Diagnoses made in an Emergency Department in rural sub-Saharan Africa

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Summary

BACKGROUND: Information on diagnoses made in emergency departments situated in rural sub-Saharan Africa is scarce. The aim was: to evaluate the frequency of different diagnoses made in a new emergency department to define relevant healthcare requirements; and to find out if in-hospital mortality rates would decrease after the implementation of the emergency department.

METHODS: In this observational study, we prospectively collated diagnoses of all patients presenting to the emergency department of the St Francis Referral Hospital in Ifakara, Tanzania during 1 year. In addition, we compared in-hospital mortality rates before and after the implementation of the emergency department.

RESULTS: From July 2016 through to June 2017, a total of 35,903 patients were included. The median age was 33.6 years (range 1 day to 100 years), 57% were female, 25% were children <5 years, 4% were pregnant and 9% were hospitalised. The most common diagnoses were respiratory tract infection (12.6%), urinary tract infection (11.4%), trauma (9.8%), undifferentiated febrile illness (5.4%), and malaria (5.2%). The most common clinical diagnoses per age group were: lower respiratory tract infection (16.1%) in children <5 years old; trauma (21.6%) in 5- to 17-year-olds; urinary tract infection (13.5%) in 18- to 50-year-olds; and hypertensive emergency (12.4%) in >50-year-olds. Respiratory tract infections peaked in April during the rainy season, whereas malaria peaked 3 months after the rainy season. In-hospital mortality rates did not decrease during the study period (5.6% in 2015 vs 7.6% in 2017).

CONCLUSIONS: The majority of diagnosed disorders were of infectious or traumatic origin. The majority of febrile illnesses were poorly defined because of the lack of diagnostic methods. Trauma systems and inexpensive accurate diagnostic methods for febrile illnesses are needed in rural sub-Saharan Africa.

Key words: emergency department, diagnosis, mortality, rural, Africa

Introduction

Emergency medical services are increasingly recognised as a critically important component of national health systems in low- and middle-income countries [1, 2]. Although large numbers of patients seek emergency care in health facilities, only few hospitals in low- and middle-income countries have an emergency department. Furthermore, these emergency departments often have limited functionality due to lack of formally trained staff, insufficient funding, inadequate infrastructure or equipment and limited supply of consumables [3, 4]. Information on diagnoses made in emergency departments of hospitals in sub-Saharan Africa is scarce, and there are no reports on hospital mortality rates before and after implementing an emergency department in a rural hospital. However, the implementation of a triaging system and training of clinical staff in emergency care has been shown to be associated with a decrease of in-hospital mortality rates in urban hospitals in Malawi, Sierra Leone and Tanzania [5–8]. During 1 year, we prospectively collated diagnoses of all patients presenting to the newly established emergency department in the St Francis Referral Hospital in Ifakara, Tanzania, and recorded in-hospital mortality rates before and after the implementation of the emergency department. Our aim was to evaluate the frequency of different diagnoses made in the emergency department, so that relevant healthcare requirements for our hospital could be defined. In addition, we wanted to find out if in-hospital mortality rates would decrease after implementing the emergency department.

Methods

Study design and setting

This prospective observational study was performed in the St Francis Referral Hospital in Ifakara, Tanzania, which serves as a referral centre for about one million people liv-
ing in rural Kilombero, Ulanga, and Malinyi districts. It has 360 beds and specialised services in internal medicine, surgery, obstetrics, urology, neonatology and gynaecology, ophthalmology, and paediatrics, has a human immunodeficiency virus (HIV) and tuberculosis clinic, but has no proper intensive care unit. Before the emergency department was available, all patients seeking care for an acute health problem were seen at the outpatient clinic by an intern doctor or a clinician on call. No triaging system or emergency care was available.

Implementation of an emergency department
In September 2015, an emergency department was constructed and emergency services were implemented, including a triaging system, with a triple-shift operational service, and training in emergency medicine and ultrasound including emergency and abdominal sonography. Additionally, echocardiography by a formally trained and experienced physician was offered for patients with signs and symptoms of heart failure. For triage, the South African Triage Scale (SATS), a scoring system previously validated in resource-limited settings, was implemented [9–11] and applied to all patients presenting from 8 a.m. to 5 p.m., i.e., during peak admission periods. During evening and night hours, triage was performed conventionally following the opinion of the responsible clinicians on duty.

