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A Triple Burden of Disease Revealed by Pilot Prospective Registry in a Major East Africa Accident and Emergency Department

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ABSTRACT

Background: Resource-limited settings are increasingly experiencing a "triple burden" of disease, comprised of trauma, non-communicable diseases, and known communicable disease patterns. However, the epidemiology is not well characterized and this limits efforts to further develop emergency care capacity.
Objective: To define the burden of disease by describing the patient population presenting to the Accident and Emergency Department (A&E) at Kenyatta National Hospital (KNH) in Kenya.
Methods: We analyzed data from the prospective pilot registry "Emergency Medicine Registry of Kenya" (EMROK) obtained via systematic sampling over 3 months in KNH's A&E. Research assistants collected data directly from patients and their charts. Chief complaint and diagnosis codes were grouped for analysis. Patient demographic characteristics were described using the mean and standard deviation for age and n and percentages for categorical variables. ICD-10 codes were categorized by 2013 Global Burden of Disease Study methods.
Results: Data were collected prospectively on 402 patients with an average age of 36 years (SD 19), and of whom, 50% were female. Patients were most likely to arrive by taxi or bus (39%), walking (28%), or ambulance (17%). Thirty-five percent of patients were diagnosed with non-communicable diseases, 24% with injuries, and 16% with communicable diseases, maternal and neonatal conditions. Overall, head injury was the single most common final diagnosis and occurred in 32 (8%) patients. The most common patient-reported mechanism for head injury was road traffic accident (39%).
Conclusion: This pilot registry describes the A&E population at a tertiary center in Kenya and highlights the triple burden of disease. Our findings emphasize the need for further development of emergency care resources and training to better address patient needs in resource-limited settings, such as KNH.

Keywords: Public Health, Trauma, Emergency Care Development, Emergency Medicine

STRENGTHS AND LIMITATIONS:

Strengths:

- Prospective and systematic sampling of Accident and Emergency Department patients via direct enrollment and chart review.
- This study highlights the growing burden of injuries and non-communicable diseases—compounding the existing burden of communicable conditions.
- The most common diagnosis and complaint, Head Injury, is elucidated by these findings.
- Results are grouped by the 2010 Global Burden of Disease study categories

Limitations:

- Kenyatta National Hospital (KNH) is a tertiary referral hospital; therefore the results may overestimate certain disease conditions in Kenya.
- Pediatric patients are underrepresented since KNH has a separate treatment area for non-traumatic patients 12 and under.
- Admission statistics may be underestimated as a result of difficulties in tracking patient flow in the A&E.

INTRODUCTION

Worldwide, the recent Ebola pandemic required healthcare systems to respond with surveillance, education, and prioritization of resources.[1,2] However, in low- and middle- income countries (LMICs), this stochastic infectious disease pattern is compounded by an increasing incidence of non-communicable diseases (such as heart disease and diabetes) and trauma (largely secondary to automotive accidents). This shifting epidemiology results in the well-described "triple burden of disease": a baseline infectious disease burden with increasing non-communicable disease, and trauma, highlighted in the 2010 Global Burden of Disease study.[3,4]

Resource limited countries would benefit from a combination of disease surveillance, health workforce education, and resource prioritization to address all categories of disease, particularly as it relates to emergency care.[5] However, resource-limited health systems are limited in their ability to adapt to shifting and novel disease patterns. Among their limitations is the widespread under-development of emergency care systems.[6,7] For instance, in most of Sub-Saharan Africa, Emergency Medicine is not a recognized specialty,[8] and there is an associated absence of data describing patients presenting for acute, emergent, and urgent care, as well as the overall burden of disease in this setting. Communicable diseases still receive a disproportionate share of health funding (in LMICs),[9–12] which is partially attributable to a lack of baseline data, hindering development of trauma and cardiac resuscitative care systems.[13]

Defining the burden of emergency disease in developing countries is a research priority of the Society for Academic Emergency Medicine (SAEM), the International Federation of Emergency Medicine (IFEM), and the African Federation for Emergency Medicine (AFEM).[14] Therefore, we conducted a prospective, observational study, the Emergency Medicine Registry of Kenya (EMROK), in the Accident and Emergency Department (A&E) of Kenyatta National Hospital (KNH) in Nairobi, Kenya. The primary objective of our study was to characterize the presenting complaint, medical conditions, diagnoses, and disposition of patients seen in the KNH A&E.

METHODS

Study Setting & Participants

The largest, public hospital in Kenya, KNH is an 1800-bed tertiary care facility. Emergency services at KNH provide care in three areas: A&E; Pediatric Emergency Unit (PEU); and the Outpatient Clinic. Providers in A&E care for adult patients presenting with high-acuity medical and surgical conditions as well as severely injured adults and children. The PEU provides medical care to children aged 0-12 years. Patients older than age 12 or injured (including burns) are directed to the A&E. The annual patient census of these combined areas is 163,426, with 69,294 patients treated in the A&E.[15] The A&E is staffed by full-time and part-time medical officers and nurses, as well as nursing and emergency medical technician (EMT) students. Medical officers are physicians who have completed medical school and one year of internship. No medical officers have completed Emergency Medicine residency training; instead, they have varying expertise and post-graduate (consultant) training. Select A&E staff have completed the equivalent of Advanced Cardiac Life Support (ACLS), Advanced Trauma

Life Support (ATLS), and possible disaster training. Many nurses have completed an additional one-year emergency nursing certification course, a nursing training program unique to KNH.

All patients access care in the A&E through a single triage point staffed by nurses, nursing students, and/or EMT students. At triage, patient information, including chief complaint and limited vital signs are collected in paper logbooks; additional documentation is completed on one sheet of letter-sized paper. Patients are triaged as critical or non-critical. If critical, they are immediately directed to an acute resuscitation area in the A&E for care. If non-critical, patients are directed either to the Outpatient Clinic, to the PEU (age 12 and under) or to the A&E waiting area.

Data Collection

Patients were enrolled in this study by a team of research assistants (RAs) via systematic sampling of every sixth patient registered in triage during eight-hour shifts from March 11, 2015 to May 30, 2015. These shifts included time frames across all 24 hours of the day and days of the week but were not randomized. The required minimal sample size was calculated to be 233 using the standard formula for the standard normal distribution and conservative estimated prevalence of 0.5%.[16]

All patients presenting to A&E who could complete an informed written consent, or had next-of-kin available to consent, were eligible for this study. Patients were excluded if they could not consent and next-of-kin was not available, were unwilling, or were sent to a treatment area outside the A&E. An RA was placed in triage to identify every sixth patient. Two RAs completed consent and collected information from the patient and chart throughout the visit. Because patient visits extended outside of data collection shift times, a fourth research assistant completed the data collection and, if admitted, tracked patients in the hospital. Data was entered via electronic tablets into REDCap®,[17] a secure, online database, supported by the University of Minnesota.[18]

Data collected included age, sex, chief complaint, mode of arrival, transfer status, acuity level, patient-reported trauma history, discharge diagnoses, and disposition. If a patient reported a road traffic accident, he or she was asked if he or she was wearing a seatbelt. If a patient reported riding a motorcycle, he or she was asked about wearing a helmet. Patients were also given the opportunity to, but not required to, report their HIV status (if known).

Chief complaints and discharge diagnoses collected by research assistants were assigned International Classification of Disease 10 (ICD-10) codes.[19] ICD-10 is the international standard for categorizing epidemiological and health management data and is used to classify diagnoses as well as reasons for consultation (chief complaint).[20]

Data Analysis

For descriptive purposes, chief complaint and diagnosis codes were grouped for analysis in the World Health Organization's twenty-one chapter format.[20] Additionally, we grouped codes in accordance with the 2010-2013 Global Burden of Disease studies.[4,21,22] This method partitions diagnoses in three main categories: 1) non-communicable diseases (NCD); 2) communicable diseases, maternal, and neonatal conditions; and 3) injuries. To our knowledge, this has not been applied to the acute care setting prior to this study.

All data analysis was completed using STATA 14 (Stata Corp, College Station, TX) and mapping was completed using ArcGIS 10.1 (Esri, Redlands, CA). The University of Nairobi/KNH Ethics Review Committee and the University of North Carolina at Chapel Hill Institutional Review Board approved the study.

RESULTS

The A&E registered 14,956 patients during the study period.[15] We identified 449 patients for enrollment. Forty-seven patients deemed eligible were ultimately excluded, and 402 patients were prospectively enrolled. Reasons for exclusion included: 8 (17%) could not be consented due to a language barrier were in critical condition and/or next of kin were unavailable; 10 (21%) refused participation; 2 (4%) were sent to Labor and Delivery; 1 (2%) was sent to the Pediatric Emergency Unit (PEU); 3 (6%) were sent to other outpatient clinics; and 26 (55%) left the A&E before consent.

The average age of participants was 36 years (standard deviation 19 years), and patients were 50% female. Patients were most likely to arrive via taxi or bus (39%), walking (28%), or ambulance (17%). Seven percent of patients were triaged as "emergent", 14% as "very urgent", 35% as "urgent", 35% as "routine", and 9% "undesignated." Referrals/transfers from outside health centers comprised of 37% of subjects. The majority of patients (62%) were discharged and 17% percent were admitted. One percent were considered dead on arrival, 1% died in the A&E, 4% left against medical advice or eloped, 1% were transferred to another hospital, and 6% of patients underwent a medical "review"[i] or were evaluated by a subspecialist in the A&E. The remaining 10% of patients had missing or incomplete information on their chart, and the RAs were unable to ascertain their disposition (Table 1). The majority of patients were from Nairobi proper (Figure 1).

Overall, abdominal pain was the single most common chief complaint and occurred in 47 (12%) of patients. The most common WHO Chapter was injury (Table 2). Head injury was the single most common final diagnosis and occurred in 32 (8%) patients. The most common patient-reported mechanism for head injury was road traffic injury (RTI) (39%), followed by assault (36%) and fall (9%) (Table 3).

Forty-three percent of participants reported a negative HIV status. Comparatively, 2% reported being HIV positive, 47% reported an "unknown" status, and 8% declined to respond (Table 4).

Presenting patient chief complaints and subsequent final A&E diagnoses were grouped according to three major categories of the Global Burden of Disease Study. Among chief complaints, 25% were injuries, 24% were non-communicable diseases, and 7% were communicable diseases and maternal or neonatal conditions. Forty-four percent were grouped as "other" according to this methodology. A&E final diagnoses were comprised of 24% injuries, 35% non-communicable diseases, and 16% were communicable diseases and maternal or neonatal conditions. Twenty-five percent were grouped "other" (Figures 2 and 3a). The top-five chief complaints and diagnoses are listed within each category in Figures 3a and 3b. Of note, injury occurred in a higher percentage of males (39%) in the 18-64 year age group compared to females patients (8%) (Figure 2).

[i] Patients presenting for a medical "review" usually present with test results from a clinic or outside hospital for subspecialty evaluation. RAs were unable to ascertain the exact disposition of this entire category of patients but noted these patients were likely discharged and not found in the admission logbook.

DISCUSSION

Our prospective, systematic analysis of the KNH A&E is one of the first comprehensive, prospective studies of patient presentation to a major East African tertiary care hospital A&E. Prior studies of emergency care in Kenya have been much more limited in scope. Wachira et al. attempted to characterize the patients presenting to a variety of A&Es across Kenya over a single 24-hour time period and found that trauma, respiratory tract infections, and malaria were the leading diagnoses.[23] House et al. conducted a more comprehensive analysis of A&E care by retrospectively analyzing all patients over a one-year period at Moi Teaching and Referral Hospital, a public tertiary hospital in western Kenya. The top-three A&E diagnoses were injuries, infections, and mental health disorders.[24] Additional studies have focused on patients with acute coronary syndrome[25] and emergency obstetrical care.[26] Given large patient volumes, shifting epidemiology, and the growing recognition of the importance of emergency care, a comprehensive understanding of the acute care needs at Kenya's largest referral center is long overdue, both to guide patient care in the acute setting and to inform broader public health and policy agendas.

Triple Burden of Disease

Our results demonstrate a "triple burden" of acute disease in the KNH A&E of non-communicable diseases; communicable diseases, maternal and neonatal conditions; and injuries, similar to the previously described triple burden of disease that is affecting Sub-Saharan Africa.[3,27]

Non-Communicable Diseases

NCDs account for 24% of chief complaints and 35% of A&E diagnoses. Cardiovascular disease was the top final diagnosis category and the second most common of chief complaint categories. In the Global Burden of Disease study, Lozano et al found that that ischemic heart disease has become the greatest burden of disease worldwide, in terms of years of life lost (YLL).[4] However, the same study reports that in Eastern Africa, ischemic heart disease ranks #17 in YLL. Our results question whether current data systems in Eastern Africa accurately capture the burden of non-communicable disease and suggest that cardiovascular disease poses a greater public health concern than recognized. Global health initiatives in East Africa have typically prioritized important infectious diseases[28], which may overestimate of their contribution to the total disease burden. Additionally, media coverage (e.g., of the Ebola virus and Zika virus crises, etc.,)[29,30] influences public perception of the burden and impact of infectious diseases[31]. This altered public perception may, in turn, indirectly influence governmental and non-governmental funding priorities. Less well publicized is that NCDs are the most common cause of YLL[4], and age-matched death rates due to NCDs are higher in developing countries[32]. These facts, combined with the volume of NCDs found at KNH, highlights the need for preventive efforts and improving acute care systems in Kenya to respond to the growing acute manifestations of chronic disease.

Injuries

Injuries account for approximately one quarter of both chief complaints (25%) and final diagnoses (24%). Head injury was by far the most common—comprising 26% of injury diagnoses and affecting 8% of all patients. The most common reported mechanism of head injury was RTI (39%). A similar trend was found at Moi Teaching and Referral Hospital in Western Kenya, where RTI was the most common chief complaint, and head injury was in the top five diagnoses.[24] In Kenya, there were approximately 3,000 reported fatalities from RTI in 2010.[33] Road traffic injury has increased from the 13th to the 11th leading cause of years of life lost in Kenya, between 1990-2010[34]. This trend is likely to increase, given the 40-fold increase in motorcycle registration between 2006 and 2011[35] and with over 200,000 new motor vehicle registrations occurring annually from 2011-2014.[36] This trend is consistent worldwide, as RTI has increased from the 14th to the 8th leading cause of global years of life lost, usurping diabetes, malaria, and tuberculosis as a leading cause of global mortality.[4] Further, traumatic brain injury (TBI), most commonly caused by RTIs is likely under-reported in Africa, due to poor access to care and absence of injury surveillance.[37] The high incidence of head injuries related to road traffic crashes in Kenya should raise concern.

Studies based in LMICs demonstrate that legislative-based interventions are the single most effective strategy for reducing road traffic injuries and death due to RTIs.[38] Of the 14 patients with head injuries from RTIs in our study, none reported use of seatbelts and/or helmets. This is lower than previously reported by Saidi et al in 2014 in admitted trauma patients at KNH, where 11.6% of occupants wore seatbelts, and 18.2% of motorcycle passengers wore helmets.[39] This discrepancy may be due to the relatively low number of patients in this category and reliance on patient reporting. While motorcycle helmet, seat-belt, and drunk driving laws exist in Kenya, they are poorly enforced.[33] In 2010, a consortium including the World Health Organization, Johns Hopkins University (JHU), and local Kenyan partners launched the Road Safety in 10 Countries (RS-10) campaign. This program aims to reduce mortality from RTIs through social marketing, strengthening public health legislation, training local law enforcement, and improving trauma care and data surveillance systems.[40] This multi-faceted approach holds promise, as there has been a modest increase in helmet utilization and decrease in road speeds as a result.[41]

Infectious Disease

The third major GBD study category, infectious diseases and maternal or neonatal conditions, appears to comprise a lesser share of the total burden of acute disease at KNH, comprising only 16% of final diagnoses. The contribution of chronic infectious diseases, such as HIV, on acute health conditions is not well elucidated by this study. The HIV prevalence in this study was 2% (self-reported), which is lower than the documented HIV prevalence among adults aged 15-49 years in Kenya in 2014 of 5.3%.[42] However, almost half (47%) of patients in our study reported an unknown HIV status. Therefore, it is possible that there is a hidden HIV burden among patients at KNH's A&E, who largely originate from Nairobi's large urban areas. HIV testing in the Emergency Department is well studied and practiced[43,44] and is crucial for vulnerable populations, whose only access to healthcare may be the Emergency Department.[45] As such, the A&E represents an opportunity for improved detection and surveillance of infectious diseases in Kenya and other LMICs. Finally, this category includes maternal and

neonatal conditions. As a primarily adult A&E with a separate PEU, many neonatal conditions are evaluated in the PEU, such as lower respiratory illnesses and diarrheal diseases, which rank #2 and #3 for YLL in Kenya, respectively[46]. Conducting a similar study in the PEU would provide a more comprehensive understanding of these conditions.

