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RESEARCH ARTICLE

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Causative Factors of Medical In-patient Mortality at a District Hospital in South Africa: A Retrospective Study

Setshone Lazarus Kagiso Pitso[1], Uchenna Bendine Okafor[2,*] and Daniel Ter Goon[3]

[1]Department of Public Health, Faculty of Health Science, University of Fort Hare, Alice, South Africa
[2]Department of Nursing Science, Faculty of Medicine and Health Sciences, Walter Sisulu University, Nelson Mandela Drive Campus, Mthatha. 5117, South Africa
[3]Faculty of Health Sciences, University of Limpopo, C/O R71 Tzaneen Road and University Street Mankweng Township, Polokwane 0727, South Africa

Abstract:

Background: In-patient mortality remains low when compared to general mortality rates; nonetheless, medical in-patient death rates are increasing. Few studies have been undertaken in South Africa to investigate the reasons for in-patient mortality, primarily at tertiary institutions and excluding rural settings. Such data are critical for informing health-system strengthening and planning policies and interventions.

Objective: This study aimed to examine the factors that contribute to hospital in-patient death in a district hospital in South Africa.

Methods: A cross-sectional analytic study design was undertaken. Data pertaining to patients aged 15 years or older were obtained from in-patient record reviews ranging the period from January 2015 to December 2016. Socio-demographic factors, clinical factors, hospital length of stay, and death outcomes were extracted. Logistic regression was used to determine factors associated with in-patient mortality and Adjusted Odds Ratios (AORs) and 95% Confidence Interval (CI) were reported.

Results: Employed patients were more likely to die than unemployed patients (AOR = 8.315; 95% CI: 1.709 - 18.443), while remaining in the hospital for three days was not protective against death compared to staying less than 24 hours (AOR = 0.139; 95% CI: 0.027-0.714). HIV-infected individuals in WHO clinical stages III/IV (AOR = 10.13; 95% CI: 8.74–12.28) and I/II (AOR = 5.309; 95% CI: 0.315–89.53) were more likely to die. Patients with cancer conditions had a 10.164 times higher mortality rate (95% CI: 1.912 to 18.62).

Conclusion: Our findings demonstrated the key modifiable predictors of in-patient mortality to include TB infection, advanced HIV stage, and prolonged hospital stay, highlighting the need for targeted interventions to address these factors in order to reduce in-patient mortality.

Keywords: In-patients, Mortality, Risk factors, Adjusted odds ratios, HIV-infected individuals, Health-system.

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*Address correspondence to this author at the Department of Nursing Science, Faculty of Medicine and Health Sciences, Walter Sisulu University, Nelson Mandela Drive Campus, Mthatha. 5117, South Africa; E-mail: ucheysonic@gmail.com

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1. INTRODUCTION

Medical in-patient mortality imposes a financial and psychological burden on families and communities. It is an interaction of patient- and health-system-related factors that cascade into socioeconomic, clinical, and hospital stay duration characteristics. The demographic factors associated with in-patient mortality encompass socio-economic characteristics, such as low education [1-3], advanced age or the elderly [4-7], young age [8, 9], and gender [10-14]. Other research studies have, however, found no age-sex difference in in-patient mortality [9, 15] influencing medical in-patient mortality. Race [9], unemployment [16-18], and low socioeconomic level or financial difficulties [9, 19, 20] are other socioeconomic and demographic characteristics related to in-patient mortality. These factors underscore the importance of addressing Socioeconomic Determinants of Health (SDoH) to improve overall population health outcomes. A paradigm shift from a curative health system to a preventative model, focusing on the SDoH that influence individuals' living, working, leisure, and aging situations, could render this attainable; yet, it remains overlooked [21]. Addressing the SDoH could potentially minimize morbidity in rural, marginalized, and underserved groups. This approach could reduce premature mortality due to noncommunicable and infectious diseases. This highlights the importance of improving non-medical treatments to address the mortality-causing factors associated with SDoH. The scientific research on the short and long-term health consequences linked with chronic and infectious diseases emphasises the necessity of including social connections in public health discourse [22-26].

Clinically, poor immunological status [27], bacterial infections [13, 27, 28], underlying co-morbidities [15, 29, 30], and undernutrition [16] could have a predictive influence on in-patient mortality. In addition, the length of stay in a facility is linked to poor health outcomes and death [5-7, 31]. Clinical strategies to minimise hospital stays and improve in-patient quality of care may help to reduce patient mortality.