The former outpatient clinic with its staff was incorporated into the new emergency department. Since January 2016, it runs with a triple-shift duty roster 24 hours a day. The medical staff comprises 13 nurses, 7 clinicians, and 5–6 intern doctors who rotate every 2 months. The emergency department is supported by an experienced emergency medicine physician. It has three consultation rooms available for emergency patients without serious conditions and an emergency room for patients with life-threatening conditions (i.e., patients with abnormal vital signs, respiratory failure, decreased consciousness, polytrauma, bleeding, or severe pain in need of immediate care). The emergency room is equipped with two monitors for noninvasive blood pressure measurement, oxygen saturation and electrocardiogram monitoring, and a permanently available ultrasound and electrophysiology machine. Point-of-care tests available 24 hours a day include malaria rapid diagnostic test (SD Bioline Malaria Ag/P.F.Pan, Abbott, USA), urine pregnancy test strips (Occidem Biotec, UK), urine dipstick (Combur 10Test, Roche, Switzerland) and blood glucose tests (On Call Plus, ACON, USA). Additionally, radiography and laboratory tests such as complete blood count with differential, liver and kidney function tests, urine analysis, Xpert MTB/RIF, HIV testing (SD Bioline HIV 1/2 3.0, Abbott, USA, and Uni-Gold HIV Rapid Test, Trinity Biotech, USA) and hepatitis serology are available. For emergency treatment, noninvasive airway management tools, oxygen, emergency drugs, fluids and a defibrillator are available. Diagnoses are made clinically by the clinician on duty and with the help of above-mentioned available tests, if indicated. Documentation is done by the responsible clinician in the patient’s medical booklet, if available, and additionally for all patients on a standardised patient log form on paper, for hospital statistics. After every shift, this document is collected by the data team from every clinician and stored and locked in a secured data room.

Study population
All patients who visited the emergency department from July 2016 to June 2017 were eligible. Patients from neonatal and labour wards were not included, because these patients are not seen at the emergency department.

Ethics statement
The study was approved by the ethics committee in Switzerland (Ethikkommission Nordwest und Zentralschweiz (EKNZ UBE-15/83)) and the ethics committees of the Ifakara Health Institute (Institutional Review Board, IHI/IRB/No 38-2015) as well as the National Institute for Medical Research, Tanzania (Ref. NIMR/HQ/ R.8a/Vol. IX/2242). All three committees waived informed consent. The study was performed according to GCP guidelines.

Data collection
All manually filed log forms from patients seen between July 2016 and June 2017 were reviewed and data (date of visit, address, age, sex, diagnosis, hospitalization, pregnancy, HIV status, insurance status) were transferred into an electronic database. If a patient had several diagnoses, all diagnoses were captured and the number of diagnoses was noted. The range of 102 different single diagnoses reported was summarised into different groups for analysis. Group 1 consisted of 41 organ-based diseases, such as upper and lower respiratory tract infection, whereas Group 2 was a further simplification into 20 different disease groups according to organ or disease mechanism, such as trauma, infectious diseases (table S1 in appendix 1). Only the main diagnosis was used for grouping of diseases, additional diagnoses were reported separately.

Distance between the patient’s home and the hospital was determined using google maps or google earth. In-hospital death rates were collected by retrospective reviews of registry books from the hospital wards (medical, surgical, gynaecological and paediatric wards from January 2015 through to December 2017).

Statistical analysis
The frequencies and proportions of admission diagnoses and in-hospital mortality were recorded, calculated and reported as rates. All statistical analyses, graphs and correlations were performed using Microsoft Excel software.

Availability of data and material
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Results
Patients
From 1 July 2016 until 30 June 2017, all 35,903 patients attending the emergency department were included in this study. The median age was 33.6 years (range 1 day to 100 years), 57.2% of patients were female and 24.8% were children below the age of 5 years. A total of 7.5% of female patients were pregnant, and 8.9% of all patients were admitted to the ward (table 1).
The distance from the patient’s home to the hospital was within 15 km for 69% of the patients, but some patients came from villages up to 152 km away from the hospital. During rainy season (March–May), the proportion of patients coming from far away decreased (fig. 1 and 2).

Diagnoses
The distribution of the main diseases diagnosed in the emergency department according to the simplified group 2 is shown in figure 3. The most common disease groups were of infectious origin (46.3%), trauma (9.8%), abdominal diseases (6.0%), gynaecological / pregnancy-related problems (5.4%), and cardiovascular diseases (5.3%). Within the more detailed group 1 classification the most common first five diagnoses were respiratory tract infections (12.6%), urinary tract infection (11.4%), trauma (9.8%), undifferentiated febrile illness (5.4%) and confirmed malaria (5.2%) (table 2).