Undifferentiated Disease

The most common chief complaints in our results were "symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" (44%), which includes complaints such as "abdominal pain", "chest pain", and "headache." There is a need for specialized training for evaluating patients with undifferentiated and syndromic complaints, an area where Emergency Medicine (EM) training is well suited.[47] The specialty of EM is by nature multidisciplinary, allowing for the rapid triage and treatment of acute injury or illness of all organ systems and populations. A proficiency in stabilizing therapeutics and procedures acquired from a multitude of medical and surgical specialties, gives the EM-trained physician a decided advantage and efficiency for treating undifferentiated A&E patients. Further, EM-trained physicians demonstrate improved consistency and quality of care in Emergency Departments.[48–50] However, EM as a specialty, is not recognized by the Kenya Medical and Dentists Board (KMDB). Emergency Medicine development in Kenya starts with recognizing EM as a specialty, which could allow residency-trained emergency physicians to form local faculty for training of health care providers in Emergency Medicine.[8]

Study Limitations

As a tertiary care hospital, the burden of disease detected at KNH will be skewed towards higher acuity conditions than would be present in secondary or primary level centers with emergency care. Therefore, the generalizations of emergency care burden to the other hospital settings in LMICs should be made cautiously. However, the results of this study, combined with the findings at Moi Teaching and Referral Hospital provide an excellent snapshot of tertiary care epidemiology in Kenya.[24] Future studies evaluating district and rural A&Es, combined with our data, would provide an improved picture of the acute disease burden in Kenya. Additionally, our data does not include patients who presented to the separate Pediatric Emergency Unit. The pediatric patients that we captured were skewed towards the critically ill and injured pediatric population. A study describing the population presenting to the PEU would certainly add to our body of knowledge in this area.

A potential pitfall of using GBD categories to assess emergency care is the imprecision in grouping chief complaints and undifferentiated illness. The net effect, when comparing to other GBD studies, would be an underestimation of the burden of acute disease. Since chief complaints may better characterize acute disease[47], it could be argued that future GBD should include variables to capture this data. Specifically, concessions to better capture the ICD-10 category, "symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" would be valuable.

There were limitations due to data systems in the A&E. Our RAs noted that some patients bypassed triage and were not recorded in the triage book, and therefore were not included in their systematic sampling. These missing data limit the accuracy of the disposition estimates. In addition, the requirement for an informed written consent for this registry project forced

sampling bias, as critically ill patients could not be consented, and therefore were excluded. And finally, due to the difficulty of patient tracking given the current paper medical record, this prospective study likely underestimated the percent of patients that were admitted. Based on our review of their admission logbooks and the total patient census, we estimate that 30% of patients typically are admitted, appreciably higher than our results. As long as written consent is required and due to the limitations of a prospective study design in this setting, it likely that a retrospective study may yield more accurate data for certain statistics, such as admission rates However, retrospective studies have other associated limitations and, given our experience, it is likely that in LMIC A&Es, retrospective and prospective studies fulfill different roles.

CONCLUSIONS

This pilot registry is a novel, prospective study characterizing the A&E population at a tertiary care center in Kenya. This study highlights the growing burden of injuries and non-communicable diseases—compounding the existing burden of communicable conditions. Current Global Burden of Disease categorization may not fully reflect the burden of emergency care needs. Our findings emphasize the need for further development of emergency resources and training to better address evolving patient needs in resource-limited settings, such as KNH.

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Contributors
JM was responsible for the conception of idea for study design, draft of protocol, data collection, analysis, and manuscript initiation, reading and approval of final manuscript. KE prepared the RedCap Database. KH was responsible for the statistical analysis and key manuscript formatting. AW was instrumental in the development of the final protocol. KE, AW, AM, andkatie IM assisted with data collection. KH, KE, AW, AM, VM, SD and IM were responsible for the analysis and revisions of study design and protocol, analysis and critical revisions of manuscript. All authors had the opportunity to read and approve the final manuscript.

Competing Interests
None declared.

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Data sharing statement

The database is conjointly owned between the individual co-investigators and their respective departments, including the University of Nairobi and the Kenyatta National Hospital Accident and Emergency Department. The ethical approval for this study obliges us to follow our data sharing agreement (available for review) and to protect the privacy of participants. According to our agreement (filed through the UofN/KNH ERC in 2014-2015), requests for access to this database for data analysis from investigators or institutions outside of the owners will be considered, pending stipulations of Data Use Agreement are observed and that all owners are made aware. Readers can apply for access and permission to this database by contacting the project coordinator at justin_myers@med.unc.edu or through contact with any of the co-investigators.

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Table 1. Characteristics of patient population by age group. All data are presented as n (%) unless otherwise noted.

Characteristic	All patients (n=402)	≤4 years (n=22)	≤17 years (n=48)	18-64 years (n=302)	≥65 years (n=44)
Age, mean (SD) (n=394)	36 (19)	1 (2)	7 (6)	35 (12)	75 (7)
Sex					
Male	201 (50)	12 (55)	29 (60)	146 (48)	23 (52)
Female	201 (50)	10 (45)	19 (40)	156 (52)	21 (48)
Mode of arrival					
Private vehicle	16 (4)	0 (0)	0 (0)	12 (4)	4 (9)
Taxi/bus	156 (39)	8 (36)	19 (40)	114 (38)	21 (48)
Ambulance	69 (17)	5 (23)	7 (15)	53 (18)	5 (11)
Walked	113 (28)	0 (0)	8 (17)	96 (32)	8 (18)
Carried	30 (8)	8 (36)	12 (25)	16 (5)	2 (5)
Wheelchair	10 (3)	0 (0)	1 (2)	4 (1)	4 (9)
Unknown/blank	5 (1)	1 (5)	1 (2)	4 (1)	0 (0)
Transferred					
Yes	147 (37)	13 (59)	20 (43)	104 (35)	20 (45)
No	238 (60)	8 (36)	25 (53)	188 (63)	21 (48)
Unknown	13 (3)	1 (5)	2 (4)	7 (2)	3 (7)
Acuity level					
Emergency (red)	29 (7)	3 (14)	5 (11)	20 (7)	4 (9)
Very urgent (orange)	55 (14)	4 (18)	11 (23)	39 (13)	4 (9)
Urgent (yellow)	140 (35)	8 (36)	12 (26)	107 (35)	18 (41)
Routine	141 (35)	3 (14)	14 (30)	110 (37)	14 (32)
Not assigned/unknown/other	36 (9)	4 (18)	5 (11)	26 (9)	4 (9)
Trauma history*					
Any	98 (24)	8 (36)	20 (42)	72 (24)	4 (9)
Road traffic accident	32 (8)	1 (5)	3 (6)	28 (9)	1 (3)
Motor or bicyclist	5 (1)	0 (0)	0 (0)	3 (1)	2 (5)
Assault	27 (7)	0 (0)	3 (6)	23 (8)	0 (0)
Pedestrian	1 (0)	0 (0)	0 (0)	1 (0)	0 (0)
Burn	8 (2)	3 (14)	5 (10)	3 (1)	0 (0)
Self-inflicted	4 (1)	2 (9)	2 (4)	2 (1)	0 (0)
Fall	21 (5)	2 (9)	7 (15)	12 (4)	1 (2)
Disposition					
Discharge from A&E	250 (62)	13 (59)	25 (52)	192 (64)	30 (68)
Admit to hospital	67 (17)	5 (23)	10 (21)	45 (15)	8 (18)
DOA	2 (1)	0 (0)	0 (0)	2 (1)	0 (0)
Death in A&E	2 (1)	0 (0)	0 (0)	1 (0)	1 (2)
DAMA/Eloped	15 (4)	0 (0)	1 (2)	13 (4)	1 (2)
Transfer to outside hospital	2 (1)	0 (0)	0 (0)	2 (1)	0 (0)
Consultant “Review”	25 (6)	1 (5)	5 (10)	18 (6)	2 (5)
“Missing/Incomplete” or Disposition field blank	39 (10)	3 (14)	7 (15)	29 (10)	2 (5)

* Patient reported

Figure 1. Kenya providence of origin of study patient population.

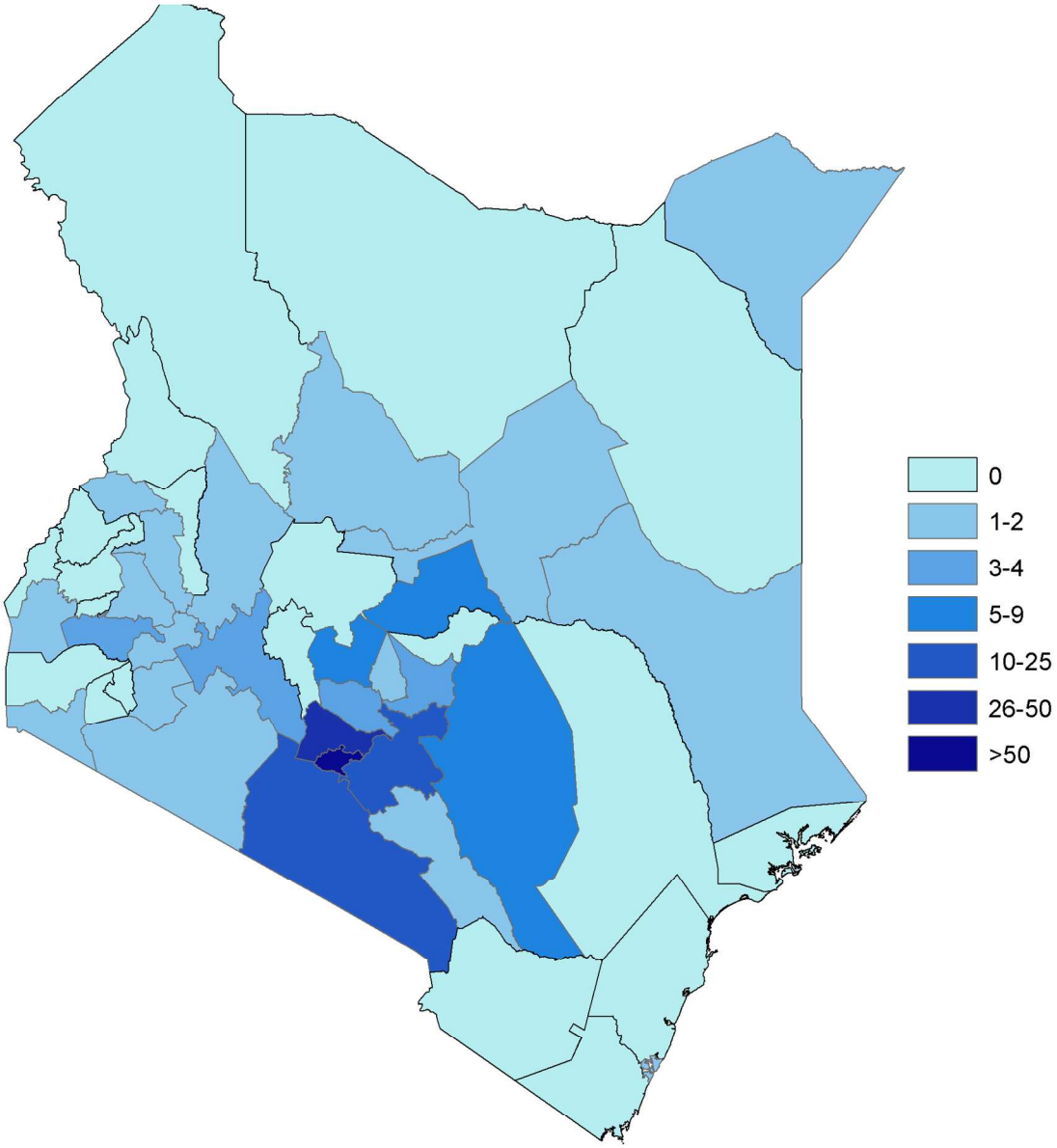


Table 2. Discharge diagnosis among patient population. All data are presented at n (%). (n=402)

World Health Organization ICD-10 chapter*	Discharge diagnosis n (%)
Injury	92 (23)
Signs and Symptoms	55 (14)
Genitourinary system	54 (13)
Circulatory	39 (10)
Injury Mechanism	38 (9)
Digestive system	34 (8)
Infectious and parasitic	30 (7)
Neoplasms	23 (6)
Musculoskeletal system	22 (5)
Pregnancy, childbirth, and the puerperium	18 (4)
Respiratory	16 (4)
Factors influencing health status	15 (4)
Skin and subcutaneous tissue	12 (3)
Diseases of Blood	9 (2)
Endocrine, nutritional and metabolic	6 (1)
Nervous system	6 (1)
Mental and behavioral	5 (1)
Congenital/chromosomal	4 (1)
Eye and adnexa	3 (1)
Perinatal period	2 (1)
Ear and mastoid process	1 (0)

* Chapters are not mutually exclusive

Table 3. Characteristics of patient population with head injury as defined by World Health Organization ICD-10 code block "Injury to the head" by age group. All data are presented as n (%) unless otherwise noted.

Characteristic	All patients (n=33)	≤4 years (n=2)	≤17 years (n=5)	18-64 years (n=28)	≥65 years (n=0)
Age, mean (SD)	29 (14)	3 (1)	5 (2)	33 (10)	
Sex					
Male	28 (85)	2 (100)	4 (80)	24 (86)	
Female	5 (15)	0 (0)	1 (20)	4 (14)	
Mode of arrival					
Private vehicle	1 (3)	0 (0)	0 (0)	1 (4)	
Taxi/bus	8 (24)	1 (50)	2 (40)	6 (21)	
Ambulance	12 (36)	1 (50)	1 (20)	11 (39)	
Walked	6 (18)	0 (0)	0 (0)	6 (21)	
Carried	3 (9)	0 (0)	2 (40)	1 (4)	
Wheelchair	1 (3)	0 (0)	0 (0)	1 (4)	
Unknown/blank	2 (6)	0 (0)	0 (0)	2 (7)	
Transferred					
Yes	13 (39)	2 (100)	2 (40)	11 (39)	
No	20 (61)	0 (0)	3 (60)	17 (61)	
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	
Acuity level					
Emergency (red)	4 (12)	0 (0)	1 (20)	3 (11)	
Very urgent (orange)	8 (24)	1 (50)	2 (40)	6 (21)	
Urgent (yellow)	12 (36)	0 (0)	0 (0)	12 (43)	
Routine	7 (21)	1 (50)	1 (20)	6 (21)	
Not assigned/unknown/other	2 (6)	0 (0)	1 (20)	1 (4)	
Trauma history*					
Any	31 (94)	1 (50)	4 (80)	27 (96)	
Road traffic accident	13 (39)	1 (50)	2 (40)	11 (39)	
Wearing seatbelt					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	
No	4 (31)	0 (0)	0 (0)	4 (36)	
Unknown	7 (54)	1 (100)	2 (100)	5 (45)	
Not recorded	2 (15)	0 (0)	0 (0)	2 (18)	
Motor or bicyclist	1 (3)	0 (0)	0 (0)	1 (4)	
Wearing helmet (n=1)					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	
No	0 (0)	0 (0)	0 (0)	0 (0)	
Unknown	1 (100)	0 (0)	0 (0)	1 (100)	
Assault	12 (36)	0 (0)	0 (0)	12 (43)	
Pedestrian	1 (3)	0 (0)	0 (0)	1 (4)	
Burn	0 (0)	0 (0)	0 (0)	0 (0)	
Self-inflicted	1 (3)	0 (0)	0 (0)	1 (4)	
Fall	3 (9)	0 (0)	2 (40)	1 (4)	
Disposition					
Discharge from A&E	19 (58)	1 (50)	3 (60)	16 (57)	
Admit to hospital	5 (15)	1 (50)	1 (20)	5 (18)	
DOA	0 (0)	0 (0)	0 (0)	0 (0)	
Death in A&E	1 (3)	0 (0)	0 (0)	1 (4)	
DAMA/Eloped	1 (3)	0 (0)	0 (0)	1 (4)	
Transfer to outside hospital	1 (3)	0 (0)	0 (0)	1 (4)	
Consultant "Review"	3 (9)	0 (0)	1 (20)	2 (7)	
"Missing/Incomplete" or Disposition field blank	2 (6)	0 (0)	0 (0)	2 (7)	

* Collected by research assistants. Categories are not mutually exclusive.

