideally in a single category. A total of 3,537 patients’ chief complaints were reviewed, of which 640 were identified as ‘potential mis-matches’. Of these ‘potential mismatches’, 191 (29.8%) were confirmed as mismatches rather than algorithmic errors (i.e., due to coding errors or mis-reading of data via ICR) when reviewed by the authors. After the Delphi process 6 (3.1%) of the 191 confirmed mismatches were identified as false mismatches where a appropriate symptom was available but not checked and 185 (96.9%) were identified as true mismatches that would have been captured by modifications to the draft list, most notably the addition of 11 additional categories to the pilot WHO-SL. Significant chief-complaint clustering was identified with

9 sets of chief complaints that were frequently selected together for the same patient. Both clustering and mismatches were addressed with nomenclature modifications to 17 additional chief complaints on the pilot symptom list. Furthermore, we identified that two categories on the pilot symptom list were never used and seemed to be of limited utility in this South African setting. Lastly, the chief complaint “Pain” was used 2,076 times for 58.7% of all patients, therefore was of limited utility in providing discrete additional data. Further analysis follows in Tables 1 & 2.

Table 1

Mismatches identified and resulting recommendations

Chief complaint (n)	Discussion	Recommendation
Abdominal pain (22)	Only Pain checked; provider did not keep searching for proper CC	Remove Pain
Abnormal blood pressure (1)	Only Pain checked; provider did not keep searching for proper CC	Change to High blood pressure
Abnormal glucose (2)	Only Pain checked; provider did not keep searching for proper CC	Remove Pain
Abscess (5)	Pain checked/too general, can be captured in Rash/skin problem	Remove Abscess
Alcohol/drug problem (2)	Medication issue checked instead of alcohol	Change to Poisoning/alcohol/drug problem
Blood in cough/nose (1)	Hemoptysis and epistaxis are separate entities	Change to Coughing/vomiting blood, as epistaxis can be captured by Ear/Nose/Mouth
Bloody D/V (4)	Bloody diarrhea deserves its own category to capture dysentery cases; move Bloody vomiting to Coughing/vomiting blood	Change to Bloody diarrhea to capture dysentery
Chest pain (11)	Pain checked; provider did not keep searching for proper CC	Remove Pain
Confusion/AMS (1)	AMS is not lay terminology	Change to Confusion
Decreased urine output (1)	Pain checked; provider did not keep searching for proper CC	Remove Pain
Diarrhea/constipation (2)	Pain checked; provider did not keep searching for proper CC	Remove Pain
ENT (12)	ENT is not lay terminology; also, likely unknown term outside of Western medicine	Change to Ear/Nose/Mouth
Eye problem (2)	Issues unrelated to Eye problem	Remove Abscess
Focal weak/numb (2)	Issues unrelated to Focal weak/numb, however can capture stroke-like symptoms in one broad category Limb weakness/facial droop	Change to Limb weakness/Facial droop
Fracture/deformity (2)	Pain checked; provider did not keep searching for proper CC	No change recommended
Generalized weakness (2)	Pain checked; provider did not keep searching for proper CC	Remove Pain