Table 1: Patient characteristics (n = 35'903).

| Characteristic                  | Value                        |
|--------------------------------|------------------------------|
| Age in years, median (range)   | 33.6 (1 day – 100 years)     |
| Age category, n (%)            |                              |
| Age <5 years                   | 8’903 (24.8)                 |
| Age 5–17 years                 | 12’618 (35.1)                |
| Age ≥18 years                  | 23’156 (64.5)                |
| Age not assessed               | 129 (0.4)                    |
| Gender                         |                              |
| Female sex, n (%)              | 20’526 (57.2)                |
| Male sex, n (%)                | 15’278 (42.6)                |
| Sex not assessed, n (%)        | 99 (0.3)                     |
| Pregnancy, n (%)               | 1’531 (7.5)*                 |
| Known HIV infection, n (%)     | 235 (0.7)                    |
| Health insurance, n (%)        | 6’400 (17.8)                 |
| Number of diagnoses, n (%)     |                              |
| 1                              | 31’158 (86.8)                |
| 2                              | 3’499 (9.7)                  |
| 3                              | 189 (0.5)                    |
| >3                             | 8 (0.02)                     |
| None                           | 1’049 (2.9)                  |
| Serious condition, n (%) *     | 2’794 (7.8) *                |
| Admitted to ward, n (%)        | 3’183 (8.9)                  |
| * percentage of females; * patients with abnormal vital signs, respiratory failure, decreased consciousness, multiple trauma, bleeding or severe pain, who were managed in the emergency room
Table 3 shows the 15 leading main diagnoses in different age groups. In children below the age of 5 years (n = 8902), the leading diagnosis (group 1) was lower respiratory tract infection (16.1%). In adults who were 5 to 17 years old (n = 3716), it was trauma (21.6%), and in adults who were 18 to 50 years old (n = 17,117), urinary tract infection (13.5%) was most common. In adults who were >50 years old (n = 6039), the most common diagnosis was hypertensive emergency (12.4%). We observed seasonality in the occurrence of respiratory tract infections, confirmed malaria, and trauma: there was a peak of respiratory tract infections in April in the middle of the rainy season, and a peak of malaria in August, 3 months after the end of the rainy season. The majority of trauma cases occurred during the dry season (fig. 4 and table 4). The most common injuries of the 3527 trauma patients were bone fractures (28.3%), joint dislocations (7.4%) and soft-tissue injuries (44.9%). Unfortunately, the reasons for trauma were not recorded in 75.6% of the cases and traffic accidents were not specifically reported, despite the fact that they probably constitute the majority of trauma causes. The leading documented causes of trauma cases were animal encounters (5.8%) and violence (n = 164, 4.6%) with a total of 50 reported rape incidents during this study period. A total of 3499 patients (9.7%) had a second diagnosis and 189 (0.5%) had a third diagnosis. The most common second and third diagnoses were dyspepsia (n = 360), anaemia (n = 347), gastroenteritis and other intestinal infections (n = 306), urinary tract infection (n = 239), skin diseases (n = 225) and hypertensive emergency (n = 224).

In-hospital mortality (excluding labour-and neonatal wards)
In 2015, the documented in-hospital mortality rate was 5.6% (8400 admissions, 467 deaths). In 2016, it was 6.6% (6310 admissions, 415 deaths), and in 2017 7.6% (5653 admissions, 427 deaths).

Table 2: Diagnoses of 35'903 patients (simplified diagnosis group 1).