Table 4. HIV status among patient population. All data are presented as n (%).

HIV status	All patients (n=402)	≤4 years (n=22)	≤17 years (n=48)	18-64 years (n=302)	≥65 years (n=44)
Positive	9 (2)	0 (0)	0 (0)	9 (3)	0 (0)
Negative	172 (43)	13 (59)	28 (60)	129 (43)	12 (27)
Unknown	187 (47)	9 (41)	19 (40)	136 (45)	27 (61)
Declined	30 (8)	0 (0)	0 (0)	25 (8)	5 (11)

Figure 2. World Health Organization disease categories by age in the study population overall and by gender.

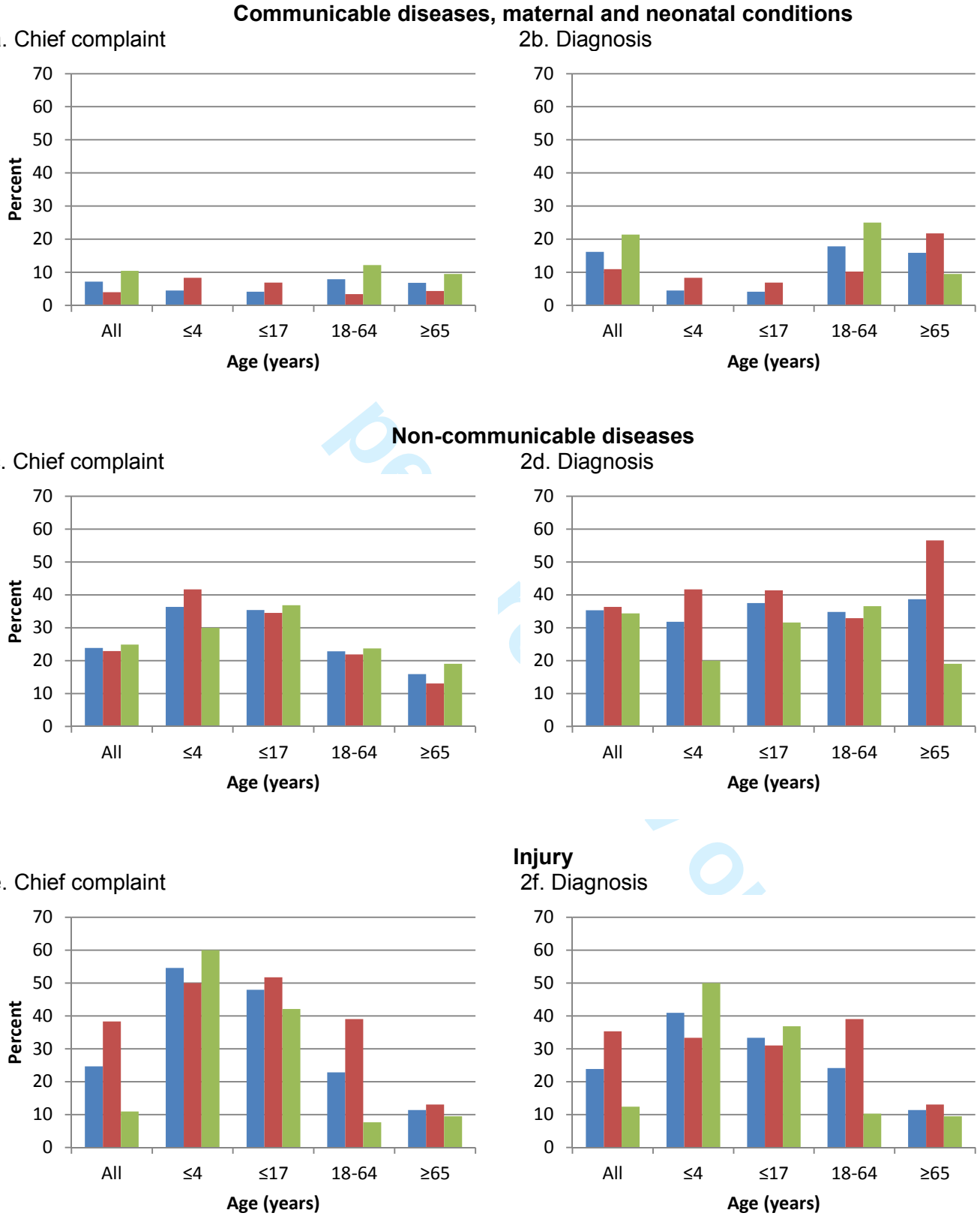


Figure 3a: Top 5 A&E Chief Complaints by each Global Burden of Disease category

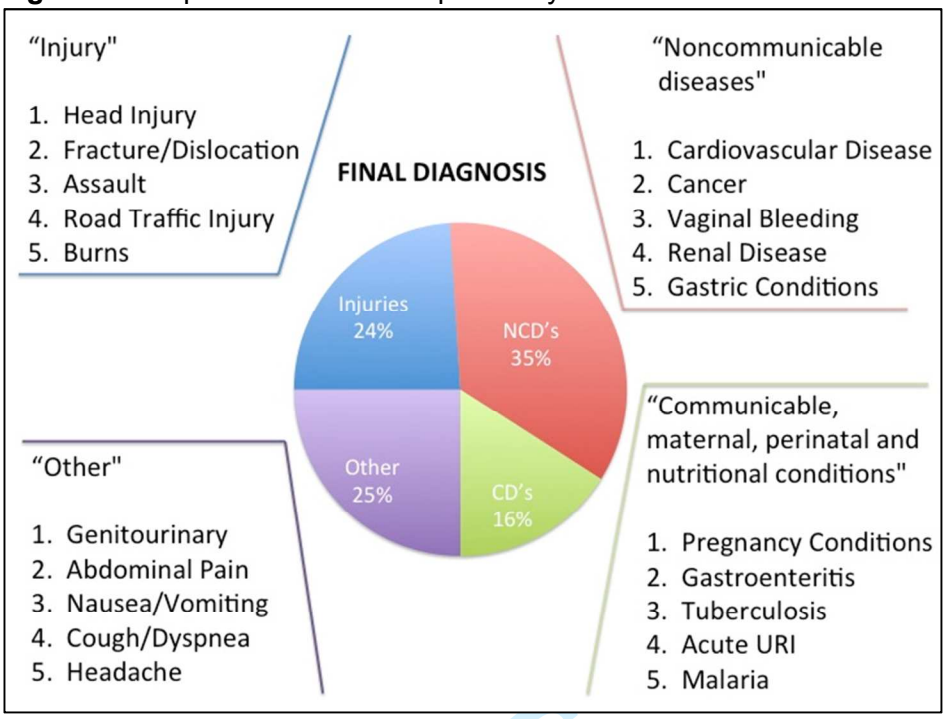
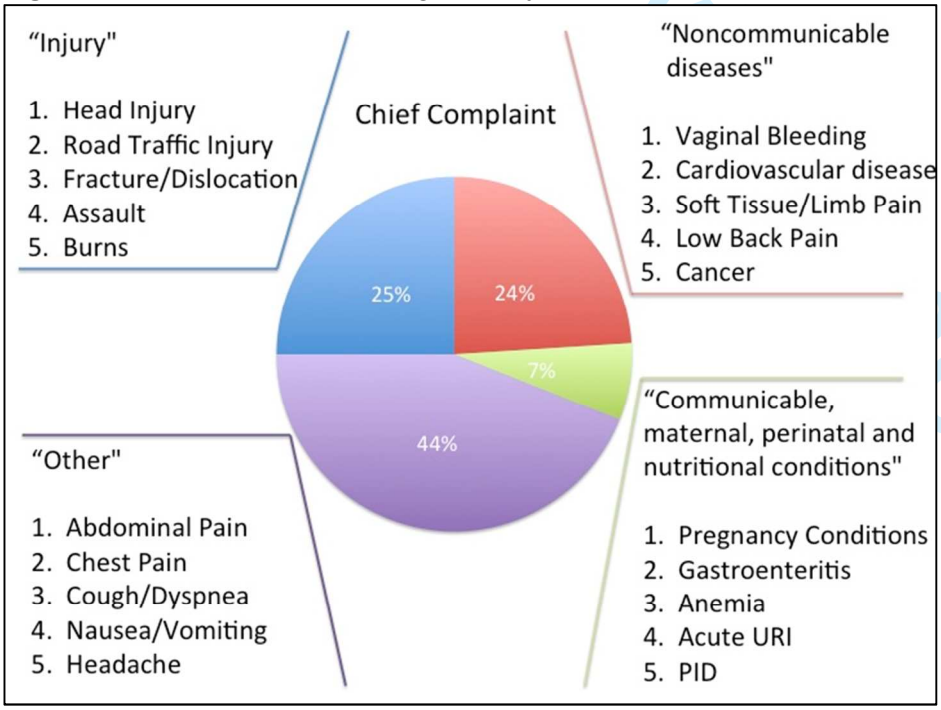


Figure 3b: Top 5 A&E Final Diagnosis by each Global Burden of Disease category



STROBE Guidelines for authors of CORR

To be used by authors of all observational clinical studies published in CORR. For this purpose a cohort study (the term used by STROBE) is considered a longitudinal study typically reporting outcomes of treatment in one or more cohorts; a case-control study is one identifying factors in outcomes; a cross-sectional study is one to identify the prevalence of factors or characteristics in a population at a single point in time.

This table is modified from and used with the permission of The STROBE Initiative, www.strobe-statement.org.

Modifications: We added a fourth column for authors to check inclusion. You must include all items in your manuscript unless the information is not applicable. Information on the study cohort (Items 13 and 14 in the STROBE guidelines) should be provided in Patients and Methods, not in Results; we have omitted the portions of the STROBE guidelines related to Results and Discussion (see our guidelines). The STROBE guidelines were developed for epidemiological studies; "exposed" or "exposure" have been modified with the words "treated" or "treatment."

STROBE Statement—Checklist of items that should be included in reports of ***case-control studies***

	Item No	Recommendation	Page number or N/A where not applicable
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, treatment, follow-up, and data collection	3,4
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Cross-sectional: 4
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of treated and untreated *Case-control study*—For matched studies, give matching criteria and the number of controls per case	

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on other treatments and potential confounders	Table 1: 15
		(b) Indicate number of participants with missing data for each variable of interest	Table 1: 15
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Variables	7	Clearly define all outcomes, treatments, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4*
Bias	9	Describe any efforts to address potential sources of bias	Limitations: 8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	4,5
		(*e*) Describe any sensitivity analyses	

*Give information separately for cases and controls.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

A prospective analysis of patient characteristics from the Accident and Emergency Department of Kenyatta National Hospital, Nairobi, Kenya

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A prospective analysis of patient characteristics from the Accident and Emergency Department of Kenyatta National Hospital, Nairobi, Kenya

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ABSTRACT

Background: Resource-limited settings are increasingly experiencing a "triple burden" of disease, comprised of trauma, non-communicable diseases, and known communicable disease patterns. However, the epidemiology of acute and emergency care is not well characterized and this limits efforts to further develop emergency care capacity.
Objective: To define the burden of disease by describing the patient population presenting to the Accident and Emergency Department (A&E) at Kenyatta National Hospital (KNH) in Kenya.
Methods: We completed a prospective descriptive assessment of patients in KNH's A&E obtained via systematic sampling over 3 months. Research assistants collected data directly from patients and their charts. Chief complaint and diagnosis codes were grouped for analysis. Patient demographic characteristics were described using the mean and standard deviation for age and n and percentages for categorical variables. ICD-10 codes were categorized by 2013 Global Burden of Disease Study methods.
Results: Data were collected prospectively on 402 patients with an average age of 36 years (SD 19), and of whom, 50% were female. Patients were most likely to arrive by taxi or bus (39%), walking (28%), or ambulance (17%). Thirty-five percent of patients were diagnosed with non-communicable diseases, 24% with injuries, and 16% with communicable diseases, maternal and neonatal conditions. Overall, head injury was the single most common final diagnosis and occurred in 32 (8%) patients. The most common patient-reported mechanism for head injury was road traffic accident (39%).
Conclusion: This study estimates the characteristics of the A&E population at a tertiary center in Kenya and highlights the triple burden of disease. Our findings emphasize the need for further development of emergency care resources and training to better address patient needs in resource-limited settings, such as KNH.

Keywords: Public Health, Trauma, Emergency Care Development, Emergency Medicine

STRENGTHS AND LIMITATIONS:

Strengths:

- Prospective and systematic sampling of Accident and Emergency Department patients via direct enrollment and chart review.
- This study highlights the growing burden of injuries and non-communicable diseases—compounding the existing burden of communicable conditions.
- The most common diagnosis and complaint, Head Injury, is elucidated by these findings.
- Results are grouped by the 2010 Global Burden of Disease study categories

Limitations:

- Kenyatta National Hospital (KNH) is a tertiary referral hospital; therefore the results may overestimate certain disease conditions in Kenya.
- Pediatric patients are underrepresented since KNH has a separate treatment area for non-traumatic patients 12 and under.
- Admission statistics may be underestimated as a result of difficulties in tracking patient flow in the A&E.

INTRODUCTION

In low- and middle- income countries (LMICs) stochastic infectious disease patterns are compounded by an increasing incidence of non-communicable diseases (such as heart disease and diabetes) and trauma (largely secondary to automotive accidents). This shifting epidemiology results in the well-described "triple burden of disease": a baseline infectious disease burden with increasing non-communicable disease, and trauma, highlighted in the 2010 Global Burden of Disease study.[1,2]

Resource-limited health systems in East Africa have a reduced ability to care for patients presenting with acute care needs.[3] Among their limitations is the widespread under-development of emergency care systems.[4,5] In most of Sub-Saharan Africa, Emergency Medicine is not a recognized specialty,[6] and there is an associated absence of data describing patients presenting for acute, emergent, and urgent care, as well as the overall burden of disease in this setting. Communicable diseases still receive a disproportionate share of health funding in LMICs,[7–10] which is also attributable to a lack of baseline data, hindering development of trauma and cardiac resuscitative care systems.[11] Resource limited countries would benefit from a combination of disease surveillance, health workforce education, and resource prioritization to address all categories of disease, particularly as it relates to emergency care.[12] Therefore, to continue to define the baseline burden of acute disease in this part of the world, we conducted a prospective, observational study, in the Accident and Emergency Department (A&E) of Kenyatta National Hospital (KNH) in Nairobi, Kenya. The primary objective of our study was to characterize the presenting complaint, medical conditions, diagnoses, and disposition of patients seen in the KNH A&E.

