



Original article

The burden of HIV and tuberculosis on the resuscitation area of an urban district-level hospital in Cape Town

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ABSTRACT

Introduction: Many patients present to emergency centres with HIV and tuberculosis related emergencies. Little is known about the influence of HIV and tuberculosis on the resuscitation areas of district-level hospitals. The primary objective was to determine the burden of non-trauma patients with HIV and/or tuberculosis presenting to the resuscitation area of Khayelitsha Hospital, Cape Town.

Methods: A retrospective analysis was performed on a prospectively collected observational database. A randomly selected 12-week sample of data from the resuscitation area was used. Trauma and paediatric (<13 years) cases were excluded. Patient demographics, HIV and tuberculosis status, disease category, investigations and procedures undertaken, disposition and in-hospital mortality were assessed. HIV and tuberculosis status were determined by laboratory confirmation or from clinical records. Descriptive statistics are presented and comparisons were done using the χ^2 -test or independent *t*-test.

Results: A total of 370 patients were included. HIV prevalence was 38.4% (n = 142; unknown n = 78, 21.1%), tuberculosis prevalence 13.5% (n = 50; unknown n = 233, 63%), and HIV/tuberculosis co-infection 10.8% (n = 40). HIV and tuberculosis were more likely in younger patients (both $p < 0.01$) and more females were HIV-positive ($p < 0.01$). Patients with tuberculosis spend 93 min longer in the resuscitation area than those without ($p = 0.02$). The acuity of patients did not differ by HIV or tuberculosis status.

Infectious-related diseases and diseases of the digestive system occurred significantly more in the HIV-positive group, and endocrine-related diseases and diseases of the nervous system in HIV-negative patients.

HIV-positive patients received more abdominal ultrasound examinations ($p < 0.01$), blood cultures ($p < 0.01$) and intravenous antibiotics ($p < 0.01$). In-hospital mortality was 17% and was not influenced by HIV status ($p = 0.36$) or tuberculosis status ($p = 0.29$).

Conclusion: This study highlights the burden of HIV and tuberculosis on the resuscitation area of a district level hospital. Neither HIV nor tuberculosis status were associated with in-hospital mortality.

African relevance

- The prevalence of HIV and tuberculosis at entry-level hospitals are high
- HIV-positive patients presents frequently with infectious and parasitic diseases
- In-hospital mortality was not associated with either HIV or tuberculosis status

Introduction

The Human Immunodeficiency Virus (HIV) poses a substantial

healthcare burden on a global scale, particularly in socio-economically deprived regions [1]. In 2018, approximately 37.9 million people were living with HIV, with an estimated 1.7 million becoming newly infected and 770,000 dying from AIDS (Acquired Immunodeficiency Syndrome) related illnesses [2]. Sub-Saharan Africa accounts for almost 70% of the global HIV incidence, with South Africa being one of the top 10 countries contributing to the burden [3]. In 2017, South Africa's HIV-prevalence was 12.6% (7 million people) [4], while the Western Cape had an HIV prevalence of 6.6% in 2015/2016 (incidence 19,396 per 100,000 population) [5]. HIV was also associated with 6.1% (n = 3061) of all deaths in the Western Cape in 2015 [6].

Tuberculosis (pulmonary and extra-pulmonary) adds a similar

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burden. An estimated 10.4 million people were diagnosed globally with tuberculosis in 2016, with 25% of cases reported from the World Health Organization African region [1]. In the same year, the South African tuberculosis incidence was 520 per 100,000 persons, with a Western Cape incidence of 681 per 100,000 population [7].

Globally, in 2015, 1.2 million patients with tuberculosis (11%) were also found to be HIV positive [8]. Fifty seven percent of South Africans with tuberculosis had a documented HIV-positive status in 2016, with 39% of all newly diagnosed tuberculosis patients in the Western Cape being HIV-positive [7].

The prevalence of HIV and tuberculosis related emergencies is dictated by disease prevalence, the availability of treatment and the expertise of the health care system. Both conditions are known to be mimics of other diseases and healthcare professionals can easily miss the diagnosis. HIV infection is also associated with non-tuberculosis related complications. Serious and possibly life-threatening complications can relate to the respiratory system (bacterial pneumonia, Pneumocystis jiroveci pneumonia), the cardiac system (pericardial disease, cardiomyopathy) and the neurological system (cryptococcal meningitis, toxoplasmosis) [9], but essentially any organ system can be involved.