GU complaint (15)	GU is not lay terminology; maybe out of cultural context. Often checked for rectal complaints	Remove GU complaint, add Urinary problem, Penis/vagina problem (or Genital problem), and Rectal problem
Headache (3)	Occasionally checked in context of traumatic injury	No change recommended
Mass (1)	Not very specific	Change to Suspected cancer/mass
Nausea/Vomiting (3)	Pain checked; provider did not keep searching for proper CC	Remove Pain
Pain (3)	Only three instances where Pain could have better described the intended CC; thousands of instances where pain was checked when another CC could provide more useful data	Remove Pain
Pregnancy complication (1)	Complication not lay terminology	Change Pregnancy complication to Pregnancy problem
Psychiatric illness/SI (1)	Was not checked when it should have been	No change recommended
Rash/skin lesion (4)	Lesion not lay terminology	Change to Rash/skin problem
Seizure/convulsion (4)	Convulsion not lay terminology	Change to Fits/seizure
Shortness of breath (5)	May be out of cultural context	Change to Breathing problem
Speech problem (1)	Was not checked when it should have been	No change recommended
Swelling (2)	Unclear whether refers to generalized edema or focal swelling	No change recommended; will place under Limb/swelling heading to discourage use for skin complaints
Syncope/fainting (2)	Syncope not lay terminology	Change Syncope/fainting to Fainting/Dizziness
Vaginal bleeding (2)	Issues unrelated to vaginal bleeding	No change recommended
Generalized weakness	Was not ticked in cases of fatigue or just weakness, thus modified to be more inclusive	Change to Generalized weakness/fatigue
GU complaint involved in several mismatches	GU is not lay terminology and was frequently used inappropriately for rectal complaints; likely unknown term outside of Western medicine. Difficult to find a ubiquitous term for these complaints	Change to Genital problem
Mass represented	It seems as if trying to capture concern	Change to Suspected

<0.5% of visits	for cancer, but was often not ticked because not explicit enough	Cancer/Mass
Medication issue represented <0.5% of visits	Unsure what this is trying to capture	Combine with Poisoning/Ingestion/Medication problem
Wound	Not specific enough and staff did not understand	Change to Wound from injury

As described above, we conducted an exploratory factor analysis using the pilot symptom list categories, to assess correlation patterns between individual symptoms as selected from the pilot symptom list. These patterns also were used to inform recommendations on adding, removing or modifying symptoms on the list, in order to effectively capture the maximum richness and diversity of free-text chief complaint data using the fewest number of symptoms. As a part of the factor analysis, two symptom categories were identified as never being used: “Suspected Malaria” and “Foreign Body Inhaled”.

Table 2
Results of factor analysis groupings

Symptom Clustering	Frequency	Discussion
Wound, Pain, Bleeding from injury	344	All of these are related to penetrating injury, pain does not add new data, not clear if it is beneficial to have both “wound” and “bleeding” from injury
Abdominal pain, Pregnancy complication, Vaginal bleeding	23	This cluster will likely occur together, perhaps can be addressed with training or changing the location of these complaints
Pain, Swelling	421	Most frequently ticked, and add little data to the underlying aetiology of the symptoms
Nausea, Diarrhoea	66	Likely cluster as often present together, but both need to remain
Cough, Chest pain	80	Likely cluster as often present together, but both need to remain
Fever, Cold	20	“Cold” does not add additional value
Weakness, Shortness of breath	50	Likely cluster as often present together, but both need to remain
ENT, Dental	20	Would be possible to merge as likely require similar resources
Blood in urine, GU complaint	30	Most did not understand “GU” complaint, could be addressed by training or remove completely
Abnormal BP, Headache	70	Likely cluster as often present together, but both need to remain

Based on the consensus discussions and the analyses above, several changes to the chief complaint list are proposed. A detailed summary of the observations made, surrounding discussion and resulting recommendations is provided in Table 3.

Table 3
Summative review of discussion and recommendations of categories removed, added and changed.