| Diagnosis                                         | N    | %    | Ranking |
|---------------------------------------------------|------|------|---------|
| Respiratory tract infection                        | 4'522| 12.6 | 1       |
| – Lower respiratory tract infection                | 2'843| 7.9  |         |
| – Upper respiratory tract infection                | 1'679| 4.7  |         |
| Urinary tract infection                           | 4'087| 11.4 | 2       |
| – Fracture or dislocation                         | 1'257| 3.5  |         |
| Undifferentiated febrile illness                  | 1'938| 5.4  |         |
| Trauma                                            | 3'527| 9.8  | 3       |
| Gastroenteritis/other gastrointestinal infection   | 1'755| 4.9  | 6       |
| Dyspepsia                                         | 1'384| 3.9  | 7       |
| Hypertensive emergency                            | 1'148| 3.2  | 8       |
| Skin diseases                                     | 1'293| 3.6  | 9       |
| No diagnosis                                      | 1'049| 2.9  | 10      |
| Gynaecological disease                            | 1'016| 2.8  | 11      |
| Sexually transmitted diseases                     | 1'000| 2.8  | 12      |
| Pregnancy complications                           | 934  | 2.6  | 13      |
| Heart failure                                     | 700  | 1.9  | 14      |
| Musculoskeletal pain                              | 627  | 1.7  | 15      |
| Other abdominal diseases                          | 614  | 1.7  | 16      |
| Other ear/nose/throat diseases                    | 612  | 1.7  | 17      |
| Cellulitis and other soft tissue infections        | 605  | 1.7  | 18      |
| Anaemia                                           | 536  | 1.5  | 19      |
| Arthritis                                         | 506  | 1.4  | 20      |
| Tuberculosis                                      | 445  | 1.2  | 21      |
| Kidney disease                                    | 441  | 1.2  | 22      |
| Other neurological diseases                       | 431  | 1.2  | 23      |
| Chronic obstructive pulmonary disease / asthma     | 383  | 1.1  | 24      |
| Ophthalmologic diseases                           | 296  | 0.8  | 25      |
| Diabetic emergency                                | 249  | 0.7  | 26      |
| Urological diseases                               | 248  | 0.7  | 27      |
| Otitis media                                      | 213  | 0.6  | 28      |
| Sepsis                                            | 209  | 0.6  | 29      |
| Psychiatric diseases                              | 196  | 0.5  | 30      |
| Acute abdomen                                     | 162  | 0.5  | 31      |
| Cancer                                            | 159  | 0.4  | 32      |
| Epilepsy                                          | 121  | 0.3  | 33      |
| Allergy                                           | 108  | 0.3  | 34      |
| Liver disease                                     | 104  | 0.3  | 35      |
| Stroke                                            | 96   | 0.3  | 36      |
| Malnutrition                                      | 67   | 0.2  | 37      |
| Meningitis                                        | 25   | 0.1  | 38      |
Discussion

This is the first report on the distribution of clinically diagnosed disorders in patients presenting to an emergency department of a referral hospital situated in rural sub-Saharan Africa. The most common disorders were of infectious or traumatic origin. The five most common diagnoses were respiratory and urinary tract infection, trauma, undifferentiated febrile illness and malaria. In the age group of >50 years, hypertensive emergency was the most frequent diagnosis, reflecting the importance of noncommunicable diseases in this setting and age group.

Table 3: Most frequent diagnoses in different age groups (simplified diagnosis group 1). A total of 129 patients are not included in the table, because their age was not assessed. In adults >50 years, GI-infections and urological diseases are of equal ranking.

| Rank | Disease Category | Children <5 years (n = 8902) | Children 5-17 years (n = 3716) | Adults 18-50 years (n = 17117) | Adults >50 years (n = 6039) |
|------|------------------|-------------------------------|-------------------------------|-------------------------------|---------------------------|
|      |                  | N    | %       | N    | %       | N    | %       | N    | %       |
| 1    | LRTI             | 1429 | 16.1    | 802  | 21.6    | 2308 | 13.5    | 749  | 12.4    |
| 2    | URTI             | 1295 | 14.5    | 396  | 10.7    | 1906 | 11.1    | 484  | 8.0     |
| 3    | UTI              | 884  | 9.9     | 263  | 7.1     | 881  | 5.1     | 442  | 7.3     |
| 4    | GI infections    | 869  | 9.8     | 260  | 7.0     | 877  | 5.1     | 389  | 6.4     |
| 5    | Malaria          | 672  | 7.5     | 212  | 5.7     | 866  | 5.1     | 367  | 6.1     |
| 6    | Undifferentiated febrile illness | 555 | 6.2 | ENT disease | 166 | 4.5 | Undifferentiated febrile illness | 865 | 5.1 | Dyspepsia | 329 | 5.4 |
| 7    | Skin disease     | 480  | 5.4     | 158  | 4.3     | 830  | 4.8     | 247  | 4.1     |
| 8    | Trauma           | 386  | 4.3     | 153  | 4.1     | Dyspepsia | 825 | 4.8 | Arthritis | 236 | 3.9 |
| 9    | Dyspepsia        | 165  | 1.9     | 109  | 2.9     | Malaria | 726 | 4.2 | Malaria | 208 | 3.4 |
| 10   | Soft tissue infec- | 152 | 1.7 | URTI      | 100 | 2.7 | GI infections     | 553 | 3.2 | GI infection | 168 | 2.8 |
|      | tion             |      |         |      |         |      |         |      |         |
| 11   | Sepsis           | 153  | 1.7     | Soft tissue infec- | 92 | 2.5 | Skin diseases | 536 | 3.1 | Urological diseases | 168 | 2.8 |
|      |                  |      |         |       |         |      |         |      |         |
| 12   | Other abdominal disease | 146 | 1.6 | Asthma    | 68  | 1.8 | ENT disease     | 417 | 2.4 | Musculoskeletal pain | 161 | 2.7 |
| 13   | Anaemia          | 139  | 1.6     | Musculoskeletal pain | 62 | 1.7 | Hypertensive emergency | 380 | 2.2 | Other abdominal disease | 140 | 2.3 |
| 14   | ENT disease      | 89   | 1.0     | Other abdominal disease | 61 | 1.6 | Musculoskeletal pain | 320 | 1.9 | Diabetic emergency | 136 | 2.3 |
| 15   | Allergy          | 47   | 0.5     | Dyspepsia | 60 | 1.6 | Kidney disease | 274 | 1.6 | Tuberculosis | 128 | 2.1 |