Patients with HIV and tuberculosis are able to access HIV and anti-tuberculosis treatment via numerous primary health care institutions across South Africa [10]. However, many of these patients still present to emergency centres, particularly with HIV and tuberculosis related emergencies. There is a perception amongst health care personnel that patients with HIV and tuberculosis place a large burden on the emergency centre [11]. Despite studies conducted within emergency centres in South Africa and the Western Cape, no studies have specifically described the burden of HIV and tuberculosis within emergency centres [12–14].

The primary objective was to determine the burden of patients with HIV and/or tuberculosis presenting to the resuscitation area of Khayelitsha Hospital, Cape Town. The secondary objective was to determine the association of HIV and tuberculosis status to in-hospital mortality.

Methods

A retrospective analysis was performed on a prospectively collected observational database. A supplementary chart review was performed to include additional variables and to limit missing data.

Khayelitsha Hospital is a 300-bed district-level hospital situated in the constantly expanding informal settlement of Khayelitsha, Cape Town [15]. It services a large, socio-economically challenged health district (population > 500,000 people) with high levels of unemployment (38%), interpersonal violence, and a high disease burden of tuberculosis and HIV [16]. The hospital provides in- and outpatient medical, surgical, paediatric and obstetric services. There is also an emergency centre that manages approximately 35,000 patients per annum with an admission rate of about 30%. The emergency centre is 30% larger than for a standard district level hospital in South Africa [15,16], with a five-bed (including one paediatric cot) dedicated resuscitation area. The area is equipped with monitoring devices (blood pressure, pulse oximetry, capnography, etc.) and acute capabilities for airway management, ventilation and defibrillation. It is the only area outside of the operating theatre where patients can be continuously monitored, as the hospital has no high care or intensive care facilities. The main admission criteria to the resuscitation area are based on a high acuity score according to the South African Triage Scale [17], or at the discretion of the senior medical practitioner on duty.

The electronic Khayelitsha Hospital Emergency Centre database is an ongoing, prospectively collected observational database and has previously been described [13]. Data are captured electronically, immediately coded and stored onto a password protected server, with a separately stored decoding sheet.

We have randomly selected 12 weeks between 1 November 2014 and 16 August 2015 from the database, using a computer-based random

number generator. The 12-week period was deemed sufficient to limit seasonal fluctuations. All patients admitted to the resuscitation area during this time period were eligible for inclusion, with the exception of paediatric (<13 years) and trauma related cases. The HIV-status of trauma patients seldom changes the provision of acute care in the emergency centre and these patients are thus not routinely tested for HIV.

Data have been collected by the investigators after a decoded, cleaned extract of the electronic database was obtained (cleaned: copied onto an Excel spreadsheet with all trauma and paediatric cases removed). The password protected Microsoft Excel® spreadsheet was then further populated by reviewing patients' electronic clinical records. Laboratory results not documented in the patient records were added by accessing the National Health Laboratory Service (NHLS) web view. NHLS data were double checked using patient name and date of birth to include results from all public health facilities that the patient may have attended.

Variables collected include patient demographics (age, gender), tuberculosis status (and treatment status if indicated), and HIV status (including CD4 lymphocyte count and antiretroviral use if HIV-positive). The CD4 cell count was accepted if performed within three months of presenting to the emergency centre. Patient acuity was measured using the South African Triage Scale, which categorises patients as Emergency (Red), Very urgent (Orange), Urgent (Yellow), and Non-urgent (Green) [17]. Data relating to the patient's stay in the resuscitation area included disease category, diagnostic tests performed, interventions received, disposition from and time spent in the resuscitation area. Diseases were categorized based on the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). The all-cause in-hospital mortality of patients was also collected and included patients that died within the emergency centre prior to hospital admission.

An HIV-positive case was defined as a laboratory confirmed result (either prior to admission or during the admission). Patients with an unknown HIV status were reported and analysed as such. An active tuberculosis case was defined as a laboratory confirmed result from any clinical specimen during the current admission, six months prior to admission, six months after admission, or patients who have been empirically diagnosed with active tuberculosis and started on anti-tuberculosis treatment. The tuberculosis status of patients with no tests related to the diagnosis of tuberculosis was reported as unknown. Results have been verified on the NHLS web view using the patient's folder number, initial and surname, or date of birth as filter criteria. Patients' clinical response to anti-tuberculosis treatment was not assessed. This is usually done at the primary health care level, and the emergency centre does not have access to these records. Patients were only tested for tuberculosis and/or HIV on clinical suspicion of the treating physician if the result was to affect the clinical management or outcome of the patient and not as a routine investigation.