Observations **(Remove Category)**	**Discussion**	**Recommendation**
Abscess often misdiagnosed	Abscess is a diagnosis rather than a complaint, associated with Rash/skin lesion in group factor analysis	Remove Abscess
Bleeding often grouped with wound and pain	Bleeding from injury was associated with Wound and Pain in group factor analysis, does not contribute helpful information	Remove Bleeding from injury
Foreign body from injury represented < 0.5% of visits	Could be captured in "wound from injury"; doesn't affect resource allocation	Remove Foreign body from injury
Foreign Body Inhaled was never checked	Not frequent enough to warrant its own category	Remove Foreign body inhaled
Pain was checked in 59% of 3,537 visits	Does not provide meaningful information or impact allocation of resources	Remove Pain
Suspected Flu/Cold represented < 0.5% of visits	Does not provide meaningful information or impact allocation of resources	Remove Suspected Flu/cold
Unable to eat isn't specific for any disease process	Could be captured with other general complaints (Generalized weakness/fatigue, Weight loss/wasting, etc)	Remove Unable to eat
Suspected HIV represented < 0.5% of visits	Important category for resource allocation/epidemiology	No change recommended
Suspected Malaria was never checked	Likely underrepresented in South Africa due to low malaria prevalence	No change recommended
Swelling	Difficult to discern generalized edema vs focal swelling	Place under Limb heading to encourage focal use
Observations **(Add Category)**	**Discussion**	**Recommendation**
Back pain not on list	Represented 1.8% of complaints; non-traumatic back pain managed differently than traumatic back pain	Add new category: Back pain
Burn	Represented 0.9% of complaints; burns in LMICs have a significant impact on morbidity and mortality, our count is likely not representative of true incidence	Add new category: Burn
Joint/MSK pain not on list	Represented about 1.8% of complaints; more specific than Pain	Add category: Joint or Limb pain

Observations (Remove Category)	Discussion	Recommendation
Sexual assault is not captured on this form	Sexual assault is a large and under reported problem in LMIC, this is a chance to gain more accurate data	Add new category: Sexual assault (under Known Injury Intent, or Genital heading)
Suspected Tuberculosis not on list	Important category for resource allocation/epidemiology	Add new category: Suspected tuberculosis
Unresponsive not on list	Frequently (1.64%) selected in Uganda chief complaint study; distinct entity from confusion/fatigue	Add new category: Unresponsive
Observations (Change Category)	**Discussion**	**Recommendation**
Abnormal BP	Patients unlikely to present with "Low BP" as a chief complaint	Change to High blood pressure
Heart beat	Even though this is low frequency, we suspect that it was underutilized due to poor understanding of "heart beat"	Change to Abnormal heart rate
Blood in cough/nose	Epistaxis can be captured by Ear/Nose/Mouth	Change to Coughing/vomiting blood
Blood in urine represented < 0.5% of visits,	Likely underrepresented in South Africa due to low schistosomiasis prevalence, too specific	Change to Urinary problem
Bloody D/V involved in several mismatches	Bloody diarrhea deserves its own category to capture dysentery cases; move Bloody vomiting to Coughing/vomiting blood as above	Change to Bloody diarrhea
Confusion/AMS represented < 0.5% of visits	"AMS" is not lay terminology	Change to Confusion
Decrease Urine output	Too specific, can combine with Blood in urine	Change to Urinary problem
Dental represented < 0.5% of visits,	Low frequency complaint, associated with ENT in group factor analysis, thus can merge with ENT	Merge "Dental" and "ENT" into "Ear/Nose/Mouth"
Diarrhea/constipation	Diarrhea important cause of morbidity and mortality worldwide, warrants its own category	Split into Non-bloody Diarrhea and Constipation

Observations (Remove Category)	Discussion	Recommendation
ENT represented < 0.5% of visits, involved in several mismatches	ENT is not lay terminology; also, likely unknown term outside of Western medicine	Change to Ear/Nose/Mouth
Focal weak/numb was involved in several mismatches	Attempting to capture large strokes with one category	Change to Limb weakness/facial droop

The pilot symptom list is a first attempt to bridge the tool gap that currently exists in presenting problem taxonomy in emergency care and develop a minimum data set that can capture the vast majority of all presenting complaints. Testing for validity and functionality of the initial draft dataset via user feedback and expert-panel modified Delphi analysis resulted in several substantial changes to the pilot symptom list, as presented in Appendix 2.