METHODS

Study Setting & Participants

This is a single site study at the largest, public hospital in Kenya that is an 1800-bed tertiary care facility. Emergency services at KNH provide care in three areas: the A&E; the Pediatric Emergency Unit (PEU); and the Outpatient Clinic. Providers in A&E care for adult patients presenting with high-acuity medical and surgical conditions as well as severely injured adults and children. The PEU provides medical care to children aged 0-12 years. Patients older than age 12 or injured (including burns) are directed to the A&E. The annual patient census of these combined areas in 2014 was 163,426, with 69,294 patients treated in the A&E.[13] The A&E is staffed by full-time and part-time medical officers and nurses, as well as nursing and emergency medical technician (EMT) students. Medical officers are physicians who have completed medical school and one year of internship. No medical officers have completed Emergency Medicine residency training; instead, they have varying expertise and post-graduate (consultant) training. Select A&E staff have completed the equivalent of Advanced Cardiac Life Support (ACLS), Advanced Trauma Life Support (ATLS), and possible disaster training. Many nurses have completed an additional one-year emergency nursing certification course, a nursing training program unique to KNH.

All patients access care in the A&E through a single triage point staffed by nurses, nursing students, and/or EMT students. At triage, patient information, including chief complaint

and limited vital signs are collected in paper logbooks; additional documentation is completed on one sheet of letter-sized paper. Patients are triaged as critical or non-critical. If critical, they are immediately directed to an acute resuscitation area in the A&E for care. If non-critical, patients are directed either to the Outpatient Clinic, to the PEU (age 12 and under) or to the A&E waiting area.

Data Collection

Patients were enrolled in this study by a team of research assistants (RAs) via convenience and systematic sampling of every sixth patient registered in triage during eight-hour shifts from March 11, 2015 to May 30, 2015. If a sixth patient was not eligible or unavailable for the study, the research assistants sought to enroll the very next (seventh) patient, and then resumed every sixth patient following that enrollment. Each research assistant enrolled patients approximately 40 hours per week and their 8 hour shifts included varying time frames across all 24 hours of the day and days of the week but were not randomized nor consecutive. This allowed a sampling of all time frames during the available working hours of the research assistants.

All patients presenting to A&E who could complete an informed written consent, or had next-of-kin available to consent, were eligible for this study. Patients were excluded if they could not consent and next-of-kin was not available, were unwilling, or were sent to a treatment area outside the A&E. An RA was placed in triage to identify every sixth patient. Two RAs completed consent and collected information from the patient and chart throughout the visit. Because patient visits extended outside of data collection shift times, a fourth research assistant completed the data collection and, if admitted, tracked patients in the hospital. Data was entered via electronic tablets into REDCap®,[14] a secure, online database, supported by the University of Minnesota.[15]

Data collected included age, sex, chief complaint, mode of arrival, transfer status, acuity level, patient-reported trauma history, discharge diagnoses, and disposition. If a patient reported a road traffic accident, he or she was asked if he or she was wearing a seatbelt. If a patient reported riding a motorcycle, he or she was asked about wearing a helmet. Patients were also given the opportunity to, but not required to, report their HIV status (if known).

Chief complaints and discharge diagnoses collected by research assistants were assigned International Classification of Disease 10 (ICD-10) codes.[16] This was completed by specially trained RAs and classifications for both common and rare diagnoses were reached through consensus among the group and with the oversight by the principal investigator. ICD-10 is the international standard for categorizing epidemiological and health management data and is used to classify diagnoses as well as reasons for consultation (chief complaint).[17] ICD-10 coding has been utilized in similar settings[18] and is utilized by electronic health records. In the event that KNH moves toward electronic record keeping, these statistics will be poised for comparison.

We aimed for a sample size that would be representative of the entire patient population. Our sample size (n= 402) was powered a priori to capture chief complaints/diagnoses that that occur in as few as 4% of the population with a precision of +/- 2%. Our sample provides an overview of common complaints at KNH over the specified time frame. We used the following formula for estimating the prevalence of disease in a standard population:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

n = sample size
Z = Z statistic for level of confidence
P = Expected prevalence or proportion
d = precision

Data Analysis

For descriptive purposes, chief complaint and diagnosis codes were grouped for analysis in the World Health Organization's twenty-one chapter format.[17] Additionally, we grouped codes in accordance with the 2010-2013 Global Burden of Disease studies.[2,19,20] This method partitions diagnoses in three main categories: 1) non-communicable diseases (NCD); 2) communicable diseases, maternal, and neonatal conditions; and 3) injuries. This provides a simple comparison between known overall global (and country-level) patterns of disease to diseases presenting acutely for care. To our knowledge, this has not been applied to the acute care setting prior to this study.

All data analysis was completed using STATA 14 (Stata Corp, College Station, TX) and mapping was completed using ArcGIS 10.1 (Esri, Redlands, CA). The University of Nairobi/KNH Ethics Review Committee and the University of North Carolina at Chapel Hill Institutional Review Board approved the study.

RESULTS

The A&E registered 14,956 patients during the study period.[13] We identified 449 patients for enrollment. Forty-seven patients deemed eligible were ultimately excluded, and 402 patients were prospectively enrolled. Reasons for exclusion included: 8 (17%) could not be consented due to a language barrier were in critical condition and/or next of kin were unavailable; 10 (21%) refused participation; 2 (4%) were sent to Labor and Delivery; 1 (2%) was sent to the Pediatric Emergency Unit (PEU); 3 (6%) were sent to other outpatient clinics; and 26 (55%) left the A&E before consent.

Presenting patient chief complaints and subsequent final A&E diagnoses were grouped according to three major categories of the Global Burden of Disease Study. Among chief complaints, 25% were injuries, 24% were non-communicable diseases, and 7% were communicable diseases and maternal or neonatal conditions (Figure 1). Forty-four percent were grouped as "other" according to this methodology. A&E final diagnoses were comprised of 24% injuries, 35% non-communicable diseases, and 16% were communicable diseases and maternal or neonatal conditions (Figure 2). Twenty-five percent were grouped "other". The top-five chief complaints and diagnoses are listed within each category in Figures 1 and 2.

The average age of participants was 36 years (standard deviation 19 years), and patients were 50% female. Patients were most likely to arrive via taxi or bus (39%), walking (28%), or ambulance (17%). During the study period, A&E nursing were undergoing training on the South African Triage Scale (SATS),[21] to replace the former gestalt method. Since the training was not completed at the time of data collection, trained RAs and the primary investigator used available patient information to estimate the triage level based on SATS methodology. Seven percent of

patients were triaged as "emergent," 14% as "very urgent,"35% as "urgent," 35% as "routine," and 9% "undesignated." Referrals/transfers from outside health centers comprised of 37% of subjects. The majority of patients (62%) were discharged and 17% percent were admitted. One percent were considered dead on arrival, 1% died in the A&E, 4% left against medical advice or eloped, 1% were transferred to another hospital, and 6% of patients underwent a medical "review"[i] or were evaluated by a subspecialist in the A&E. The remaining 10% of patients had missing or incomplete information on their chart, and the RAs were unable to ascertain their disposition (Table 1). The majority of patients were from Nairobi proper (Figure 3).

Overall, abdominal pain was the single most common chief complaint and occurred in 47 (12%) of patients. The most common WHO Chapter was injury (Table 2). Head injury was the single most common final diagnosis and occurred in 32 (8%) patients. The most common patient-reported mechanism for head injury was road traffic injury (RTI) (39%), followed by assault (36%) and fall (9%) (Table 3).

Forty-three percent of participants reported a negative HIV status. Comparatively, 2% reported being HIV positive, 47% reported an "unknown" status, and 8% declined to respond.

DISCUSSION

This study provides an important overview of patients presenting for emergency care in Kenya. Wachira et al. characterized patients presenting to a variety of A&Es across Kenya over a single 24-hour time period and found that trauma, respiratory tract infections, and malaria were the leading diagnoses.[22] House et al. conducted a more comprehensive analysis of A&E care by retrospectively analyzing all patients over a one-year period at Moi Teaching and Referral Hospital, a public tertiary hospital in western Kenya. The top-three A&E diagnoses were injuries, infections, and mental health disorders.[18] Additional studies have focused on patients with acute coronary syndrome[23] and emergency obstetrical care.[24] Our results demonstrate a "triple burden" of acute disease in the KNH A&E of non-communicable diseases (NCDs); communicable diseases, maternal and neonatal conditions (CD&Ms); and injuries, similar to the previously described triple burden of disease that is affecting Sub-Saharan Africa.[1,25]

In Kenya specifically, CD&Ms, CDs, and Injuries rank first, second and third, respectively for premature death (Years of Life Lost). Overwhelmingly, in 2015, CD&Ms were responsible for the most causes of death, premature death and disability[26]. However, our study demonstrates the opposite patterns of disease presenting for acute care; CD's were the most common cause, followed by Injuries, with the least presentations for CD&M's

Non-Communicable Diseases

NCDs account for 24% of chief complaints and 35% of A&E diagnoses. Among NCD's, cardiovascular disease was the most common condition and the second most common of chief complaints. In the Global Burden of Disease study, Lozano et al found that ischemic heart disease has become the greatest burden of disease worldwide, in terms of years of life lost

[i] Patients presenting for a medical "review" usually present with test results from a clinic or outside hospital for subspecialty evaluation. RAs were unable to ascertain the exact disposition of this entire category of patients but noted these patients were likely discharged and not found in the admission logbook.

(YLL).[2] However, the same study reports that in Eastern Africa, ischemic heart disease ranks #17 in YLL. Our results question whether current data systems in Eastern Africa accurately capture the burden of non-communicable disease and suggest that cardiovascular disease poses a greater public health concern than recognized. Global health initiatives in East Africa have typically prioritized important infectious diseases[27], which may overestimate of their contribution to the total disease burden. Additionally, media coverage (e.g., of the Ebola virus and Zika virus crises, etc.,)[28,29] influences public perception of the burden and impact of infectious diseases[30]. This altered public perception may, in turn, indirectly influence governmental and non-governmental funding priorities. Less well publicized is that NCDs are the most common cause of YLL[2], and age-matched death rates due to NCDs are higher in developing countries[31]. These facts, combined with the volume of NCDs found at KNH, highlights the need for preventive efforts and improving acute care systems in Kenya to respond to the growing acute manifestations of chronic disease.

Injuries

Injuries account for approximately one quarter of both chief complaints (25%) and final diagnoses (24%). Head injury was by far the most common—comprising 26% of injury diagnoses and affecting 8% of all patients. The most common reported mechanism of head injury was RTI (39%). A similar trend was found at Moi Teaching and Referral Hospital in Western Kenya, where RTI was the most common chief complaint, and head injury was in the top five diagnoses.[18] Additionally, in a study from Kampala, Uganda (neighboring Kenya), RTIs were the most common causes of injury for all age groups and seventy-five percent of admitted trauma mortality had concomitant head injury[32]. In Kenya, there were approximately 3,000 reported fatalities from RTI in 2010.[33] Road traffic injury has increased from the 13th to the 11th leading cause of years of life lost in Kenya, between 1990-2010[34]. This trend is likely to increase, given the 40-fold increase in motorcycle registration between 2006 and 2011[35] and with over 200,000 new motor vehicle registrations occurring annually from 2011-2014.[36] This trend is consistent worldwide, as RTI has increased from the 14th to the 8th leading cause of global years of life lost, usurping diabetes, malaria, and tuberculosis as a leading cause of global mortality.[2] Further, traumatic brain injury (TBI), most commonly caused by RTIs is likely under-reported in Africa, due to poor access to care and absence of injury surveillance.[37] The international collaborative trauma study, Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage (CRASH) predicts that TBI patients in LMICs have over twice the odds of dying following severe TBI (OR 2.23, 95% CI 1.51–3.30)[38]. The high incidence of head injuries related to road traffic crashes in Kenya should raise concern.

Studies from LMICs demonstrate that legislative-based interventions are the single most effective strategy for reducing road traffic injuries and death due to RTIs.[39] Of the 14 patients with head injuries from RTIs in our study, none reported use of seatbelts and/or helmets. This is lower than previously reported by Saidi et al in 2014 in admitted trauma patients at KNH, where 11.6% of occupants wore seatbelts, and 18.2% of motorcycle passengers wore helmets.[40] This discrepancy may be due to the relatively low number of patients in this category and reliance on patient reporting. While motorcycle helmet, seat-belt, and drunk driving laws exist in Kenya, they are poorly enforced.[33] In 2010, a consortium including the World Health Organization, Johns Hopkins University (JHU), and local Kenyan partners launched the Road Safety in 10 Countries (RS-10) campaign. This program aims to reduce mortality from RTIs through social

marketing, strengthening public health legislation, training local law enforcement, and improving trauma care and data surveillance systems.[41] This multi-faceted approach holds promise, as there has been a modest increase in helmet utilization and decrease in road speeds as a result.[42]

Communicable, Maternal, Perinatal and Nutritional Disease

The third major GBD study category, infectious diseases and maternal or neonatal conditions, appears to comprise a lesser share of the total burden of acute disease at KNH, comprising only 16% of final diagnoses. This is curious, given that top five causes of death in this category in Kenya are from HIV/AIDS, diarrhea, lower respiratory tract infections, neonatal encephalopathy, preterm births.[26]

The contribution of chronic infectious diseases, such as HIV, on acute health conditions is not well elucidated by this study. The HIV prevalence in this study was 2% (self-reported), which is lower than the documented HIV prevalence among adults aged 15-49 years in Kenya in 2014 of 5.3%.[43] However, almost half (47%) of patients in our study reported an unknown HIV status. Therefore, it is possible that there is a hidden HIV burden among patients at KNH's A&E, who largely originate from Nairobi's large urban areas. HIV testing in the Emergency Department is well studied and practiced[44,45] and is crucial for vulnerable populations, whose only access to healthcare may be the Emergency Department.[46] As such, the A&E represents an opportunity for improved detection and surveillance of infectious diseases in Kenya and other LMICs.

Finally, this category includes maternal and neonatal conditions. As a primarily adult A&E with a separate PEU, many neonatal conditions are evaluated in the PEU, such as lower respiratory illnesses and diarrheal diseases, which rank #2 and #3 for YLL in Kenya, respectively[47]. Conducting a similar study in the PEU would provide a more comprehensive understanding of these pediatric conditions.

Other (Undifferentiated Disease)

Third category of "other" consist of diagnoses and chief complaints that do not fit into the GBD categorization. These are syndromic complaints such as "abdominal pain", "chest pain" and "headache". These complaints fall under "symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" which comprised the majority of our chief complaints (44%). These undifferentiated complaints were better categorized into one of the three GBD categories as their final diagnoses were elucidated (undifferentiated final diagnoses made up 25%). There is a need for specialized training for evaluating patients with undifferentiated and syndromic complaints, an area where Emergency Medicine (EM) training is well suited.[48] The specialty of EM is by nature multidisciplinary, allowing for the rapid triage and treatment of acute injury or illness of all organ systems and populations. A proficiency in stabilizing therapeutics and procedures acquired from a multitude of medical and surgical specialties, gives the EM-trained physician a decided advantage and efficiency for treating undifferentiated A&E patients. Further, EM- trained physicians demonstrate improved consistency and quality of care in Emergency Departments.[49–51] However, EM as a specialty, is not recognized by the Kenya Medical and Dentists Board (KMDB). Emergency Medicine development in Kenya starts with recognizing EM as a specialty, which could allow residency-

trained emergency physicians to form local faculty for training of health care providers in Emergency Medicine.[6]

Study Limitations

The ratio of Global Burden of Disease categories presenting to KNH appears different than Kenya's country level burden of disease pattern. This could be due to the lack of pediatric data as our study does not include patients who presented to the separate Pediatric Emergency Unit. The pediatric patients that we captured were skewed towards the critically ill and injured pediatric population. A study describing the population presenting to the PEU would certainly add to our body of knowledge in this area. This could also be due to seasonal variation in presentations. Finally, the 25% of final diagnoses that remain in the "undifferentiated" category may also contribute to this difference.