LRTI: lower respiratory tract infection; URTI: upper respiratory tract infection; UTI: urinary tract infection; GI-infection: gastroenteritis and other intestinal infections; STDs: sexually transmitted diseases; ENT-diseases: ear-nose-throat diseases.
piratory tract infections were the most common diagnoses in children <5 years. Respiratory tract infections typically occurred during the rainy season, whereas malaria was diagnosed mostly 3 months after the rainy season and trauma most commonly during the dry season.

After the implementation of the emergency department, we did not note a reduction of the in-hospital mortality rate during the study period, in contrast to findings in urban settings [9–11].

The seasonal variation of the incidence of respiratory tract infections is a well-known phenomenon. Studies from tropical regions such as Africa, Asia and South America showed a peak of respiratory tract infections and respiratory viruses – especially respiratory syncytial virus and influenza virus – during the rainy season [12, 13]. Because of a lack of adequate diagnostics, we were unable to identify the pathogens causing respiratory tract infections. However, in a study done in our hospital and in an urban hospital in Dar es Salaam in 2008, which included febrile children 2 months to 10 years of age, acute respiratory tract infection was the most frequent diagnosis in 625 out of 1005 (62.2%) febrile episodes. Viral pathogens were common and were found in 81% of all respiratory tract infections, in 89% of the cases of clinically diagnosed pneumonia and in 77% of radiologically confirmed pneumonia cases. The most common viruses detected by polymerase chain reaction (PCR) were rhinovirus, influenza virus, adenovirus, coronavirus, bocavirus and respiratory syncytial virus [14]. Similar viruses were found in 73% of children <3 years of age with upper- and lower respiratory tract infections in a hospital in Ouagadougo, Burkina Faso, and bacteria were detected in one third of the cases only [15].

The high number of urinary tract infections corresponds to other studies on emergency department diagnoses. In a study from the United States, urinary tract infection was present in 25.3% of all infectious disease-related emergency department visits of adults aged >65 years [16]. The prevalence of urinary tract infections in an emergency unit in Nigeria was 9% in febrile children <5 years [17]. The incidence for urinary tract infection in girls by the age of 7 years has been reported to be up to 7.8% in Scandinavia [18]. On the other hand, overdiagnosis and overtreatment of elderly women diagnosed with urinary tract infection in an emergency department without confirmation by urine culture was reported to be present in half of the patients [19]. Considering this, overdiagnosis of urinary tract infection in our emergency department is possible, and some of those patients who received this diagnosis might have suffered from another disease.

All malaria cases were confirmed with blood slides or malaria rapid diagnostic tests, which have good sensitivity and specificity of more than 90% [20]. The high number of malaria cases presenting at the emergency department reflects the ongoing burden of this disease [21]. We observed peak numbers of malaria cases in August, 3 months after the end of the rainy season, when temperatures increase to moderate levels. The clustering of malaria cases 2 to 3 months after periods of increased rainfall has been reported previously [22, 23].

Undifferentiated febrile illness was more frequent than confirmed malaria in all age groups except in children <5 years old, and was one of the leading diagnoses, especially in 5- to 17-year-old patients, were it was present in 7.1%. This is in line with other reports on burden of febrile illnesses in sub-Saharan Africa [24].
Because of the absence of microbiological diagnostic methods such as bacterial cultures, PCR and serological tests, we were not able to define the aetiology of these diseases, but this should represent an aim for future investigations. In very young children, it is likely that most of these cases were of viral aetiology [14]. In addition, acute bacterial zoonoses such as rickettsioses, leptospirosis, Q-fever and brucellosis might represent underestimated causes. This was recently unveiled in studies from south-east Asia and from northern Tanzania, where zoonotic diseases were involved in 26% of admitted adults and children with non-malarial febrile illnesses [25–27]. This study also documented bloodstream infections in 10% of patients, but the actual causes of febrile illnesses remained unknown in one third of adults and two thirds of children, despite careful microbiological evaluation [25]. These findings highlight the importance of performing causes-of-fever studies and sero-epidemiological surveys to elucidate better the aetiologies of common febrile illnesses.