Discussion

Chief complaints are essential to the practice of emergency care and chief complaint data contains a wealth of information to inform clinicians, researchers and policymakers as to the nature and diversity of emergency condition presentations, as well as the emergency care resource and training needs associated with them. As such, the absence of a standard chief complaint naming convention, minimum data set and organizational strategy that retains functionality in a diversity of settings represents a critical tool gap in global emergency care. By classifying chief complaints, the most challenging portion of the labor of taxonomy is complete. Sorting the chief complaints expressed in the patients' own words into an established classification system using lay terminology thereby becomes much easier and with this ease comes reliability and consistency, improving data quality and helping fill the data gap in global emergency care.

As described, the absence of a unified, valid and functional chief complaint short-list with tested utility in global resource-constrained acute care settings has had significant adverse effects on clinical care, research and informed public. In this paper we present a systematic approach to refining a chief compliant list for limited resource settings. Themes that were predominant in this analysis included issues of taxonomy, nomenclature and frequency. Chief complaints that were removed were often taken out because they were overly generic and were selected by staff in preference to more specific and accurate chief complaints available on the list. Elimination of these complaints will improve the frequency with which a specific single accurate complaint is chosen. Inaccurate selection of chief complaint also occurred frequently on the basis of nomenclature confusion. The initial list included North America-centric jargon and abbreviations e.g. "ENT" and "GU" to refer to otolaryngologic and genitourinary complaints, respectively. This naming convention was confusing, opaque and

incomprehensible to the staff completing patient triage as it was not commonly used terminology/nomenclature in that population and culture. The elimination of jargon and acronyms and the use of simpler language/lay terminology to reflect similar sign/symptom complexes addresses this issue and thereby improves legibility and identification of accurate chief complaints but does not address potential translation errors when used in a non-English speaking setting.

An additional taxonomic problem identified in factor analysis was the grouping of chief complaints that have substantial overlap (such as pain and swelling) or associate as a part of cardinal presentations of illness (such as chest pain and cough). This was addressed in some cases by combining chief complaints with substantial overlap into a single chief complaint while allowing individual elements of cardinal presentations to remain as standalone complaints using frequency data to inform these changes. Finally, frequency data and mis-match data were used to sub-divide extant chief complaints as well as to include chief complaints not currently captured in the original list of conditions and symptoms but responsible for notable fractions of presentations. One example of this pattern would be “back pain” which was the presenting concern in 2% of all presentations but was not well captured by any existing complaint. This final process and review of the 185 true mismatches resulted in adding 11 new complaints. Examination of frequency data also resulted in the identification of chief complaints with low frequency related to rarity and unlikely to enhance capture rates substantially through inclusion on the chief complaint list, such as "inhaled foreign body". These latter chief complaints were eliminated from the list.

Strengths of this study include that this is, to our knowledge, the first prospective piloting for validity of a minimum set of chief complaints intended for use in both low- and middle-income settings as well as wealthy settings. One limitation is that establishing this as a minimum set generalizable across geographic and cultural boundaries will require further testing in settings outside of South Africa, including in settings with less mature emergency medical systems and non-English speaking settings. In recognition of the limitation of testing the pilot symptom list in a single country, the researchers recognize that some of the chief complaints with a low frequency, such as “suspected malaria”, were likely secondary to geographical biases of the database and thus would be beneficial to keep. Additional strengths include the development of a concise 47-item list; the goal of producing a minimum set that will allow for easy aggregation and categorization of patient presentations would not be possible with a more lengthy or more technical list of complaints, such as the Canadian ED Diagnosis Shortlist which captures 99% of all presenting complaints but requires 837 individual chief complaints to do so.[10] The goal of the analysis was to present a rapidly “scan-able” list of complaints that could be used by a triage or check-in provider with little-to-no specialty training in emergency care.

An additional limitation of this study is that there was no process in place to test the impact of the presentation of the pilot symptom list in its original form, including impact of individual item findability due to ordering effects and overall ease of use. We propose changes to the ordering and organization of the chief complaint list based on functionality data provided by in-depth interviews with study staff. However, testing unique variations of the organization of the pilot symptom list in each of the 3 sites in

addition to interviews about use would have provided more robust data on the impact of user experience effects on functionality of the list overall. Lastly, we used similar data from interviews to inform revisions of the trauma categorization but formal usability testing strategies of these recommendations would add strength to claims of improved functionality.