As a tertiary care hospital, the burden of disease detected at KNH will be skewed towards higher acuity conditions than would be present in secondary or primary level centers with emergency care. Therefore, the generalizations of emergency care burden to the other hospital settings in LMICs should be made cautiously. However, the results of this study, combined with the findings at Moi Teaching and Referral Hospital provide an excellent snapshot of tertiary care epidemiology in Kenya.[18] Future studies evaluating district and rural A&Es, combined with our data, would provide an improved picture of the acute disease burden in Kenya.

A potential pitfall of using GBD categories to assess emergency care is the imprecision in grouping chief complaints and undifferentiated illness. The net effect, when comparing to other GBD studies, would be an underestimation of the burden of acute disease. Since chief complaints may better characterize acute disease[48], it could be argued that future GBD should include variables to capture this data. Specifically, concessions to better capture the ICD-10 category, "symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" would be valuable.

There were limitations due to current A&E data systems. The A&E is high volume with paper based charting and minimal patient tracking. There are no centralized patient tracking boards or electronic tracking systems. There is variability in the extent of documentation among health providers. Research assistants had to personally follow their enrolled subjects throughout each shift. Our RAs noted that some patients bypassed triage and were not recorded in the triage book, and therefore were not included in their systematic sampling. These missing data limit the accuracy of the disposition estimates. These challenges were not anticipated and will be taken into account in the design of future studies. Additionally, although it would be ideal to enroll every patient for the most accurate description of the total burden of disease, systems for a complete prospective registry in this setting are currently not available.

In addition, the requirement for an informed written consent for this registry project forced sampling bias, as critically ill patients could not be consented, and therefore were excluded. This combined with difficulties tracking patient disposition, it is likely that actual admission and death rates are higher than our estimates. Based on our review of their admission logbooks and the total patient census, we estimate that 30% of patients typically are admitted, appreciably higher than our results. As long as written consent is required and due to the limitations of a prospective study design in this setting, it likely that a retrospective study may yield more accurate data for certain statistics, such as admission rates. However, retrospective

studies have other associated limitations and, given our experience, it is likely that in LMIC A&Es, retrospective and prospective studies fulfill different roles.

CONCLUSIONS

This pilot study is a novel, prospective study characterizing the A&E population at a tertiary care center in Kenya. This study highlights the growing burden of injuries and non-communicable diseases—compounding the existing burden of communicable conditions, presenting for acute care. The majority of patients are presenting with acute conditions related to non-communicable diseases and injuries. The prevalence of infectious disease is likely underreported by this study. Given large patient volumes, shifting epidemiology, and the growing recognition of the importance of emergency care, a comprehensive understanding of the acute care needs at Kenya's largest referral center is long overdue, both to guide patient care in the acute setting and to inform broader public health and policy agendas. Our findings provide an initial frame of reference in which to guide development of emergency resources and training at KNH.

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Contributors

JM was responsible for the conception of idea for study design, draft of protocol, data collection, analysis, and manuscript initiation, reading and approval of final manuscript. KE prepared the RedCap Database. KH was responsible for the statistical analysis and key manuscript formatting. AW was instrumental in the development of the final protocol. KE, AW, AM, andkatie IM assisted with data collection. KH, KE, AW, AM, VM, SD and IM were responsible for the analysis and revisions of study design and protocol, analysis and critical revisions of manuscript. All authors had the opportunity to read and approve the final manuscript.

Competing Interests

None declared.

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Data sharing statement

The database is conjointly owned between the individual co-investigators and their respective departments, including the University of Nairobi and the Kenyatta National Hospital Accident and Emergency Department. The ethical approval for this study obliges us to follow our data sharing agreement (available for review) and to protect the privacy of participants. According to our agreement (filed through the UofN/KNH ERC in 2014-2015), requests for access to this database for data analysis from investigators or institutions outside of the owners will be considered, pending stipulations of Data Use Agreement are observed and that all owners are made aware. Readers can apply for access and permission to this database by contacting the project coordinator at justin_myers@med.unc.edu or through contact with any of the co-investigators.

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Table 1. Characteristics of patient population by age group. All data are presented as n (%) unless otherwise noted.

Characteristic	All patients (n=402)	<5 years (n=22)	≤17 years (n=48)	18-64 years (n=302)	≥65 years (n=44)
Age, mean (SD) (n=394)	36 (19)	1 (2)	7 (6)	35 (12)	75 (7)
Sex					
Male	201 (50)	12 (55)	29 (60)	146 (48)	23 (52)
Female	201 (50)	10 (45)	19 (40)	156 (52)	21 (48)
Mode of arrival					
Private vehicle	16 (4)	0 (0)	0 (0)	12 (4)	4 (9)
Taxi/bus	156 (39)	8 (36)	19 (40)	114 (38)	21 (48)
Ambulance	69 (17)	5 (23)	7 (15)	53 (18)	5 (11)
Walked	113 (28)	0 (0)	8 (17)	96 (32)	8 (18)
Carried	30 (8)	8 (36)	12 (25)	16 (5)	2 (5)
Wheelchair	10 (3)	0 (0)	1 (2)	4 (1)	4 (9)
Unknown/blank	5 (1)	1 (5)	1 (2)	4 (1)	0 (0)
Transferred					
Yes	147 (37)	13 (59)	20 (43)	104 (35)	20 (45)
No	238 (60)	8 (36)	25 (53)	188 (63)	21 (48)
Unknown	13 (3)	1 (5)	2 (4)	7 (2)	3 (7)
Acuity level (Estimated)*					
Emergency (red)	29 (7)	3 (14)	5 (11)	20 (7)	4 (9)
Very urgent (orange)	55 (14)	4 (18)	11 (23)	39 (13)	4 (9)
Urgent (yellow)	140 (35)	8 (36)	12 (26)	107 (35)	18 (41)
Routine	141 (35)	3 (14)	14 (30)	110 (37)	14 (32)
Not assigned/unknown/other	36 (9)	4 (18)	5 (11)	26 (9)	4 (9)
Trauma history**					
Any	98 (24)	8 (36)	20 (42)	72 (24)	4 (9)
Road traffic accident	32 (8)	1 (5)	3 (6)	28 (9)	1 (3)
Motor or bicyclist	5 (1)	0 (0)	0 (0)	3 (1)	2 (5)
Assault	27 (7)	0 (0)	3 (6)	23 (8)	0 (0)
Pedestrian	1 (0)	0 (0)	0 (0)	1 (0)	0 (0)
Burn	8 (2)	3 (14)	5 (10)	3 (1)	0 (0)
Self-inflicted	4 (1)	2 (9)	2 (4)	2 (1)	0 (0)
Fall	21 (5)	2 (9)	7 (15)	12 (4)	1 (2)
Disposition					
Discharge from A&E	250 (62)	13 (59)	25 (52)	192 (64)	30 (68)
Admit to hospital	67 (17)	5 (23)	10 (21)	45 (15)	8 (18)
DOA	2 (1)	0 (0)	0 (0)	2 (1)	0 (0)
Death in A&E	2 (1)	0 (0)	0 (0)	1 (0)	1 (2)
DAMA/Eloped	15 (4)	0 (0)	1 (2)	13 (4)	1 (2)
Transfer to outside hospital	2 (1)	0 (0)	0 (0)	2 (1)	0 (0)
Consultant “Review”	25 (6)	1 (5)	5 (10)	18 (6)	2 (5)
“Missing/Incomplete” or Disposition field blank	39 (10)	3 (14)	7 (15)	29 (10)	2 (5)

*Determined by research assistants and/or primary investigator utilizing the South African Triage Scale(SATS)[21]
**Patient reported

Table 2. Discharge diagnosis among patient population. All data are presented at n (%). (n=402)

World Health Organization ICD-10 chapter*	Discharge diagnosis n (%)
Injury	92 (23)
Signs and Symptoms	55 (14)
Genitourinary system	54 (13)
Circulatory	39 (10)
Injury Mechanism	38 (9)
Digestive system	34 (8)
Infectious and parasitic	30 (7)
Neoplasms	23 (6)
Musculoskeletal system	22 (5)
Pregnancy, childbirth, and the puerperium	18 (4)
Respiratory	16 (4)
Factors influencing health status	15 (4)
Skin and subcutaneous tissue	12 (3)
Diseases of Blood	9 (2)
Endocrine, nutritional and metabolic	6 (1)
Nervous system	6 (1)
Mental and behavioral	5 (1)
Congenital/chromosomal	4 (1)
Eye and adnexa	3 (1)
Perinatal period	2 (1)
Ear and mastoid process	1 (0)

* Chapters are not mutually exclusive

Table 3. Characteristics of patient population with head injury as defined by World Health Organization ICD-10 code block "Injury to the head" by age group. All data are presented as n (%) unless otherwise noted.

Characteristic	All patients (n=33)	<5 years (n=2)	≤17 years (n=5)	18-64 years (n=28)	≥65 years (n=0)
Age, mean (SD)	29 (14)	3 (1)	5 (2)	33 (10)	
Sex					
Male	28 (85)	2 (100)	4 (80)	24 (86)	
Female	5 (15)	0 (0)	1 (20)	4 (14)	
Mode of arrival					
Private vehicle	1 (3)	0 (0)	0 (0)	1 (4)	
Taxi/bus	8 (24)	1 (50)	2 (40)	6 (21)	
Ambulance	12 (36)	1 (50)	1 (20)	11 (39)	
Walked	6 (18)	0 (0)	0 (0)	6 (21)	
Carried	3 (9)	0 (0)	2 (40)	1 (4)	
Wheelchair	1 (3)	0 (0)	0 (0)	1 (4)	
Unknown/blank	2 (6)	0 (0)	0 (0)	2 (7)	
Transferred					
Yes	13 (39)	2 (100)	2 (40)	11 (39)	
No	20 (61)	0 (0)	3 (60)	17 (61)	
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	
Acuity level (Estimated)*					
Emergency (red)	4 (12)	0 (0)	1 (20)	3 (11)	
Very urgent (orange)	8 (24)	1 (50)	2 (40)	6 (21)	
Urgent (yellow)	12 (36)	0 (0)	0 (0)	12 (43)	
Routine	7 (21)	1 (50)	1 (20)	6 (21)	
Not assigned/unknown/other	2 (6)	0 (0)	1 (20)	1 (4)	
Trauma history**					
Any	31 (94)	1 (50)	4 (80)	27 (96)	
Road traffic accident	13 (39)	1 (50)	2 (40)	11 (39)	
Wearing seatbelt					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	
No	4 (31)	0 (0)	0 (0)	4 (36)	
Unknown	7 (54)	1 (100)	2 (100)	5 (45)	
Not recorded	2 (15)	0 (0)	0 (0)	2 (18)	
Motor or bicyclist	1 (3)	0 (0)	0 (0)	1 (4)	
Wearing helmet (n=1)					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	
No	0 (0)	0 (0)	0 (0)	0 (0)	
Unknown	1 (100)	0 (0)	0 (0)	1 (100)	
Assault	12 (36)	0 (0)	0 (0)	12 (43)	
Pedestrian	1 (3)	0 (0)	0 (0)	1 (4)	
Burn	0 (0)	0 (0)	0 (0)	0 (0)	
Self-inflicted	1 (3)	0 (0)	0 (0)	1 (4)	
Fall	3 (9)	0 (0)	2 (40)	1 (4)	
Disposition					
Discharge from A&E	19 (58)	1 (50)	3 (60)	16 (57)	
Admit to hospital	5 (15)	1 (50)	1 (20)	5 (18)	
DOA	0 (0)	0 (0)	0 (0)	0 (0)	
Death in A&E	1 (3)	0 (0)	0 (0)	1 (4)	
DAMA/Eloped	1 (3)	0 (0)	0 (0)	1 (4)	
Transfer to outside hospital	1 (3)	0 (0)	0 (0)	1 (4)	
Consultant "Review"	3 (9)	0 (0)	1 (20)	2 (7)	
"Missing/Incomplete" or Disposition field blank	2 (6)	0 (0)	0 (0)	2 (7)	

*Determined by research assistants and/or primary investigator utilizing the South African Triage Scale(SATS)[21]

** Collected by research assistants. Categories are not mutually exclusive.

Figure 1: Top 5 A&E Chief Complaints by each Global Burden of Disease category

Figure 2: Top 5 A&E Final Diagnoses by each Global Burden of Disease category

Figure 3: Kenya providence of origin of study patient population

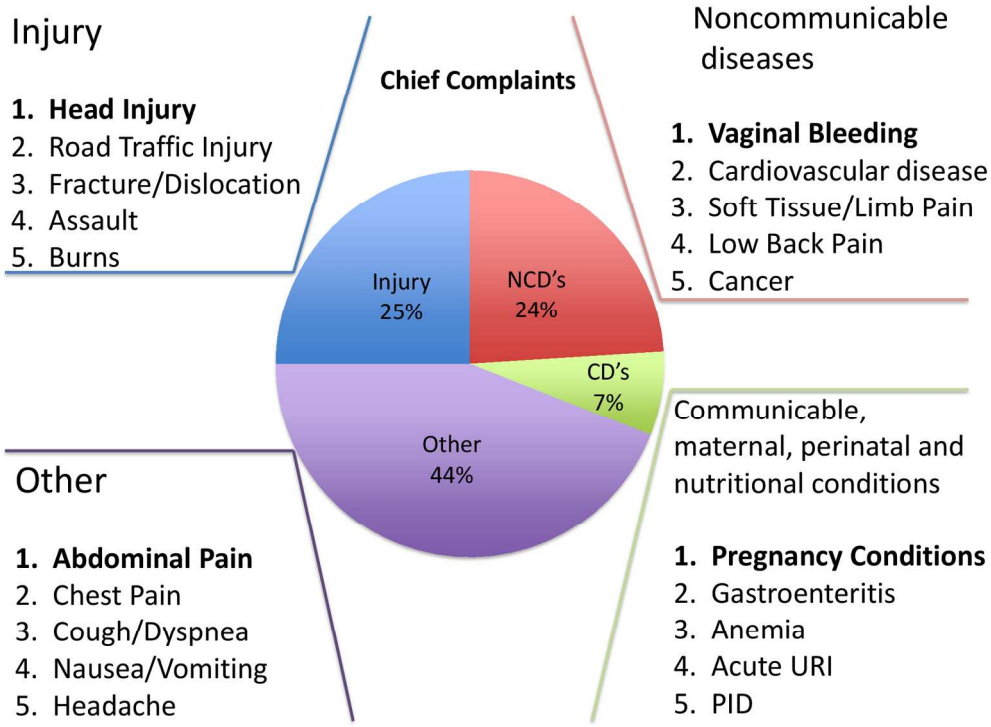

Figure 1: Top 5 A&E Chief Complaints by each Global Burden of Disease category

169x127mm (300 x 300 DPI)