Trauma was the third most common cause for a disorder, and occurred in almost 10%. More than one third of trauma cases had a bone fracture or dislocation, and trauma was the most common diagnosis in 5- to 17-year-old children. Of note, there were 164/3527 (4.6%) documented cases of trauma due to human violence, including 50 cases of rape. However, the actual number of violence cases is likely to be higher, as a result of underreporting of violence against children, especially girls [28, 29].

Table 4: Description of trauma cases.

| Patients characteristics | N    | %     |
|--------------------------|------|-------|
| Female                   | 1429 | 40.5% |
| Median age, years (range)| 25   | 0.05-96 |
| Hospitalisation          | 480  | 13.6% |
| Serious condition        | 532  | 15.1% |

| Injuries                  |      |       |
|---------------------------|------|-------|
| Skin and soft tissue injury| 1562 | 44.9% |
| Fracture                  | 997  | 28.3% |
| Bone or joint dislocation | 260  | 7.4%  |
| Multiple injuries         | 175  | 5.0%  |
| Head injury               | 172  | 4.9%  |
| Chest injury              | 70   | 2.0%  |
| Abdominal injury          | 24   | 0.7%  |
| Eye/ear/nose/mouth injury | 22   | 0.6%  |
| Spine injury              | 21   | 0.6%  |
| Pelvic injury             | 5    | 0.1%  |
| Not defined               | 199  | 5.6%  |

| Trauma mechanism          |      |       |
|---------------------------|------|-------|
| Trauma after animal encounter | 204 | 5.8%  |
| – Dog                     | 127  |       |
| – Snake                   | 33   |       |
| – Crocodile               | 8    |       |
| – Other/non reported      | 36   |       |
| Human violence            | 164  | 4.6%  |
| – Assault                 | 81   |       |
| – Rape                    | 50   |       |
| – Bite                    | 24   |       |
| – Other                   | 9    |       |
| Burn (fire, hot water)    | 112  | 3.2%  |
| Other                     | 11   | 0.3%  |
| Undefined*                | 2668 | 75.6% |

*road traffic accidents and falls from trees

Trauma cases occurred almost twice as frequently as maligna cases. This corresponds to a recent 1-day survey in all 105 Tanzanian district and regional hospitals, where 9.7% of the patients presented with trauma-related complaints [30]. Globally, an estimated 973 million people sustained injuries that warranted healthcare in 2013, and accounted for 10% of the global burden of disease [31]. More than 5 million people die each year as a result of injuries. This accounts of 9% of the world deaths, notably 1.7 times the number of fatalities resulting from HIV, tuberculosis and malaria combined. About 90% of injury-related deaths occur in low-and middle income countries [32]. Advanced trauma live support (ATLS), including extended focused assessment with sonography in trauma (eFAST) to detect bleeding and pneumothorax, has been implemented in our emergency department [33]. However, data that education in ATLS is associated with lower mortality are lacking [34, 35]. On the other hand, trauma systems (i.e., organised, regional, multidisciplinary response to injury) have been shown to be associated with reduced mortality, reduced disability and reduced cost in high-income countries [36, 37]. Trauma systems do not exist in rural sub-Saharan Africa, and are urgently needed.

Cardiovascular diseases were amongst the most frequent diagnoses in adults, especially in the age group of >50 years, where hypertensive emergency was the most common diagnosis. According to WHO estimates, cardiovascular diseases are the second most common cause of death in Africa [38]. Hypertension is prevalent in urban and rural sub-Saharan Africa, mostly not treated, and rarely well controlled [39, 40]. In a cross-sectional study performed in Ifakara, the overall prevalence of hypertension was 30%, and was 40 to 70% in the age group of >50 years [41].

Despite reports of a growing burden of cancer in low- and middle-income countries [42], cancer was the diagnosis in 0.4% of the cases only. Although x-ray and ultrasound were available, we cannot exclude the possibility that cancer was missed. However, cancer was not among the 30 leading causes of global prevalence and incidence for diseases in 2016 [43].