Suggested groupings of the chief complaints by body system for usability follow as Figs. 2 and 3.

Conclusion

This study found that the pilot symptom list with aforementioned recommendations can be applied to a low resource emergency system. The recommendations include removal, addition and/or modification of chief complaint terms thus resulting in the capture of the majority of presentations to an emergency setting. These recommendations will allow for improved validity and functionality of the pilot symptom list in a low resource environment. Further studies will require validation of suggested recommendations and application of these changes to improve functionality. Additionally, further research will need to determine generalizability of the proposed list across other LMICs outside of South Africa. A patient's chief complaint is a vital tool, that when easily accessible from a validated list to be wielded by trained emergency medical personnel may help triage patients, streamline emergency care delivery and improve patient outcomes.

Abbreviation List

BOD – Burden of disease

CRF – Case Report Form

ED – Emergency Department

HIV – Human immunodeficiency virus

ICR – Intelligent Character Recognition

LH – Livingstone Hospital

MRH – Mthatha Regional Hospital

NAMH – Nelson Mandela Academic Hospital

WHO – World Health Organization

WHO-SL – Pilot symptom list from the World Health Organization

WISE - Walter Sisulu Infectious Diseases Screening in Emergency Departments

Declarations

Ethics approval & consent to participate:

Approval for this study was received by the Institutional Review Board for the Johns Hopkins University School of Medicine, the Human Research Ethics Committee at Walter Sisulu University, and the Research Ethics Committee at the University of Cape Town. Written consent was provided by all participants enrolled; separate consents were required for the demographic data collection and for HIV point-of-care testing. The collection of de-identified patient data from patients presenting to the ED who did not consent to participate in any portion of the study was not approved.

Consent for publication:

Not applicable

Availability of data and materials:

The anonymized dataset supporting this conclusion will be available upon request to the corresponding author.

Competing interests:

The authors have no financial and non-financial interests to disclose.

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Author Contributions:

BH, EH, AR and AP made substantial contributions to the conceptualization and design of the work; EH and AR made substantial contributions to the acquisition of data and data analysis; All authors participated in the modified delphi and data interpretation. All authors contributed to the drafting the work and/or revising it critically for important intellectual content; AND approved the final version to be published. All authors are in agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors read and approved the final version of the manuscript

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Appendix

Appendix 1– World Health Organization Symptom List (WHO-SL)

CONDITION OR SYMPTOM

5. *Mark all that apply:*

☐ *Fracture / deformity*	☐ *Fever / Chills*	☐ *Headache*
☐ *Wound*	☐ *Abscess*	☐ *Syncope / fainting*
☐ *Pain*	☐ *Rash / skin lesion*	☐ *Eye problem*
☐ *Foreign body from injury*	☐ *Cough*	☐ *ENT*
☐ *Bleeding from injury*	☐ *Susp. Malaria*	☐ *Dental*
☐ *Generalized Weak*	☐ *Susp. HIV*	☐ *Shortness of breath*
☐ *Sz/Convulsion*	☐ *Susp. Flu / Cold*	☐ *Chest Pain*
☐ *Confusion / AMS*	☐ *Bloody D/V*	☐ *Abnormal Heart beat*
☐ *Focal weak/numb*	☐ *Blood in cough / nose*	☐ *Nausea / Vomiting*
☐ *Difficulty walking*	☐ *Blood in urine*	☐ *Diarrhea / Constipation*
☐ *Speech problem*	☐ *Foreign body - inhaled*	☐ *Jaundice*
☐ *Psychiatric illness/SI*	☐ *Foreign body - swallowed*	☐ *Abdominal pain*
☐ *Alcohol/Drug problem*	☐ *Abnormal BP*	☐ *GU complaint*
☐ *Weigh loss / wasting*	☐ *Abnormal Glucose*	☐ *Decrease Urine output*
☐ *Unable to eat*	☐ *Medication issue*	☐ *Pregnancy comp.*
☐ *Swelling*	☐ *Mass*	☐ *Vaginal bleeding*