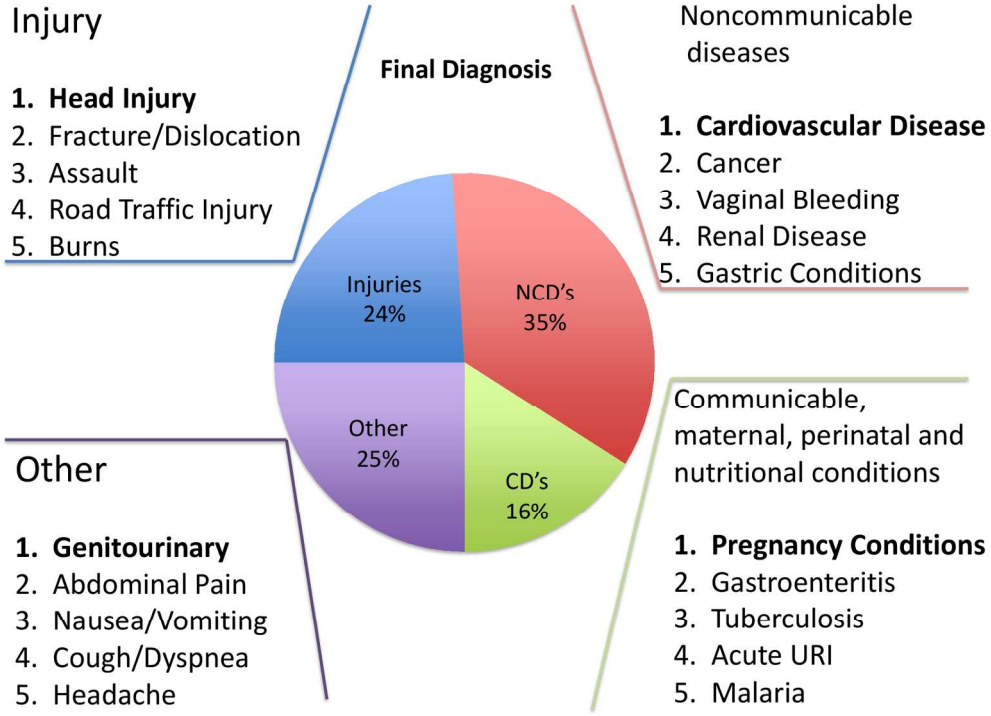

Figure 2: Top 5 A&E Final Diagnoses by each Global Burden of Disease category

169x127mm (300 x 300 DPI)

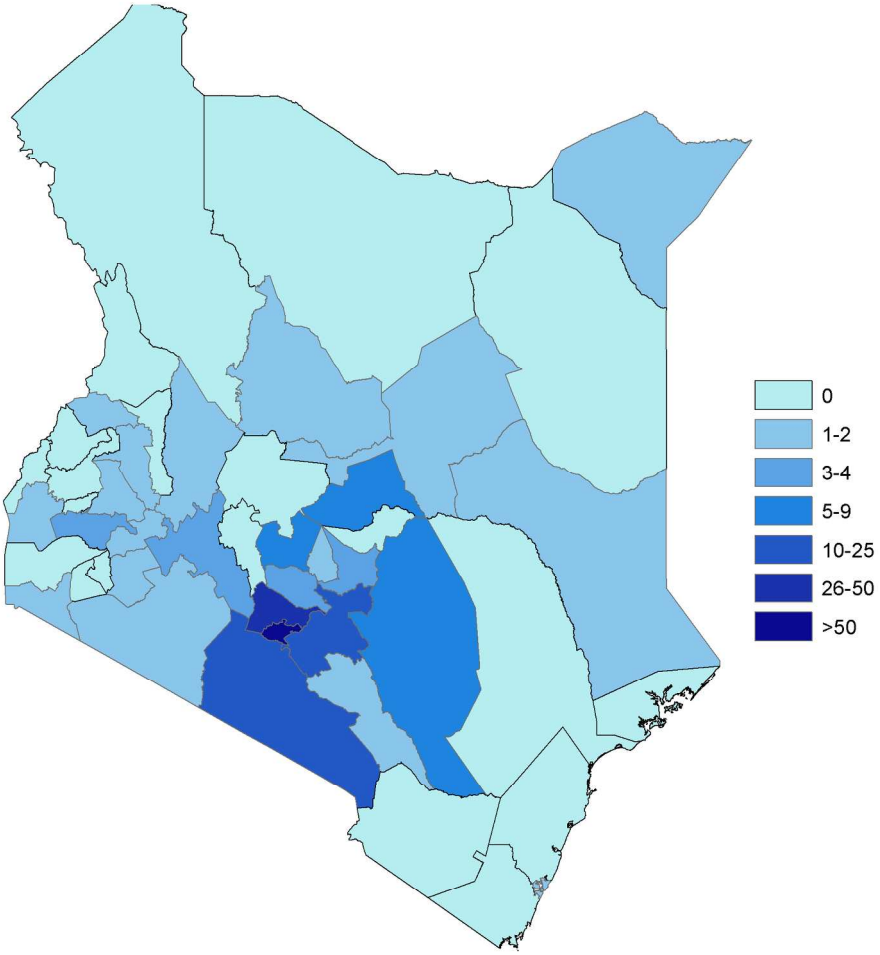

Figure 3: Kenya providence of origin of study patient population

185x193mm (300 x 300 DPI)

STROBE Guidelines for authors of CORR

To be used by authors of all observational clinical studies published in CORR. For this purpose a cohort study (the term used by STROBE) is considered a longitudinal study typically reporting outcomes of treatment in one or more cohorts; a case-control study is one identifying factors in outcomes; a cross-sectional study is one to identify the prevalence of factors or characteristics in a population at a single point in time.

This table is modified from and used with the permission of The STROBE Initiative, www.strobe-statement.org.

Modifications: We added a fourth column for authors to check inclusion. You must include all items in your manuscript unless the information is not applicable. Information on the study cohort (Items 13 and 14 in the STROBE guidelines) should be provided in Patients and Methods, not in Results; we have omitted the portions of the STROBE guidelines related to Results and Discussion (see our guidelines). The STROBE guidelines were developed for epidemiological studies; "exposed" or "exposure" have been modified with the words "treated" or "treatment."

STROBE Statement—Checklist of items that should be included in reports of ***case-control studies***

	Item No	Recommendation	Page number or N/A where not applicable
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, treatment, follow-up, and data collection	3,4
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Cross-sectional: 3,4
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of treated and untreated *Case-control study*—For matched studies, give matching criteria and the number of controls per case	

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	4
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on other treatments and potential confounders	Table 1: 16
		(b) Indicate number of participants with missing data for each variable of interest	Table 1: 16
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Variables	7	Clearly define all outcomes, treatments, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*3,4*
Bias	9	Describe any efforts to address potential sources of bias	Limitations: 9,10
Study size	10	Explain how the study size was arrived at	4,5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	4,5
		(*e*) Describe any sensitivity analyses	

*Give information separately for cases and controls.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

Patient characteristics of the Accident and Emergency Department of Kenyatta National Hospital, Nairobi, Kenya – a cross-sectional, prospective analysis

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Patient characteristics of the Accident and Emergency Department of Kenyatta National Hospital, Nairobi, Kenya – a cross-sectional, prospective analysis

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ABSTRACT

Background: Resource-limited settings are increasingly experiencing a "triple burden" of disease, comprised of trauma, non-communicable diseases, and known communicable disease patterns. However, the epidemiology of acute and emergency care is not well characterized and this limits efforts to further develop emergency care capacity.
Objective: To define the burden of disease by describing the patient population presenting to the Accident and Emergency Department (A&E) at Kenyatta National Hospital (KNH) in Kenya.
Methods: We completed a prospective descriptive assessment of patients in KNH's A&E obtained via systematic sampling over 3 months. Research assistants collected data directly from patients and their charts. Chief complaint and diagnosis codes were grouped for analysis. Patient demographic characteristics were described using the mean and standard deviation for age and n and percentages for categorical variables. ICD-10 codes were categorized by 2013 Global Burden of Disease Study methods.
Results: Data were collected prospectively on 402 patients with an average age of 36 years (SD 19), and of whom, 50% were female. Patients were most likely to arrive by taxi or bus (39%), walking (28%), or ambulance (17%). Thirty-five percent of patients were diagnosed with non-communicable diseases, 24% with injuries, and 16% with communicable diseases, maternal and neonatal conditions. Overall, head injury was the single most common final diagnosis and occurred in 32 (8%) patients. The most common patient-reported mechanism for head injury was road traffic accident (39%).
Conclusion: This study estimates the characteristics of the A&E population at a tertiary center in Kenya and highlights the triple burden of disease. Our findings emphasize the need for further development of emergency care resources and training to better address patient needs in resource-limited settings, such as KNH.

Keywords: Public Health, Trauma, Emergency Care Development, Emergency Medicine

STRENGTHS AND LIMITATIONS:

Strengths:

- Prospective and systematic sampling of Accident and Emergency Department patients via direct enrollment and chart review.
- This study highlights the growing burden of injuries and non-communicable diseases—compounding the existing burden of communicable conditions.
- One of the most common diagnoses and complaints, Head Injury, is elucidated by these findings.
- Results are grouped by the 2010 Global Burden of Disease study categories

Limitations:

- Kenyatta National Hospital (KNH) is a tertiary referral hospital; therefore the results may overestimate certain disease conditions in Kenya.
- Pediatric patients are underrepresented since KNH has a separate treatment area for non-traumatic patients 12 and under.
- Admission statistics may be underestimated as a result of difficulties in tracking patient flow in the A&E.

INTRODUCTION

In low- and middle- income countries (LMICs) stochastic infectious disease patterns are compounded by an increasing incidence of non-communicable diseases (such as heart disease and diabetes) and trauma (largely secondary to automotive accidents). This shifting epidemiology results in the well-described "triple burden of disease": a baseline infectious disease burden with increasing non-communicable disease, and trauma, highlighted in the 2010 Global Burden of Disease study.[1,2]

Resource-limited health systems in East Africa have a reduced ability to care for patients presenting with acute care needs.[3] Among their limitations is the widespread under-development of emergency care systems.[4,5] In most of Sub-Saharan Africa, Emergency Medicine is not a recognized specialty,[6] and there is an associated absence of data describing patients presenting for acute, emergent, and urgent care, as well as the overall burden of disease in this setting. Communicable diseases still receive a disproportionate share of health funding in LMICs,[7–10] which is also attributable to a lack of baseline data, hindering development of trauma and cardiac resuscitative care systems.[11] Resource limited countries would benefit from a combination of disease surveillance, health workforce education, and resource prioritization to address all categories of disease, particularly as it relates to emergency care.[12] Therefore, to continue to define the baseline burden of acute disease in this part of the world, we conducted a prospective, observational study, in the Accident and Emergency Department (A&E) of Kenyatta National Hospital (KNH) in Nairobi, Kenya. The primary objective of our study was to characterize the presenting complaint, medical conditions, diagnoses, and disposition of patients seen in the KNH A&E.

METHODS

Study Setting & Participants

This is a single site study at the largest, public hospital in Kenya that is an 1800-bed tertiary care facility. Emergency services at KNH provide care in three areas: the A&E; the Pediatric Emergency Unit (PEU); and the Outpatient Clinic. Providers in A&E care for adult patients presenting with high-acuity medical and surgical conditions as well as severely injured adults and children. The PEU provides medical care to children aged 0-12 years. Patients older than age 12 or injured (including burns) are directed to the A&E. The annual patient census of these combined areas in 2014 was 163,426, with 69,294 patients treated in the A&E.[13] The A&E is staffed by full-time and part-time medical officers and nurses, as well as nursing and emergency medical technician (EMT) students. Medical officers are physicians who have completed medical school and one year of internship. No medical officers have completed Emergency Medicine residency training; instead, they have varying expertise and post-graduate (consultant) training. Select A&E staff have completed the equivalent of Advanced Cardiac Life Support (ACLS), Advanced Trauma Life Support (ATLS), and possible disaster training. Many nurses have completed an additional one-year emergency nursing certification course, a nursing training program unique to KNH.

All patients access care in the A&E through a single triage point staffed by nurses, nursing students, and/or EMT students. At triage, patient information, including chief complaint and limited vital signs are collected in paper logbooks; additional documentation is completed on one sheet of letter-sized paper. Patients are triaged as critical or non-critical. If critical, they are immediately directed to an acute resuscitation area in the A&E for care. If non-critical, patients are directed either to the Outpatient Clinic, to the PEU (age 12 and under) or to the A&E waiting area.

Data Collection

Patients were enrolled in this study by a team of research assistants (RAs) via convenience and systematic sampling of every sixth patient registered in triage during eight-hour shifts from March 11, 2015 to May 30, 2015. If a sixth patient was not eligible or unavailable for the study, the research assistants sought to enroll the very next (seventh) patient, and then resumed every sixth patient following that enrollment. Each research assistant enrolled patients approximately 40 hours per week and their 8 hour shifts included varying time frames across all 24 hours of the day and days of the week but were not randomized nor consecutive. This allowed a sampling of all time frames during the available working hours of the research assistants.

All patients presenting to A&E who could complete an informed written consent, or had next-of-kin available to consent, were eligible for this study. Patients were excluded if they could not consent and next-of-kin was not available, were unwilling, or were sent to a treatment area outside the A&E. The first RA was placed in triage to identify every sixth patient. The second and third RAs completed consent, and collected initial information from the patient and chart throughout the visit. Because patient visits extended outside of data collection shift times, a fourth research assistant completed the data collection and, if admitted, tracked patients in the hospital. Data was entered via electronic tablets into REDCap®,[14] a secure, online database, supported by the University of Minnesota.[15]

Data collected included age, sex, chief complaint, mode of arrival, transfer status, acuity level, patient-reported trauma history, discharge diagnoses, and disposition. If a patient reported a road traffic accident, he or she was asked if he or she was wearing a seatbelt. If a patient reported riding a motorcycle, he or she was asked about wearing a helmet. Patients were also given the opportunity to, but not required to, report their HIV status (if known).

Chief complaints and discharge diagnoses collected by research assistants were assigned International Classification of Disease 10 (ICD-10) codes, as utilized in similar research settings.[16,17] This was completed by specially trained RAs and classifications for both common and rare diagnoses were reached through consensus among the group and with the oversight by the principal investigator.

We aimed for a sample size that would be representative of the entire patient population. Our sample size (n= 402) was powered a priori to capture chief complaints/diagnoses that that occur in as few as 4% of the population with a precision of +/- 2%. Our sample provides an overview of common complaints at KNH over the specified time frame. We used the following formula for estimating the prevalence of disease in a standard population:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

n = sample size
Z = Z statistic for level of confidence
P = Expected prevalence or proportion
d = precision

Data Analysis

For descriptive purposes, chief complaint and diagnosis codes were grouped for analysis in the World Health Organization's twenty-one chapter format.[18] Additionally, we grouped codes in accordance with the 2010-2013 Global Burden of Disease studies.[2,19,20] This method partitions diagnoses in three main categories: 1) non-communicable diseases (NCD); 2) communicable diseases, maternal, and neonatal conditions (CD&Ms); and 3) injuries. This provides a simple comparison between known overall global (and country-level) patterns of disease to diseases presenting acutely for care. To our knowledge, this has not been applied to the acute care setting prior to this study.

All data analysis was completed using STATA 14 (Stata Corp, College Station, TX) and mapping was completed using ArcGIS 10.1 (Esri, Redlands, CA). The University of Nairobi/KNH Ethics Review Committee and the University of North Carolina at Chapel Hill Institutional Review Board approved the study.

RESULTS

The A&E registered 14,956 patients during the study period.[13] During the RA shifts, 449 eligible patients were identified. Of these, 47 were excluded for a final sample size of 402. The number of eligible patients was less than every sixth patient as total RA enrollment hours in the A&E were determined based on the sample size calculation. Importantly, final RA shifts encompassed all days of the week and all hours of the day. Reasons for exclusion included: 8 (17%) could not be consented due to a language barrier or were in critical condition and/or next of kin were unavailable; 10 (21%) refused participation; 2 (4%) were sent to Labor and Delivery; 1 (2%) was sent to the Pediatric Emergency Unit (PEU); 3 (6%) were sent to other outpatient clinics; and 26 (55%) left the A&E before consent.