The annual in-hospital mortality rates remained similar, between 5.6 and 7.6% from 2015 to 2017, although hospital admissions declined in recent years. This might reflect that the overall disease severity of hospitalised patients was higher as a result of improved triage, but also of a rise in hospital admission fees in 2016. These data stand in contrast to other studies, were in-hospital mortality rate decreased after implementation of a triaging system and emergency care in urban hospitals in sub-Saharan Africa [5–8]. Data about mortality in our study were retrospectively retrieved from register books from the wards, which might not have been completed properly. Other reasons might be the lack of a trauma system and intensive care unit, and distance to the hospital and lack of a rapid transport by ambulances, leading to late presentation. Delayed presentation has been shown to be associated with a poor outcome in sepsis, trauma and pregnancy-related problems [44–47], and might have outweighed the benefit of an emergency department.

This study has limitations: First, the reported data relies on the clinical judgment of clinicians, which was based on clinical skills, available point-of-care tests, convention-
al x-ray and ultrasound. All clinicians were experienced and trained in emergency medicine during the study period. Second, the reporting was not standardised, such as according to ICD-10 codes, leading to possible reporting bias. This was most visible in the reporting of trauma mechanism, where we found comparatively detailed documentation on violence or animal encounters and little documentation on road accidents. By introducing a standardised categorisation into groups wherever possible, we attempted to address the possible bias. Third, triage with documentation of the South African triage scale score was not performed over 24 hours, but during regular working hours only. Thus, we could not analyse this score conclusively. Fourth, we were confronted with limited outcome measures to assess the impact of the emergency department: information on waiting time, time to diagnosis, time to treatment, or death in the emergency department was not available. Since in-hospital mortality depends on many factors, it does not represent an ideal outcome measure to evaluate the possible benefit of an emergency department. Fifth, we had no reliable data about patients attending the emergency department in 2015. Thus, we could not compare the number of admissions per number of patients. This information could have supported the theory that better triage contributed to in-hospital mortality. Finally, this was a single centre study and therefore findings might not be generalisable to other settings.

In conclusion, infectious diseases and trauma were the most common emergency department diagnoses during 1 year, with varying seasonal occurrence of respiratory tract infections, malaria and trauma. A substantial number of the patients suffered from a febrile illness whose cause remained unknown because of lack of diagnostic methods. Therefore, cheap and easy implementable diagnostic methods are needed. The implementation of trauma systems including pre-hospital emergency care, rapid transport with ambulances, surgery and intensive care medicine is urgently needed in rural sub-Saharan Africa.

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Competing interests

None

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Appendix 1

Supplementary data
| Diagnoses (n = 102) | Summarised diagnoses group 1 (shown in tables 2 and 3) (n = 41) | Summarised diagnoses group 2 (shown in figure 2) (n = 20) |
|---------------------|---------------------------------------------------------------|-------------------------------------------------------------|
| Acute Bronchitis    | Respiratory tract infection                                  | Infectious diseases                                         |
| Pneumonia           | -- lower respiratory tract infection                         |                                                              |
| Other acute respiratory problems |                     |                                                              |
| Upper respiratory tract infections |                   |                                                              |
| Urinary tract infection | Urinary tract infection                                    |                                                              |
| Fever of not defined origin | Fever of not defined origin                                 |                                                              |
| Malaria             | Malaria                                                      |                                                              |
| Diarrhoea           | Gastroenteritis/other intestinal infections                  |                                                              |
| Gastroenteritis     |                                                              |                                                              |
| Infection with helminths, parasites |                       |                                                              |
| Food poisoning      |                                                              |                                                              |
| Pelvic inflammatory disease | Sexual transmitted diseases (STD) |                                                              |
| Other sexually transmitted disease |                             |                                                              |
| Cellulitis          | Cellulitis and other soft tissue infections                 |                                                              |
| Abscess             |                                                              |                                                              |
| Myositis            |                                                              |                                                              |
| Wound infection     |                                                              |                                                              |
| Sepsis              | Sepsis                                                       |                                                              |
| Meningitis          | Meningitis                                                   |                                                              |
| Tuberculosis        | Tuberculosis                                                 |                                                              |
| HIV                 | HIV                                                          |                                                              |
| Trauma, not defined | Trauma                                                       | Trauma                                                      |
| Trauma due to animal encounter |                               |                                                              |
| Trauma due to fall of tree |                                             |                                                              |
| Trauma due to other mechanism |                         |                                                              |
| Trauma due to traffic accident |                              |                                                              |
| Trauma due to violence |                                           |                                                              |
| Trauma with dislocation |                                      |                                                              |
| Trauma with fracture |                                               |                                                              |
| Trauma with soft tissue injury |                                    |                                                              |
| Acute abdomen       | Acute abdomen                                                | Abdominal diseases                                          |
| Appendicitis        | Appendicitis                                                 |                                                              |
| Dyspepsia           | Dyspepsia                                                    |                                                              |
| GI problems (undefined) |                         | Other abdominal diseases                                      |
| GI obstruction      |                                                              |                                                              |
| Haemorrhoids        |                                                              |                                                              |
| Hernia, rectal prolapse |                          |                                                              |
| Other GI problems   |                                                              |                                                              |
| Hypertensive emergency | Hypertensive emergency                                      | Cardiovascular diseases                                     |
| Heart failure       | Heart failure                                                |                                                              |
| Stroke              | Stroke                                                       |                                                              |
| Gynaecological cyst | Gynaecological disease                                       | Gynaecological and pregnancy-related diseases                |
| Gynaecological problems (undefined) |                  |                                                              |
| Gynaecological problems, other |                        |                                                              |
| Gynaecological tumor |                                                              |                                                              |
| Menstruation abnormalities |                           |                                                              |
| Abortion            | Pregnancy complications                                      |                                                              |
| Hyperemesis gravidum |                                                              |                                                              |
| Physiological pregnancy problems |                     |                                                              |
| Preeclampsia        |                                                              |                                                              |
| Pregnancy problems (undefined) |                 |                                                              |
| Pregnancy problems, others |                           |                                                              |
| Lumbago             | Musculoskeletal pain                                         | Diseases of joints, bones and muscles                       |
| Other musculoskeletal disorders |                         |                                                              |
| Arthritis           | Arthritis                                                    |                                                              |
| Lipoma              | Skin diseases                                                | Diseases of skin and mucous membranes                       |
| Oral diseases       |                                                              |                                                              |
| Skin diseases unspecified |                           |                                                              |
| Other skin diseases |                                                              |                                                              |
| Otitis media        | Otitis media                                                 | ENT-and ophthalmological diseases                           |
| Cerumen impaction   | Other ENT diseases                                           |                                                              |