In developed nations, studies have indicated that circulatory, respiratory, and cancerous disorders are the leading causes of death [32]. Cardiovascular events are the second largest cause of mortality in France, while cancer is the first major cause of death in China [33]. In contrast, infectious diseases appear to be the main cause of medical in-patient mortality in most less-developed countries [34]. Notably, Tuberculosis (TB) continues to be one of the leading causes of death among infectious diseases in Malaysia and South Africa. Similarly, the comorbidity of tuberculosis and HIV-positive mortality is apparent in South Africa. It is estimated that about 360,000 people developed tuberculosis in South Africa in 2019, with 58% being HIV-positive and 17% dying [35]. Several studies have documented the co-occurrence of tuberculosis alongside HIV/AIDS interaction, which has resulted in mortality among hospitalised patients, both in South Africa [29, 36, 37] and in other nations [10, 30, 38, 39]. These studies have demonstrated how comorbidities affect patient mortality. To reduce morbidity and mortality among hospitalised patients, as well as the economic and social burden of disease, additional interventions are required for both communicable and non-communicable conditions. An improvement in the population's lifestyle choices, behaviours, and attitudes concerning their health may potentially contribute to enhanced health outcomes. As Li *et al*. [18] pointed out, any change in lifestyle or working environment can raise rates of respiratory transmission, and delayed healthcare access can extend the duration of contagiousness of TB-affected patients, creating more opportunities for transmission. Furthermore, surveillance studies on communicable and non-communicable diseases are required for early detection and management to reduce mortality.

The South African public health sector has made major investments in tackling preventable causes of death in public hospitals by ensuring continual training of its professionals to meet the demands of the quadruple burden of disease that impacts communities [40]. Additionally, several initiatives have been implemented in the country to combat the scourge of HIV/AIDS and tuberculosis, such as universal tests and TB screening tools and tracing treatment defaulters and loss to follow-ups. Despite the government's efforts, facility in-patient mortality rates continue to rise, creating an unfavourable perspective on public healthcare services because of a lack of knowledge regarding the causative factors of medical in-patient deaths. In South Africa, one of the multifactorial reasons for inpatient medical mortality is a lack of knowledge about the health issues that contribute to hospital admission and related deaths in the hospital in rural and semi-rural hospitals [13].

Most studies examining the epidemiology and outcomes of in-patient adults admitted to health facilities due to various medical conditions in South Africa have focused on tertiary health facilities across urban settings [41-45], while there is a paucity of data on district health facilities mostly located in rural areas. Schweizer Reneke District Hospital (SRDH) is a level 1 rural hospital dedicated to disease prevention, treatment, and control; yet its crude fatality rate is 7.6, owing to medical in-patient mortality. Investigating the factors that contribute to in-patient death in rural-based healthcare facilities, such as SRDH, can help influence government health policy on medical in-patient mortality. Context specific health facility in-patient mortality analyses are crucial to inform specific interventions to reduce in-patient mortality. This retrospective analysis was conducted to identify the factors contributing to medical in-patient death at SRDH.

2. MATERIALS AND METHODS

2.1. Research Design

This was a cross-sectional, retrospective investigation to evaluate the causes of medical in-patient death at SRDH from January 1, 2015, to December 31, 2016.

2.2. Setting Study Population

The study was carried out at SRDH, located in the small farming community of Schweizer Reneke. As part of a primary health care provider network consisting of four clinics and one community health center, SRDH has 63 operational in-patient units and serves an approximate 65,000-person catchment area. The medical wards feature a general medical ward and a short stay in an accident and emergency section.

2.3. Inclusion and Exclusion Criteria

The study's inclusion criteria were in-patient mortality in the general medical ward and medical short-stay ward, age above 15, and duration from January 2015 to December 2016. Exclusion criteria included fatalities in maternity and paediatric wards involving in-patients younger than 15 years of age, prior to arrival, or occurring between January 2015 and December 2016.

2.4. Sample Size Estimation

Using data from the District Hospital Information, we determined the sample size by counting the number of patients who died within the designated period. We used EPINFO 7 to calculate the sample size, based on the medical inpatient fatalities (population) of 278. We selected a sample of 161 with an acceptance margin error of 5% and a confidence level of 95%. In consideration of a 25% contingency for missing data and multiple comparisons during data analysis, the final sample size comprised 201 participants. We applied systematic sampling, selecting every third medical in-patient file in the row, to avoid bias.

2.5. Data Collection

The data for this study were collected from medical case records of the deceased and DHIS from SRDH utilising a checklist tool reflecting the objective of the study. The study's variables were based on the type of mortality and risk factors. The independent factors were age (years), gender (male, female), race, marital status, employment status, education, socioeconomic status, HIV status, and hospital stay duration. The confounding variables were residential area, alcohol use, smoking, and treatment support. The medical records of the deceased inpatients were rigorously examined by the primary author to ensure accuracy and completeness, with verification against the data collection checklist listing all relevant variables. The data were then captured on an Excel Microsoft spreadsheet, double-checked, and exported to Statistical Package for Social Sciences (SPSS) version 29.0 for cleaning and analysis.