Analysis was done using Microsoft Excel® and SPSS Statistics for Windows, Version 25.0 (IBM Corp. Released 2017. Armonk, NY: IBM Corp.). Patients with incomplete information have been excluded from analysis for those variables where information was missing. Summary statistics have been used to describe all variables. Distributions of variables are presented with frequency tables. The prevalence of HIV, tuberculosis and HIV/tuberculosis co-infection was calculated using the total number of patients in the sample as the denominator. The denominator for HIV and tuberculosis categories only included patients of whom the status could be determined as described above (i.e. unknown status was excluded). Data were categorized into four nominal variables to enable the comparison of in-hospital mortality: i) No active tuberculosis and HIV-negative, ii) No active tuberculosis and HIV-positive; iii) Active tuberculosis and HIV-negative, and iv) Active tuberculosis and HIV-positive. Pearson's χ^2 -test or Fisher's exact test were used for comparing proportions, and the independent samples *t*-test to compare medians. A 5% significance level was applied. The effect size of in-

hospital mortality is presented as odds ratio with 95% confidence intervals (CIs).

The study has been approved by the Stellenbosch University Health Research Ethics Committee (Ref: S15/10/243). The database from which the initial data was drawn is registered with the Stellenbosch University Health Research Ethics Committee (Ref: N14/08/102). A waiver of informed consent was granted.

Results

A total of 370 patients were analysed (Fig. 1). The prevalence of HIV was 38.4% (n = 142) (unknown status: n = 78, 21.1%), with only 48.6% (n = 69) of HIV-positive patients receiving anti-retroviral therapy (defaulted n = 8, 5.6%; unknown if on treatment n = 31, 21.9%). The median absolute CD4 cell count was 230 cells/mm³ (25th–75th percentile 61 to 420) in the 95 patients who had a documented absolute CD4 cell count.

The prevalence of tuberculosis was 13.5% (n = 50), although the majority of patients (n = 233, 63.0%) did not have any investigations to exclude or confirm a diagnosis of tuberculosis. Forty-four patients (88.0%) with active tuberculosis received treatment; four (8.0%) patients did not receive treatment while in hospital (treatment status unknown n = 2, 4.0%). The HIV/tuberculosis co-infection prevalence was 10.8% (n = 40).

The median age of patients was 40 years (25th–75th percentile 28 to 56) with HIV and tuberculosis more likely in younger patients (Table 1). The acuity of most patients were at least very urgent (n = 245, 66.2%).

The most frequent diseases managed in the resuscitation area during the study period involved intentional overdoses (n = 61, 16.5%), the respiratory system (n = 53, 14.3%) and the circulatory system (n = 45, 12.2%). Infectious-related diseases and diseases of the digestive system occurred significantly more in the HIV-positive group, whereas endocrine-related diseases and diseases of the nervous system were more frequent in HIV-negative patients (Table 2).

A total of 251 (67.8%) patients received a chest X-ray, 184 (49.6%) had an electrocardiogram (ECG) and 73 (19.7%) had an abdominal ultrasound examination (Table 3). HIV-positive patients were more likely

to be investigated by an abdominal ultrasound (p < 0.01) and a blood culture (p < 0.01). An HIV rapid test was performed on 87 (23.5%) patients and sputum investigations for tuberculosis done in 13 (3.5%) patients. The administration of intravenous antibiotics (n = 141, 38.1%) occurred significantly more in the HIV-positive group (78 (54.9%) versus 45 (30.0%), p < 0.01) (Table 3).

Half of the patients (n = 185, 50.0%) were subsequently managed by in-hospital specialist teams of which 44.9% (83/185) were HIV-positive and 18.4% (34/185) had active tuberculosis (Table 1). The in-hospital mortality during the study period was 17.0% (n = 63). Twenty-one patients (33.3%) died in the resuscitation area, 27 patients (42.9%) with in-hospital teams at Khayelitsha Hospital and 15 patients (23.8%) who were referred to a tertiary facility. Neither HIV-status (p = 0.36), nor tuberculosis status (p = 0.29) were associated with all-cause in-hospital mortality. The odds of dying while in hospital were 1.76 times higher for HIV-positive patients who also had active tuberculosis; this association was not significant (Table 4). Overall, 12 (19.0%) deaths related to the respiratory system, 11 (17.5%) to infectious and parasitic diseases, 9 (14.3%) to the digestive system, and 8 (12.7%) to the circulatory system.