Appendix 2 – Summary of recommended modifications for WHO-SL

Added	Removed	Modified	Untouched
Back Pain	Abscess	High Blood Pressure	Weight loss / Wasting
Burn	Bleeding from injury	Abnormal Heart Rate	Fever / Chills
Joint or Limb Pain (includes swelling)	Foreign Body from Injury	Coughing / Vomiting Blood	Abnormal Glucose
Genital Problem - Complaint of Penis, Testicle or Vulva (includes sexual assualt)	Foreign Body - Inhaled	Confusion	Headache
Suspected Tuberculosis	Pain	Urinary Problem	Speech Problem
Unresponsive	Suspected Flu / Cold	Ear/Nose/Mouth Problem	Eye Problem
Bloody Diarrhea			
Poisoning/Ingestion/Medication Problem	Unable to Eat	Non-bloody Diarrhea	Cough
Rectal Problem	Shortness of Breath	Constipation	Chest Pain
	Focal Weak/Numb	Limb weakness/Facial Droop	Suspected HIV
-	Medication Issue	Generalized Weakness or Fatigue	Suspected Malaria
	GU Complaint	Alcohol or Drug Related Problem	Abdominal Pain
		Fits/Seizure	Foreign Body - Swallowed
		Fainting or Dizziness	Nausea or Vomiting
		Suspected Cancer/Mass	Vaginal Bleeding
		Pregnancy Problem	Fracture or Deformity
		Wound from Injury	Difficulty Walking
		Rash/Skin Problem	Jaundice
		Breathing Problem	Psychiatric Illness or Suicidal