2.6. Ethical Consideration

The University of Fort Hare Health research ethics committee approved the study (FER021SPIT01). Furthermore, the district manager for the Department of Health authorised the collection of data. The present study adhered to all relevant research regulations and ensured the protection of participants' rights and privacy. There was no physical interaction between the deceased patient and their family members. Therefore, the requirement for participant permission was waived. The deceased's medical records and the DHIS dataset were both kept strictly confidential.

2.7. Data Analysis

Descriptive statistics were used to describe the data in terms of counts, frequencies, means, and standard deviation. Bivariate cross-tabulations were done, and the Chi-squared 2 test was employed to determine any significant relationships or differences in proportions regarding mortality outcome. Furthermore, inferential statistics (logistic regression) were used to determine the associations between socio-demographics (age, gender, marital status, place of residence, and education) and clinical characteristics and mortality and adjusted ratios and 95% confidence intervals. A *p*-value of 0.05 was used to signify statistically significant testing. All statistical analyses were carried out using Statistical Package for Social Sciences (SPSS) version 29.0.

3. RESULTS

The patients' socio-demographic factors are summarised in Table **1**. Most of the participants were aged 15-49 years (40.8%), males (66.17%), and Black Africans (97.5%). The majority of the study participants were single (62.2%), while a significant group were single (62.19%) and residing in the Ipelegeng region (78.1%). Most study participants were employed (38.3%) and attained secondary or tertiary education (32.8%). There were 43.3% who took alcohol and 48.8% were smokers.

Table 1. Participants' socio-demographic characteristics.

Variable	n (%)
Age (years)	
15-49	82 (40.80)
50-65	62 (30.85)
66 and above	57 (28.36)
Gender	
Male	133 (66.17)
Female	68 (33.83)
Race	
Black African	196 (97.51)

(Table 1) contd.....

Variable	n (%)
White	1 (0.50)
Coloured	4 (1.99)
Marital status	
Married	57 (28.35)
Divorced	2 (1.00)
Single	125 (62.19)
Widowed	17 (8.46)
Residential area	
Amalia	14 (6.97)
Ipelegeng	157 (78.11)
Migdol	11 (5.47)
Farms	8 (3.98)
Other areas	11 (5.47)
Employment status	
No	25 (12.44)
Yes	77 (38.31)
Not specified	25 (12.44)
Pensioners	74 (36.82)
Level of education	
Primary	22 (10.95)
Secondary/tertiary	66 (32.84)
Not specified	113 (56.22)
Alcohol use	
No	77 (38.31)
Yes	87 (43.28)
Not specified	37 (18.41)
Smoking	
No	65 (32.34)
Yes	98 (48.76)
Not specified	38 (18.91)

The clinical characteristics of the study participants are shown in Table **2**. The majority of the participants (80.1%) had access to treatment support, 37.8% were referred, and 39.3% were HIV positive, and most of these were in WHO clinical stage III/IV (28.9%). Most of the participants were admitted to the hospital for at least four days (46.8%), and the diagnosis at death included TB infection (26.4%), cancer (11%), and cardiac failure (9%). There was a substantial difference in the association between mortality and HIV status (p=0.001), WHO HIV clinical stages (p=0.002), Cotrimoxazole Prophylactic Therapy (CPT) and Isoniazid (INH) prophylaxis (p=0.002), being on Antiretroviral Therapy (ART) (p=0.004) and the diagnosis at death (p<0.001) (Table **2**).

The home, clinic or outpatients, hospital admission or emergency, and ward or hospital modifiable factors are displayed in Table **3**. Few participants had danger signs not identified (2.99%); however, there were more participants delayed for diagnosis (60.7%). Those who defaulted treatment or follow-up accounted for 21.89%, and 27.9% of participants had clinic/outpatient modifiable factors. For the admission and emergency modifiable factors, 32.8% had danger signs not identified, 13.4% had a second opinion not sought, and 15.9% had investigations not done. Similarly, for the ward or hospital modifiable factors, 21.9% of the participants had danger signs not identified, 14.9% had delayed investigations, and 26.4% did not have a second opinion performed. The bivariate analyses indicated that home, hospital stay duration, admission or emergency, and ward or hospital modifiable factors were significantly associated with the mortality outcome, except for admission and emergency hospital where danger signs were not identified (p<0.001).