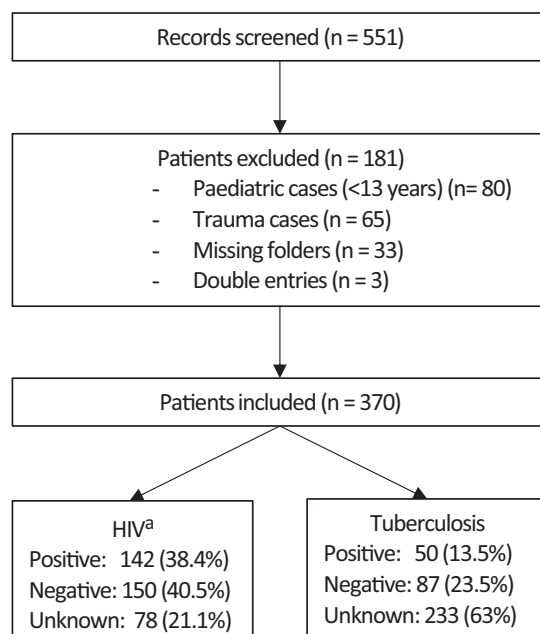
Discussion

This study describes the burden of tuberculosis and HIV on the resuscitation area of a district level hospital. HIV-positive patients place a unique burden on the resuscitation area of Khayelitsha Hospital with regards to intentional overdose and ultrasound examinations. The in-hospital mortality rate was high, but not associated with either HIV or tuberculosis status.

Our study findings suggest that the HIV prevalence of patients attending the resuscitation area is substantially higher than the provincial prevalence. This is in contrast to data from a district level emergency centre in KwaZulu-Natal, where the HIV prevalence of emergency admissions was similar to the provincial prevalence (emergency centre prevalence 44.4%; provincial prevalence 49.7%) [18]. The HIV prevalence in our study (38%) was three times higher than the national HIV prevalence in 2016, despite the Western Cape having an HIV prevalence rate well below the national figure [4]. However, Khayelitsha has the highest antenatal HIV prevalence in the Western Cape (34%) [19]. This would support a higher HIV prevalence in Khayelitsha than the rest of the Western Cape, despite taking into account that the antenatal HIV prevalence will be higher than the community prevalence as it reflects young sexually active females. Furthermore, the prevalence in the resuscitation area is expected to be higher than the prevalence in the community as HIV is known to make patients sicker. The exclusion of trauma patients also inflates the HIV prevalence as these patients are typically healthy young adults (a previous study reported a HIV prevalence of 23% in all adults presenting to the emergency centre) [13]. Nevertheless, HIV infection most likely does result in a disproportionate increase in admissions compared to HIV negative status.

The in-hospital mortality of medical patients presenting to the resuscitation area was substantially higher than trauma-related deaths from the same clinical area (17% versus 3%) [14]. This is expected as the mortality rate in medical patients is usually higher than in other clinical disciplines [20]. The in-hospital tuberculosis mortality rate (28%) was very similar to the national tuberculosis mortality rate of 21% in 2015 [8], but substantially higher than the 6% of the Western Cape [7]. Nonetheless, it was similar to the global tuberculosis in-hospital mortality amongst persons living with HIV of 27% in 2016 [21]. Neither HIV nor tuberculosis status correlated significantly with mortality, but our results may be confounded by the large proportion of patients that had an unknown tuberculosis and/or HIV status. More robust data regarding mortality rates in district level hospitals in South Africa is needed.

Point-of-care and formal ultrasound was used notably more in HIV-positive patients. The frequency of its use is considerably higher than



^a Human Immunodeficiency Virus

Fig. 1. Flow diagram of study population.

^a Human Immunodeficiency Virus.

Table 1

Patient demographics, acuity and mortality according to HIV and tuberculosis status in patients managed in the resuscitation area of Khayelitsha Hospital.