	Limb/swelling	-

Figures

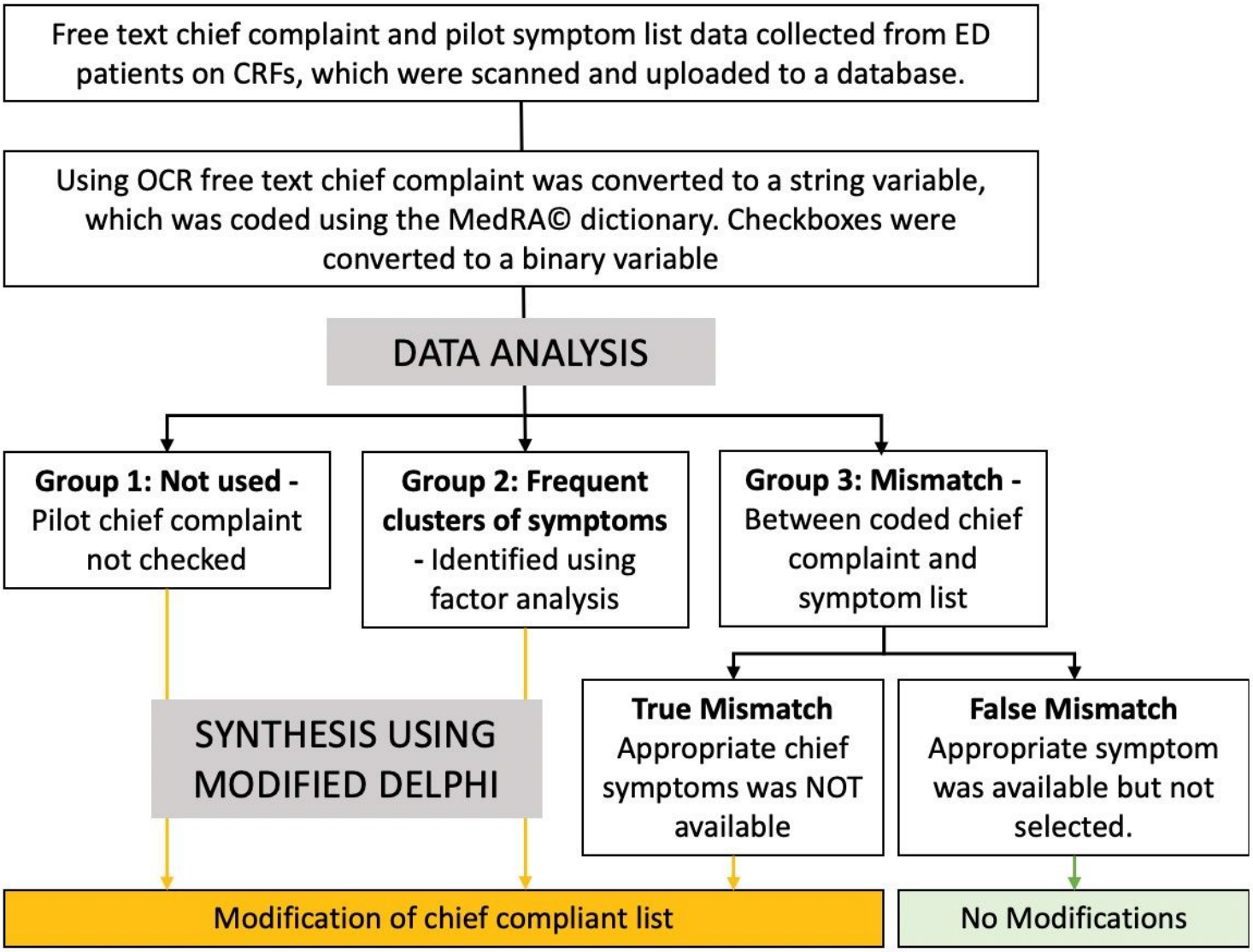

Figure 1

Free text chief complaint and pilot symptom list tick box matching algorithm

GENERAL	*Generalized Weakness*	CHEST	*Breathing Problem*		*Pregnancy Problem*
	Weight loss / Wasting		*Cough*	LIMB/BACK	*Fracture or Deformity*
	Fever / Chills		*Coughing Blood / Vomiting Blood*		*Joint or Limb Pain*
	Abnormal Glucose		*Chest Pain*		*Bleeding from injury*
	Alcohol or Drug Problem		*Abnormal Heart Rate*		*Limb weakness or facial droop*
	Poisoning / Ingestion		*High Blood Pressure*		*Difficulty walking*
	Psychiatric Illness or Suicidal	ABDOMEN	*Abdominal Pain*		*Swelling*
HEAD	*Fits / Seizure*		*Nausea or Vomiting*		*Back Pain*
	Confusion		*Non-bloody Diarrhea*	SKIN	*Wound from injury*
	Unresponsive		*Bloody Diarrhea*		*Rash / Skin Problem*
	Headache		*Constipation*		*Burn*
	Fainting or Dizziness		*Foreign Body - Swallowed*		*Jaundice*
FACE	*Speech Problem*	GU	*Urine Problem*	OTHER	*Suspected Cancer / Mass*
	Eye Problem		*Genital Problem*		*Suspected HIV*
	Mouth / Ear / Nose Problem		*Rectal Problem*		*Suspected Malaria*
			Vaginal Bleeding		*Suspected Tuberculosis*

Figure 2

Revised Symptom or Complaint list

Mechanism		Location		Intent	
Road Traffic	Fall	Had/Face/Neck	Eyes	Unintentional	Assault
Gunshot	Stab/Cut	Chest	Abdomen	Self-Harm	Legal/Military
Poisoning/Ingest	Blunt force	Extremity	Back		
Animal Bite	Drowning	Pelvis			
Envenomation	Burn				

Figure 3

Known Injury Classification