Presenting patient chief complaints and subsequent final A&E diagnoses were grouped according to three major categories of the Global Burden of Disease Study. Among chief complaints, 25% were injuries, 24% were non-communicable diseases, and 7% were communicable diseases and maternal or neonatal conditions (Figure 1). Forty-four percent were grouped as "other" according to this methodology. A&E final diagnoses were comprised of 24% injuries, 35% non-communicable diseases, and 16% were communicable diseases and maternal or neonatal conditions (Figure 2). Twenty-five percent were grouped "other". The top-five chief complaints and diagnoses are listed within each category in Figures 1 and 2.

The average age of participants was 36 years (standard deviation 19 years), and patients were 50% female. Patients were most likely to arrive via taxi or bus (39%), walking (28%), or ambulance (17%). During the study period, A&E nursing were undergoing training on the South African Triage Scale (SATS),[21] to replace the former gestalt method. Since the training was not

completed at the time of data collection, trained RAs and the primary investigator used available patient information to estimate the triage level based on SATS methodology. Seven percent of patients were triaged as "emergent," 14% as "very urgent,"35% as "urgent," 35% as "routine," and 9% "undesignated." Referrals/transfers from outside health centers comprised of 37% of subjects. The majority of patients (62%) were discharged and 17% percent were admitted. One percent were considered dead on arrival, 1% died in the A&E, 4% left against medical advice or eloped, 1% were transferred to another hospital, and 6% of patients underwent a medical "review"[i] or were evaluated by a subspecialist in the A&E. The remaining 10% of patients had missing or incomplete information on their chart, and the RAs were unable to ascertain their disposition (Table 1). The majority of patients were from Nairobi proper (Figure 3).

Overall, abdominal pain was the single most common chief complaint and occurred in 47 (12%) of patients. The most common WHO Chapter was injury (Table 2). Head injury was the single most common final diagnosis and occurred in 32 (8%) patients. The most common patient-reported mechanism for head injury was road traffic injury (RTI) (39%), followed by assault (36%) and fall (9%) (Table 3).

Forty-three percent of participants reported a negative HIV status. Comparatively, 2% reported being HIV positive, 47% reported an "unknown" status, and 8% declined to respond.

DISCUSSION

This study provides an important overview of patients presenting for emergency care in Kenya. Wachira et al. characterized patients presenting to a variety of A&Es across Kenya over a single 24-hour time period and found that trauma, respiratory tract infections, and malaria were the leading diagnoses.[22] House et al. conducted a more comprehensive analysis of A&E care by retrospectively analyzing all patients over a one-year period at Moi Teaching and Referral Hospital, a public tertiary hospital in western Kenya. The top-three A&E diagnoses were injuries, infections, and mental health disorders.[17] Additional studies have focused on patients with acute coronary syndrome[23] and emergency obstetrical care.[24] Our results demonstrate a "triple burden" of acute disease in the KNH A&E of non-communicable diseases (NCDs); communicable diseases, maternal and neonatal conditions (CD&Ms); and injuries, similar to the previously described triple burden of disease that is affecting Sub-Saharan Africa.[1,25]

In Kenya specifically, CD&Ms, NCDs, and Injuries rank first, second and third, respectively for premature death (Years of Life Lost). Overwhelmingly, in 2015, CD&Ms were responsible for the most causes of death, premature death and disability[26]. However, our study demonstrates the opposite patterns of disease presenting for acute care; CD's were the most common cause, followed by Injuries, with the least presentations for CD&M's

Non-Communicable Diseases

NCDs account for 24% of chief complaints and 35% of A&E diagnoses. Among NCD's, cardiovascular disease was the most common condition and the second most common of chief

[i] Patients presenting for a medical "review" usually present with test results from a clinic or outside hospital for subspecialty evaluation. RAs were unable to ascertain the exact disposition of this entire category of patients but noted these patients were likely discharged and not found in the admission logbook.

complaints. In the Global Burden of Disease study, Lozano et al found that NCD's, such as ischemic heart disease, have become the greatest burden of disease worldwide, in terms of years of life lost (YLL).[2] The same study reports that in Eastern Africa, ischemic heart disease ranks #17 in YLL, and unfortunately, age-matched death rates due to NCDs are higher in developing countries[27]. Addressing this burden is challenging since global health initiatives and media coverage (e.g., of the Ebola virus and Zika virus crises, etc.,) have typically prioritized important infectious diseases[28,29,30] which may be influencing public perception[31] and funding priorities. There is a need for preventive efforts and funding for improving acute care systems in Kenya to respond to the growing burden of NCD's.

Injuries

Injuries account for approximately one quarter of both chief complaints (25%) and final diagnoses (24%). Head injury was by far the most common—comprising 26% of injury diagnoses and affecting 8% of all patients. The most common reported mechanism of head injury was RTI (39%). A similar trend was found at Moi Teaching and Referral Hospital in Western Kenya, where RTI was the most common chief complaint, and head injury was in the top five diagnoses.[17] Additionally, in a study from Kampala, Uganda (neighboring Kenya), RTIs were the most common causes of injury for all age groups and seventy-five percent of admitted trauma mortality had concomitant head injury[32]. Traumatic brain injury (TBI), most commonly caused by RTIs is likely under-reported in Africa, due to poor access to care and absence of injury surveillance.[33] The international collaborative trauma study, Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage (CRASH) predicts that TBI patients in LMICs have over twice the odds of dying following severe TBI (OR 2.23, 95% CI 1.51–3.30)[34]. The high incidence of head injuries related to road traffic crashes in Kenya should raise concern.

Studies from LMICs demonstrate that legislative-based interventions are the single most effective strategy for reducing road traffic injuries and death due to RTIs.[35] Of the 14 patients with head injuries from RTIs in our study, none reported use of seatbelts and/or helmets. This is lower than previously reported by Saidi et al in 2014 in admitted trauma patients at KNH, where 11.6% of occupants wore seatbelts, and 18.2% of motorcycle passengers wore helmets.[36] This discrepancy may be due to the relatively low number of patients in this category and reliance on patient reporting. While motorcycle helmet, seat-belt, and drunk driving laws exist in Kenya, they are poorly enforced.[37] In 2010, a consortium including the World Health Organization, Johns Hopkins University (JHU), and local Kenyan partners launched the Road Safety in 10 Countries (RS-10) campaign. This program aims to reduce mortality from RTIs through social marketing, strengthening public health legislation, training local law enforcement, and improving trauma care and data surveillance systems.[38] This multi-faceted approach holds promise, as there has been a modest increase in helmet utilization and decrease in road speeds as a result.[39]

Communicable, Maternal, Perinatal and Nutritional Disease

The third major GBD study category, infectious diseases and maternal or neonatal conditions, appears to comprise a lesser share of the total burden of acute disease at KNH, comprising only 16% of final diagnoses. This is curious, given that top five causes of death in this category in Kenya are from HIV/AIDS, diarrhea, lower respiratory tract infections, neonatal encephalopathy, preterm births.[26]

The contribution of chronic infectious diseases, such as HIV, on acute health conditions is not well elucidated by this study. The HIV prevalence in this study was 2% (self-reported), which is lower than the documented HIV prevalence among adults aged 15-49 years in Kenya in 2014 of 5.3%.[40] However, almost half (47%) of patients in our study reported an unknown HIV status. Therefore, it is possible that there is a hidden HIV burden among patients at KNH's A&E, who largely originate from Nairobi's large urban areas. HIV testing in the Emergency Department is well studied and practiced[41,42] and is crucial for vulnerable populations, whose only access to healthcare may be the Emergency Department.[43] As such, the A&E represents an opportunity for improved detection and surveillance of infectious diseases in Kenya and other LMICs.

Finally, this category includes maternal and neonatal conditions. As a primarily adult A&E with a separate PEU, many neonatal conditions are evaluated in the PEU, such as lower respiratory illnesses and diarrheal diseases, which rank #2 and #3 for YLL in Kenya, respectively[44]. Conducting a similar study in the PEU would provide a more comprehensive understanding of these pediatric conditions.

Other (Undifferentiated Disease)

Third category of "other" consist of diagnoses and chief complaints that do not fit into the GBD categorization. These are syndromic complaints such as "abdominal pain", "chest pain" and "headache". These complaints fall under "symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" which comprised the majority of our chief complaints (44%). These undifferentiated complaints were better categorized into one of the three GBD categories as their final diagnoses were elucidated (undifferentiated final diagnoses made up 25%). There is a need for specialized training for evaluating patients with undifferentiated and syndromic complaints, an area where Emergency Medicine (EM) training is well suited.[45] The specialty of EM is by nature multidisciplinary, allowing for the rapid triage and treatment of acute injury or illness of all organ systems and populations. A proficiency in stabilizing therapeutics and procedures acquired from a multitude of medical and surgical specialties, gives the EM-trained physician a decided advantage and efficiency for treating undifferentiated A&E patients. Further, EM- trained physicians demonstrate improved consistency and quality of care in Emergency Departments.[46–48] However, EM as a specialty, is not recognized by the Kenya Medical and Dentists Board (KMDB). Emergency Medicine development in Kenya starts with recognizing EM as a specialty, which could allow residency-trained emergency physicians to form local faculty for training of health care providers in Emergency Medicine.[6]

Study Limitations

The ratio of Global Burden of Disease categories presenting to KNH appears different than Kenya's country level burden of disease pattern. This could be due to the lack of pediatric data as our study does not include patients who presented to the separate Pediatric Emergency Unit. The pediatric patients that we captured were skewed towards the critically ill and injured pediatric population. A study describing the population presenting to the PEU would certainly add to our body of knowledge in this area. This could also be due to seasonal variation in

presentations. Finally, the 25% of final diagnoses that remain in the "undifferentiated" category may also contribute to this difference.

As a tertiary care hospital, the burden of disease detected at KNH will be skewed towards higher acuity conditions than would be present in secondary or primary level centers with emergency care. Therefore, the generalizations of emergency care burden to the other hospital settings in LMICs should be made cautiously. However, the results of this study, combined with the findings at Moi Teaching and Referral Hospital provide an excellent snapshot of tertiary care epidemiology in Kenya.[17] Future studies evaluating district and rural A&Es, combined with our data, would provide an improved picture of the acute disease burden in Kenya.

A potential pitfall of using GBD categories to assess emergency care is the imprecision in grouping chief complaints and undifferentiated illness. The net effect, when comparing to other GBD studies, would be an underestimation of the burden of acute disease. Since chief complaints may better characterize acute disease[45], it could be argued that future GBD should include variables to capture this data. ICD-10 is the international standard for categorizing epidemiological and health management data and is used to classify diagnoses as well as reasons for consultation (chief complaint).[18] However, concessions to better capture the ICD-10 category, "symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" would be valuable.

There were limitations due to current A&E data systems. The A&E is high volume with paper based charting and minimal patient tracking. There are no centralized patient tracking boards or electronic tracking systems. There is variability in the extent of documentation among health providers. Research assistants had to personally follow their enrolled subjects throughout each shift. Our RAs noted that some patients bypassed triage and were not recorded in the triage book, and therefore were not included in their systematic sampling. These missing data limit the accuracy of the disposition estimates. These challenges were not anticipated and will be taken into account in the design of future studies. Additionally, although it would be ideal to enroll every patient for the most accurate description of the total burden of disease, systems for a complete prospective registry in this setting are currently not available.

In addition, the requirement for an informed written consent for this registry project forced sampling bias, as critically ill patients could not be consented, and therefore were excluded. This combined with difficulties tracking patient disposition, it is likely that actual admission and death rates are higher than our estimates. Based on our review of their admission logbooks and the total patient census, we estimate that 30% of patients typically are admitted, appreciably higher than our results. As long as written consent is required and due to the limitations of a prospective study design in this setting, it likely that a retrospective study may yield more accurate data for certain statistics, such as admission rates. However, retrospective studies have other associated limitations and, given our experience, it is likely that in LMIC A&Es, retrospective and prospective studies fulfill different roles.

CONCLUSIONS

This pilot study is a novel, prospective study characterizing the A&E population at a tertiary care center in Kenya. This study highlights the growing burden of injuries and non-communicable diseases—compounding the existing burden of communicable conditions, presenting for acute care. The majority of patients are presenting with acute conditions related to non-communicable diseases and injuries. The prevalence of infectious disease is likely

underreported by this study. Given large patient volumes, shifting epidemiology, and the growing recognition of the importance of emergency care, a comprehensive understanding of the acute care needs at Kenya's largest referral center is long overdue, both to guide patient care in the acute setting and to inform broader public health and policy agendas. Our findings provide an initial frame of reference in which to guide development of emergency resources and training at KNH.

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Contributors
JM was responsible for the conception of idea for study design, draft of protocol, data collection, analysis, and manuscript initiation, reading and approval of final manuscript. KE prepared the RedCap Database. KH was responsible for the statistical analysis and key manuscript formatting. AW was instrumental in the development of the final protocol. KE, AW, AM, and IM assisted with data collection. KH, KE, AW, AM, VM, SD and IM were responsible for the analysis and revisions of study design and protocol, analysis and critical revisions of manuscript. All authors had the opportunity to read and approve the final manuscript.

Competing Interests
None declared.

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Data sharing statement

The database is conjointly owned between the individual co-investigators and their respective departments, including the University of Nairobi and the Kenyatta National Hospital Accident and Emergency Department. The ethical approval for this study obliges us to follow our data

sharing agreement (available for review) and to protect the privacy of participants. According to our agreement (filed through the UofN/KNH ERC in 2014-2015), requests for access to this database for data analysis from investigators or institutions outside of the owners will be considered, pending stipulations of Data Use Agreement are observed and that all owners are made aware. Readers can apply for access and permission to this database by contacting the project coordinator at justin_myers@med.unc.edu or through contact with any of the co-investigators.

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Table 1. Characteristics of patient population by age group. All data are presented as n (%) unless otherwise noted.