	Overall (N = 370)	HIV ^a -positive (n = 142)	HIV ^a -negative (n = 150)	p-Value	Tuberculosis positive (n = 50)	Tuberculosis confirmed negative (n = 87)	p-Value
Age (years), median(Q ₁ -Q ₃) ^b	40 (28–56)	36 (29–45)	46 (28–64)	<0.01	36 (30–45)	49 (34–68)	<0.01
Male, n (%)	149 (40.3)	42 (29.6)	75 (50.0)	<0.01	22 (44.0)	44 (50.6)	0.42
Time spent in area (minutes), median(Q ₁ -Q ₃) ^b	270 (135–480)	289 (145–500)	285 (135–480)	0.96	380 (240–730)	287 (182–483)	0.02
Patient acuity ^c , n (%)							
Non-urgent (green)	64 (17.3)	19 (13.4)	22 (14.7)	0.73	3 (6.0)	10 (11.5)	0.37
Urgent (yellow)	61 (16.5)	24 (16.9)	25 (16.7)	0.99	8 (16.0)	14 (16.1)	0.97
Very urgent (orange)	113 (30.5)	48 (33.8)	42 (28.0)	0.30	17 (34.0)	33 (37.9)	0.71
Emergency (red)	132 (35.7)	51 (35.9)	61 (40.7)	0.45	22 (44.0)	30 (34.5)	0.28
Disposition from resuscitation area							
Managed by emergency centre staff outside the resuscitation area	100 (27.0)	28 (19.7)	37 (24.7)	0.31	1 (2.0)	9 (10.3)	0.09
Referred to in-hospital services within Khayelitsha Hospital	185 (50.0)	83 (58.5)	74 (49.3)	0.12	34 (68.0)	54 (62.1)	0.58
Referred to tertiary facilities	63 (17.0)	23 (16.2)	30 (20.0)	0.40	11 (22.0)	18 (20.7)	0.51
Died in resuscitation area	21 (5.7)	7 (4.9)	9 (6.0)	0.69	4 (8.0)	6 (6.9)	1.00
Refused hospital treatment	1 (0.3)	1 (0.7)	0 (0)	–	0 (0)	0 (0)	–

^a Human Immunodeficiency Virus.^b 25th–75th percentile.^c According to the South African Triage Scale.**Table 2**

Disease categories of patients managed in the resuscitation area of Khayelitsha Hospital, overall and according to HIV-status.

ICD-10 ^a category, n (%)	Overall (N = 370)	HIV ^b -positive (n = 142)	HIV ^b -negative (n = 150)	p-Value
I Certain infectious and parasitic diseases	35 (9.5)	28 (19.7)	5 (3.3)	<0.01
IV Endocrine, nutritional and metabolic diseases	30 (8.1)	3 (2.1)	21 (14.0)	<0.01
VI Diseases of the nervous system	38 (10.3)	9 (6.3)	26 (17.3)	<0.01
IX Diseases of the circulatory system	45 (12.2)	14 (9.9)	22 (14.7)	0.21
X Diseases of the respiratory system	53 (14.3)	23 (16.2)	23 (15.3)	0.84
XI Diseases of the digestive system	42 (11.4)	26 (18.3)	13 (8.7)	0.02
XIV Diseases of the genitourinary system	21 (5.7)	5 (3.5)	9 (6.0)	0.32
XV Pregnancy, childbirth and the puerperium	15 (4.1)	6 (4.2)	4 (2.7)	0.46
XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	11 (3.0)	1 (0.7)	6 (4.0)	0.12
XIX Injury, poisoning and certain other consequences of external causes	61 (16.5)	21 (14.8)	13 (8.7)	0.10
Other	19 (5.1)	6 (4.2)	8 (5.3)	0.66

^a International Statistical Classification of Diseases and Related Health Problems 10th Revision.^b Human Immunodeficiency Virus.

data from a HIV-cohort presenting to an emergency centre in KwaZulu/Natal [18]. Ultrasound has been used to diagnose extra-pulmonary tuberculosis in mainly HIV-positive patients [25–27], despite the lack of robust evidence for its use. Abdominal ultrasound had a pooled sensitivity of 63% and pooled specificity of 68% in diagnosing bacteriologically confirmed HIV-associated tuberculosis; however the review reported very low quality evidence and only included one study evaluating point-of-care ultrasound [28]. Issues encountered with point-of-care ultrasound in the emergency centre environment are that not all

Table 3

Diagnostic tests and therapeutic interventions performed in patients managed in the resuscitation area of Khayelitsha Hospital.