Table S1: Classification of diagnoses
| Diagnoses (n = 102) | Summarised diagnoses group 1 (shown in tables 2 and 3) (n = 41) | Summarised diagnoses group 2 (shown in figure 2) (n = 20) |
|---------------------|---------------------------------------------------------------|----------------------------------------------------------|
| Tonsillitis         |                                                               |                                                          |
| Epistaxis           |                                                               |                                                          |
| Goitre              |                                                               |                                                          |
| Laryngitis          |                                                               |                                                          |
| Nasal polyp         |                                                               |                                                          |
| Otitis media        |                                                               |                                                          |
| Rhinitis            |                                                               |                                                          |
| Sinusitis           |                                                               |                                                          |
| Other ear/nose/throat diseases |                       |                                                          |
| Ophthalmological diseases |                |                                                          |
| Asthma              | COPD/Asthma                                                   | Lung diseases                                             |
| Chronic obstructive lung disease |                      |                                                          |
| Other lung diseases | Other lung diseases                                           |                                                          |
| Epilepsy            | Epilepsy                                                      | Neurological diseases                                     |
| Bell's Palsy        | Other neurological diseases                                   |                                                          |
| Guillain Barré      |                                                              |                                                          |
| Polyneuropathy      |                                                              |                                                          |
| Other neurological disease |                      |                                                          |
| Hypoglycaemia       | Diabetic emergency                                            | Diabetic emergency                                        |
| Ketoacidosis        |                                                               |                                                          |
| Anaemia             | Anaemia/Sickle cell disease                                   | Haematological diseases                                   |
| Sickle cell disease |                                                               |                                                          |
| Malnutrition        | Malnutrition                                                  | Malnutrition                                              |
| Vitamin deficiency  |                                                               |                                                          |
| Liver disease       | Liver disease                                                 | Liver disease                                             |
| Kidney disease      | Kidney disease                                                | Kidney disease                                            |
| Cancer              | Cancer                                                        |                                                          |
| Urological diseases | Urological diseases                                           | Urological diseases                                       |
| Allergy             | Allergy                                                       |                                                          |
| Psychosis           | Psychiatric diseases                                          | Psychiatric diseases                                      |
| Panic attack        |                                                              |                                                          |
| other psychiatric disorders |                                      |                                                          |
| Check-up            | Other diseases                                                |                                                          |
| Dehydration         |                                                               |                                                          |
| Foreign body        |                                                               |                                                          |
| Lymphadenopathy     |                                                               |                                                          |
| No diagnosis        |                                                               |                                                          |
| Not readable        |                                                               |                                                          |
| Other disease       |                                                               |                                                          |
| Tongue tie          |                                                               |                                                          |
| Dead body           | Dead body                                                     |                                                          |