Characteristic	All patients (n=402)	<5 years (n=22)	≤17 years (n=48)	18-64 years (n=302)	≥65 years (n=44)
Age, mean (SD) (n=394)	36 (19)	1 (2)	7 (6)	35 (12)	75 (7)
Sex					
Male	201 (50)	12 (55)	29 (60)	146 (48)	23 (52)
Female	201 (50)	10 (45)	19 (40)	156 (52)	21 (48)
Mode of arrival					
Private vehicle	16 (4)	0 (0)	0 (0)	12 (4)	4 (9)
Taxi/bus	156 (39)	8 (36)	19 (40)	114 (38)	21 (48)
Ambulance	69 (17)	5 (23)	7 (15)	53 (18)	5 (11)
Walked	113 (28)	0 (0)	8 (17)	96 (32)	8 (18)
Carried	30 (8)	8 (36)	12 (25)	16 (5)	2 (5)
Wheelchair	10 (3)	0 (0)	1 (2)	4 (1)	4 (9)
Unknown/blank	5 (1)	1 (5)	1 (2)	4 (1)	0 (0)
Transferred					
Yes	147 (37)	13 (59)	20 (43)	104 (35)	20 (45)
No	238 (60)	8 (36)	25 (53)	188 (63)	21 (48)
Unknown	13 (3)	1 (5)	2 (4)	7 (2)	3 (7)
Acuity level (Estimated)*					
Emergency (red)	29 (7)	3 (14)	5 (11)	20 (7)	4 (9)
Very urgent (orange)	55 (14)	4 (18)	11 (23)	39 (13)	4 (9)
Urgent (yellow)	140 (35)	8 (36)	12 (26)	107 (35)	18 (41)
Routine	141 (35)	3 (14)	14 (30)	110 (37)	14 (32)
Not assigned/unknown/other	36 (9)	4 (18)	5 (11)	26 (9)	4 (9)
Trauma history**					
Any	98 (24)	8 (36)	20 (42)	72 (24)	4 (9)
Road traffic accident	32 (8)	1 (5)	3 (6)	28 (9)	1 (3)
Motor or bicyclist	5 (1)	0 (0)	0 (0)	3 (1)	2 (5)
Assault	27 (7)	0 (0)	3 (6)	23 (8)	0 (0)
Pedestrian	1 (0)	0 (0)	0 (0)	1 (0)	0 (0)
Burn	8 (2)	3 (14)	5 (10)	3 (1)	0 (0)
Self-inflicted	4 (1)	2 (9)	2 (4)	2 (1)	0 (0)
Fall	21 (5)	2 (9)	7 (15)	12 (4)	1 (2)
Disposition					
Discharge from A&E	250 (62)	13 (59)	25 (52)	192 (64)	30 (68)
Admit to hospital	67 (17)	5 (23)	10 (21)	45 (15)	8 (18)
DOA	2 (1)	0 (0)	0 (0)	2 (1)	0 (0)
Death in A&E	2 (1)	0 (0)	0 (0)	1 (0)	1 (2)
DAMA/Eloped	15 (4)	0 (0)	1 (2)	13 (4)	1 (2)
Transfer to outside hospital	2 (1)	0 (0)	0 (0)	2 (1)	0 (0)
Consultant “Review”	25 (6)	1 (5)	5 (10)	18 (6)	2 (5)
“Missing/Incomplete” or Disposition field blank	39 (10)	3 (14)	7 (15)	29 (10)	2 (5)

*Determined by research assistants and/or primary investigator utilizing the South African Triage Scale(SATS)[21]
**Patient reported

Table 2. Discharge diagnosis among patient population. All data are presented at n (%). (n=402)

World Health Organization ICD-10 chapter*	Discharge diagnosis n (%)
Injury	92 (23)
Signs and Symptoms	55 (14)
Genitourinary system	54 (13)
Circulatory	39 (10)
Injury Mechanism	38 (9)
Digestive system	34 (8)
Infectious and parasitic	30 (7)
Neoplasms	23 (6)
Musculoskeletal system	22 (5)
Pregnancy, childbirth, and the puerperium	18 (4)
Respiratory	16 (4)
Factors influencing health status	15 (4)
Skin and subcutaneous tissue	12 (3)
Diseases of Blood	9 (2)
Endocrine, nutritional and metabolic	6 (1)
Nervous system	6 (1)
Mental and behavioral	5 (1)
Congenital/chromosomal	4 (1)
Eye and adnexa	3 (1)
Perinatal period	2 (1)
Ear and mastoid process	1 (0)

* Chapters are not mutually exclusive

Table 3. Characteristics of patient population with head injury as defined by World Health Organization ICD-10 code block "Injury to the head" by age group. All data are presented as n (%) unless otherwise noted.

Characteristic	All patients (n=33)	<5 years (n=2)	≤17 years (n=5)	18-64 years (n=28)	≥65 years (n=0)
Age, mean (SD)	29 (14)	3 (1)	5 (2)	33 (10)	
Sex					
Male	28 (85)	2 (100)	4 (80)	24 (86)	
Female	5 (15)	0 (0)	1 (20)	4 (14)	
Mode of arrival					
Private vehicle	1 (3)	0 (0)	0 (0)	1 (4)	
Taxi/bus	8 (24)	1 (50)	2 (40)	6 (21)	
Ambulance	12 (36)	1 (50)	1 (20)	11 (39)	
Walked	6 (18)	0 (0)	0 (0)	6 (21)	
Carried	3 (9)	0 (0)	2 (40)	1 (4)	
Wheelchair	1 (3)	0 (0)	0 (0)	1 (4)	
Unknown/blank	2 (6)	0 (0)	0 (0)	2 (7)	
Transferred					
Yes	13 (39)	2 (100)	2 (40)	11 (39)	
No	20 (61)	0 (0)	3 (60)	17 (61)	
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	
Acuity level (Estimated)*					
Emergency (red)	4 (12)	0 (0)	1 (20)	3 (11)	
Very urgent (orange)	8 (24)	1 (50)	2 (40)	6 (21)	
Urgent (yellow)	12 (36)	0 (0)	0 (0)	12 (43)	
Routine	7 (21)	1 (50)	1 (20)	6 (21)	
Not assigned/unknown/other	2 (6)	0 (0)	1 (20)	1 (4)	
Trauma history**					
Any	31 (94)	1 (50)	4 (80)	27 (96)	
Road traffic accident	13 (39)	1 (50)	2 (40)	11 (39)	
Wearing seatbelt					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	
No	4 (31)	0 (0)	0 (0)	4 (36)	
Unknown	7 (54)	1 (100)	2 (100)	5 (45)	
Not recorded	2 (15)	0 (0)	0 (0)	2 (18)	
Motor or bicyclist	1 (3)	0 (0)	0 (0)	1 (4)	
Wearing helmet (n=1)					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	
No	0 (0)	0 (0)	0 (0)	0 (0)	
Unknown	1 (100)	0 (0)	0 (0)	1 (100)	
Assault	12 (36)	0 (0)	0 (0)	12 (43)	
Pedestrian	1 (3)	0 (0)	0 (0)	1 (4)	
Burn	0 (0)	0 (0)	0 (0)	0 (0)	
Self-inflicted	1 (3)	0 (0)	0 (0)	1 (4)	
Fall	3 (9)	0 (0)	2 (40)	1 (4)	
Disposition					
Discharge from A&E	19 (58)	1 (50)	3 (60)	16 (57)	
Admit to hospital	5 (15)	1 (50)	1 (20)	5 (18)	
DOA	0 (0)	0 (0)	0 (0)	0 (0)	
Death in A&E	1 (3)	0 (0)	0 (0)	1 (4)	
DAMA/Eloped	1 (3)	0 (0)	0 (0)	1 (4)	
Transfer to outside hospital	1 (3)	0 (0)	0 (0)	1 (4)	
Consultant "Review"	3 (9)	0 (0)	1 (20)	2 (7)	
"Missing/Incomplete" or Disposition field blank	2 (6)	0 (0)	0 (0)	2 (7)	

*Determined by research assistants and/or primary investigator utilizing the South African Triage Scale(SATS)[21]
** Collected by research assistants. Categories are not mutually exclusive.

Figure 1: Top 5 A&E Chief Complaints by each Global Burden of Disease category

Figure 2: Top 5 A&E Final Diagnoses by each Global Burden of Disease category

Figure 3: Kenya providence of origin of study patient population

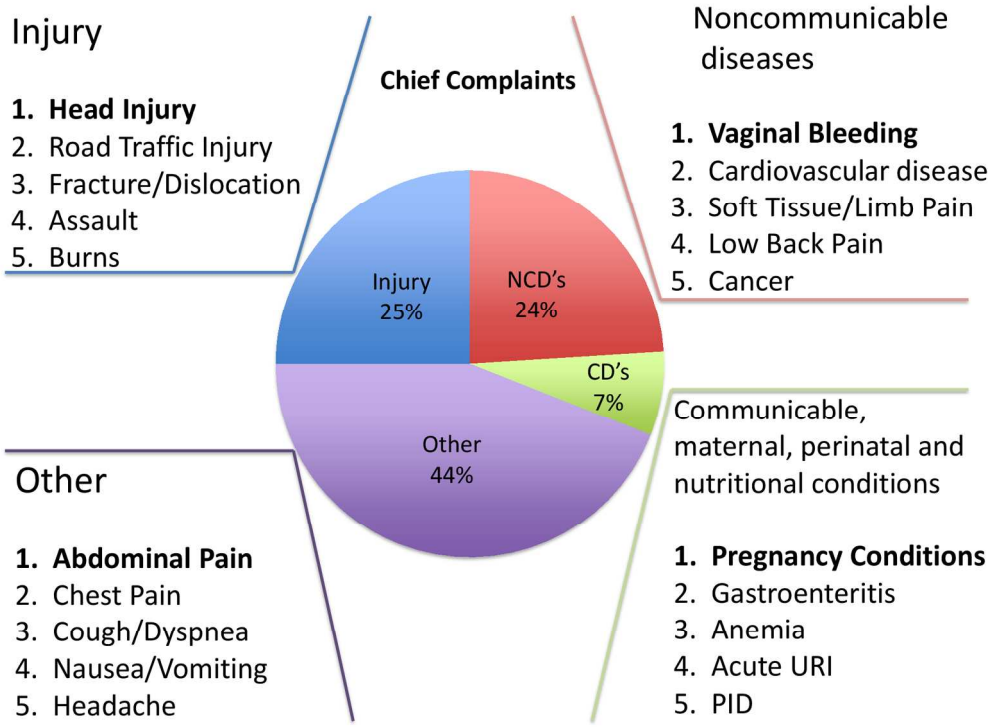

Figure 1: Top 5 A&E Chief Complaints by each Global Burden of Disease category

169x127mm (300 x 300 DPI)

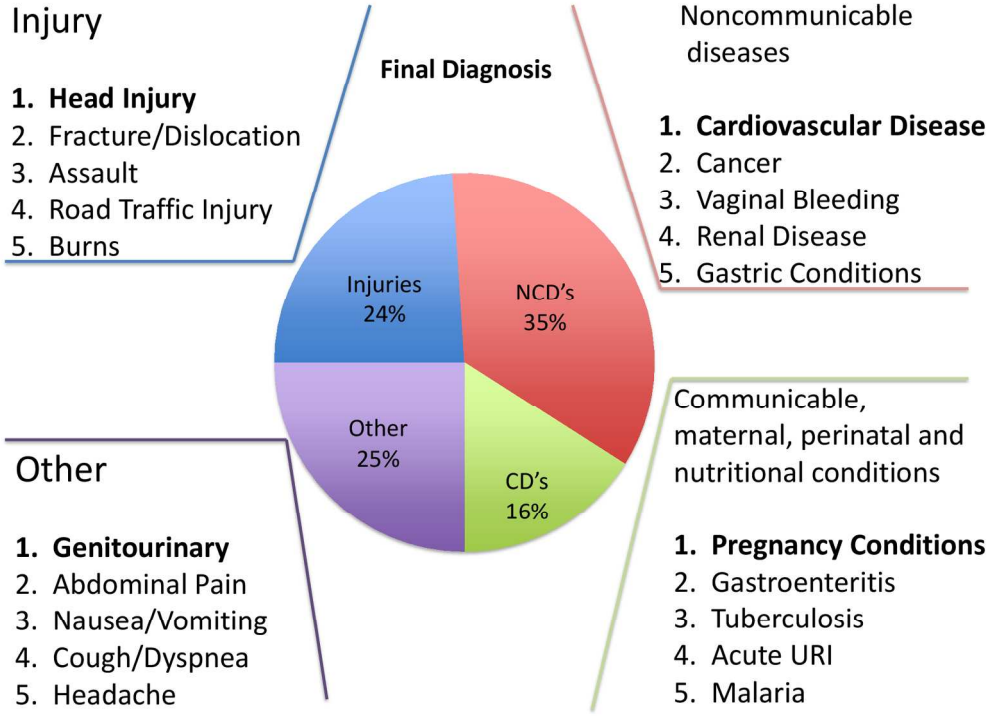

Figure 2: Top 5 A&E Final Diagnoses by each Global Burden of Disease category

169x127mm (300 x 300 DPI)

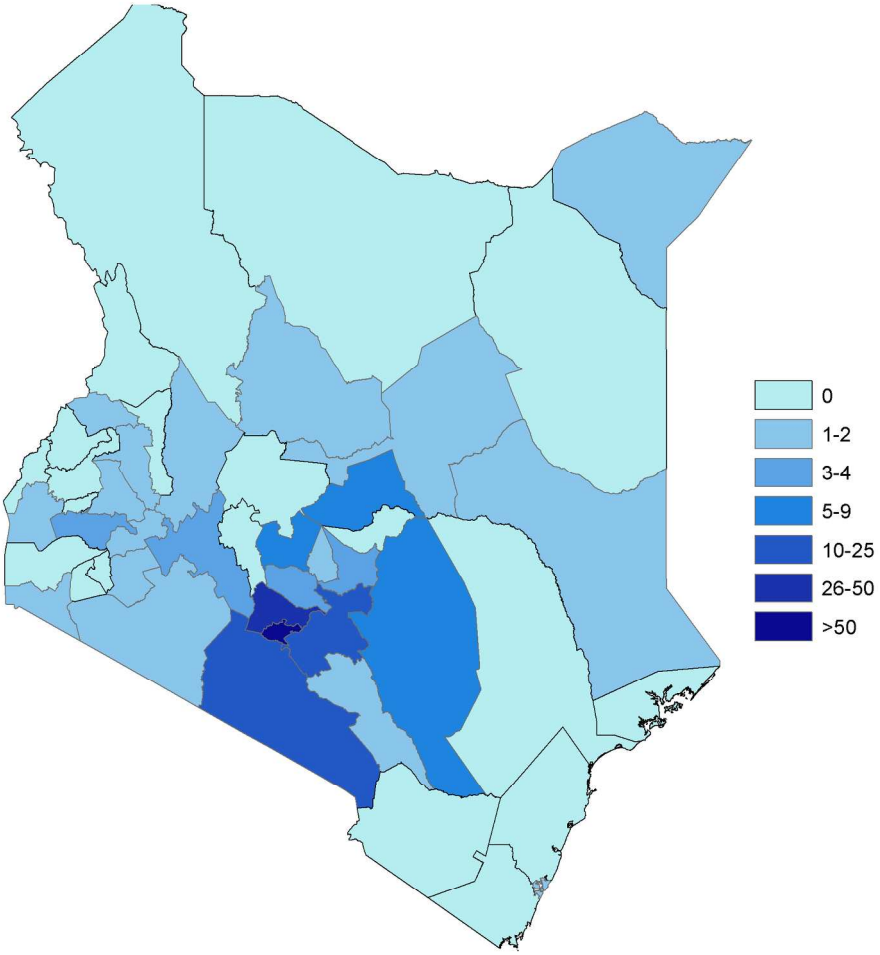

Figure 3: Kenya providence of origin of study patient population

185x193mm (300 x 300 DPI)

STROBE Guidelines for authors of CORR

To be used by authors of all observational clinical studies published in CORR. For this purpose a cohort study (the term used by STROBE) is considered a longitudinal study typically reporting outcomes of treatment in one or more cohorts; a case-control study is one identifying factors in outcomes; a cross-sectional study is one to identify the prevalence of factors or characteristics in a population at a single point in time.

This table is modified from and used with the permission of The STROBE Initiative, www.strobe-statement.org.

Modifications: We added a fourth column for authors to check inclusion. You must include all items in your manuscript unless the information is not applicable. Information on the study cohort (Items 13 and 14 in the STROBE guidelines) should be provided in Patients and Methods, not in Results; we have omitted the portions of the STROBE guidelines related to Results and Discussion (see our guidelines). The STROBE guidelines were developed for epidemiological studies; "exposed" or "exposure" have been modified with the words "treated" or "treatment."

STROBE Statement—Checklist of items that should be included in reports of ***case-control studies***

	Item No	Recommendation	Page number or N/A where not applicable
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, treatment, follow-up, and data collection	3,4
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Cross-sectional: 3,4
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of treated and untreated *Case-control study*—For matched studies, give matching criteria and the number of controls per case	

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	4
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on other treatments and potential confounders	Table 1: 16
		(b) Indicate number of participants with missing data for each variable of interest	Table 1: 16
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Variables	7	Clearly define all outcomes, treatments, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*3,4*
Bias	9	Describe any efforts to address potential sources of bias	Limitations: 9,10
Study size	10	Explain how the study size was arrived at	4,5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	4,5
		(*e*) Describe any sensitivity analyses	

*Give information separately for cases and controls.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.