Variable, n (%)	Overall (N = 370)	HIV ^a -positive (n = 142)	HIV ^a -negative (n = 150)	p-Value
Diagnostic test				
Chest X-ray	251 (67.8)	109 (76.8)	105 (70.0)	0.12
Electrocardiogram (ECG)	184 (49.7)	63 (44.4)	74 (49.3)	0.46
Abdominal ultrasound (point-of-care or formal)	73 (19.7)	42 (29.6)	20 (13.3)	<0.01
Blood culture	72 (19.5)	44 (31.0)	22 (14.7)	<0.01
Therapeutic intervention				
Intravenous antibiotics	141 (38.1)	78 (54.9)	45 (30.0)	<0.01
Intravenous potassium replacement	16 (4.3)	8 (5.6)	7 (4.7)	0.03
Continuous positive airway pressure	16 (4.3)	2 (1.4)	9 (6.0)	<0.01
Intubation and ventilation	12 (3.2)	2 (1.4)	8 (5.3)	<0.01
Inotropes	8 (2.2)	3 (2.1)	2 (1.3)	<0.01

^a Human Immunodeficiency Virus.

emergency doctors are proficiently trained in performing these investigations, which are operator dependant and may yield variable results depending on the user [29]. Formal abdominal ultrasound is also subject to the availability of proficiently trained sonographers in an already burdened radiology department, where imaging often only happens the following day or when sonographers are available. Care should be taken to overrely on abdominal ultrasound for the diagnosis of tuberculosis as the additional yield in relation to other point-of-care and near-patient tests are limited [30].

Several factors may have influenced the results of this study. A major limitation in this study was the large number of patients with an unknown HIV and/or tuberculosis status. It is thus possible that the prevalence of these diseases may therefore be underestimated. The study was confined to the resuscitation area and not all areas of the emergency centre. The capacity of the resuscitation area is limited and it is possible that patients who should have been managed in the resuscitation area

Table 4

The association between HIV and tuberculosis status and in-hospital mortality in patients managed within the resuscitation area of Khayelitsha Hospital.

	HIV ^a -positive				HIV ^a -negative			
	Tuberculosis positive (n = 40)		Tuberculosis confirmed negative (n = 41)		Tuberculosis positive (n = 10)		Tuberculosis confirmed negative (n = 41)	
In-hospital mortality	n (%)	Odds ratio (95% CI ^b)	n (%)	Odds ratio (95% CI ^b)	n (%)	Odds ratio (95% CI ^b)	n (%)	Odds ratio (95% CI ^b)
Dead	12 (30.0)	1.76 (0.75–4.12)	8 (19.5)	0.76 (0.31–1.89)	2 (20.0)	0.84 (0.17–4.18)	8 (19.5)	0.76 (0.31–1.89)
Alive	28 (70.0)		33 (80.5)		8 (80.0)		33 (80.5)	

^a Human Immunodeficiency Virus.^b Confidence interval.

were managed in the general emergency centre when the resuscitation area was fully occupied. The actual disease burden on the emergency centre as a complete entity remains unclear. Care should be taken to generalise the results of this study to other health districts, provinces or countries due to the small sample size and the unique population profile of Khayelitsha. The actual causes of death were not analysed, and it remains unclear whether HIV and/or tuberculosis were just contributing factors or the actual cause of death. A single trained reviewer, not blinded to the study objective, performed the chart review using a standardized data collection form. Important variables were also clearly defined. However, the validity of the results could have been improved by using a second reviewer and assessing the interrater agreement.

Conclusion

This study highlights the burden of HIV and tuberculosis on the provision of acute care at a district-level hospital. Despite this burden, the in-hospital mortality was not associated with either HIV or tuberculosis status indicating that the biggest impact on patient outcome seems to relate to the acuity of the presentation.

Dissemination of results

Results from this study were shared with the management team at the data collection site. The results were also presented at the African Conference on Emergency Medicine 2018 in Kigali, Rwanda.

CRedit authorship contribution statement

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content:

LS contributed 60%, DJvH 35%; and SL contributed 5%.

All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Authors' contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: *LS contributed 60%, DJvH 35%; and SL contributed 5%*. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflicts of interest.

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