The univariate and multiple logistic regression models determined the socio-demographic, clinical, and modifiable factors associated with mortality (Table **4**). The univariate regression analysis demonstrated that HIV-positive patients were 77.8% less likely to die than those who were HIV-negative (COR=0.228; 95%CI: 0.100-0.519). Regarding those who were HIV negative, those who were in WHO clinical stage I/II were 79% less likely to die (COR=0.205; 95%CI: 0.079-0.531), those who were currently on CPT prophylaxis were 82.8% less likely to die (COR=0.171; 95%CI: 0.612-0.472), and those who were presently on INH prophylaxis were 78% less likely to die (COR=0.216; 95%CI: 0.077-0.605). Those diagnosed with cancer were 12 times (95%CI: 3.885-37.061) more likely to die compared to those diagnosed with other conditions.

Table 2. Clinical characteristics of the patients stratified by mortality outcome variable.

Variable	n (%)	Chi-squared Test
Treatment support available		
Yes	161 (80.10)	0.883
No	40 (19.90)	
Referred		
Yes	76 (37.81)	0.267
No	40 (19.90)	
Referring facility and/or in-transit		
Clinic	55 (27.36)	0.768
Private	11 (5.47)	
Other facilities	135 (67.16)	
HIV/AIDS results		
Negative	86 (42.79)	
Positive	79 (39.30)	**0.001**
Unknown	36 (17.91)	
WHO HIV clinical staging		
I & II	14 (6.97)	
III & IV	58 (28.86)	**0.002**
Unknown	43 (21.39)	
HIV negative	86 (42.79)	
HIV/AIDS CPT prophylaxis		
Current	57 (28.36)	
Ever	14 (6.97)	**0.002**
Never	44 (21.89)	
HIV negative	86 (42.79)	
HIV/AIDS INH prophylaxis		
Current	46 (22.64)	
Ever	12 (5.97)	**0.002**
Never	14 (6.97)	
Unknown	43 (21.39)	
HIV negative	86 (42.79)	
HIV/AIDS on ART		
Current	51 (25.37)	
Ever	16 (7.96)	**0.004**
Never	11 (5.47)	
Unknown	37 (18.41)	
HIV negative	86 (42.79)	
Hospital stay duration		
0-1 days	65 (32.34)	0.166
2-3 days	5 (10.64)	
4 and above days	102 (46.81)	
Diagnosis at death		
Tuberculosis	53 (26.37)	
Other infections	66 (32.84)	**0.001**
Cerebrovascular disease	19 (9.45)	
Cancer	22 (10.95)	
Shock	23 (11.44)	
Cardiac failure	18 (8.96)	

Abbreviations: CPT; Cotrimoxazole prophylactic therapy, INH; Isoniazid, ART; Antiretroviral therapy.

Table 3. Modifiable factors associated with mortality.

Variable	n (%)	Chi-squared Test
Home: Danger signs not identified		
Yes	195 (97.01)	0.559
No	6 (2.99)	
Home: Delayed in seeking medical help		
Yes	79 (39.30)	0.857
No	122 (60.70)	
Home: Defaulted treatment or follow-up		
Yes	157 (78.11)	0.774
No	44 (21.89)	
Clinic/outpatients modifiable		
Yes	145 (72.14)	0.128
No	56 (27.86)	
Admissions and emergency hospital: Danger signs not identified		
Yes	135 (67.16)	0.001
No	66 (32.84)	
Admissions and emergency hospital: The second opinion was not sought		
Yes	174 (86.57)	0.737
No	27 (13.43)	
Admissions and emergency hospital: Investigations not done		
Yes	169 (84.08)	0.814
No	32 (15.92)	
Ward/hospital: Danger signs not identified		
Yes	157 (78.11)	0.185
No	44 (21.89)	
Ward/hospital: Delay in doing investigations		
Yes	171 (85.07)	0.994
No	30 (14.93)	
Ward/hospital: The second opinion was not done		
Yes	148 (73.63)	0.365
No	53 (26.37)	

The multiple regression model (Table 4) showed variations to the crude estimates in some covariates. We incorporated all dependent and independent factors in the full regression model to demonstrate their interactions, while controlling for confounding variables to maintain the internal validity of the results. The confounding variables in multiple regression analysis, along with specific comorbidities, highlighted the interplay of clinical and demographic variables in predicting the causes of in-patient death. Adjusting for confounding factors, those who had stayed in the hospital for three days were 86.1% times more likely to die compared to those who waited for less than 24 hours (AOR=0.139; 95%CI: 0.027-0.714) and those who were referred were 3.021 times (95%CI: 1.081-8.44) more likely to die compared to those who were not referred. Regarding those who were HIV negative, those in WHO clinical stage III/IV were 10.13 times (95%CI: 8.74-12.28) more likely to die, while those in WHO clinical stage I/II were 5.309 times (95%CI: 0.315-89.53) more likely to die. The odds of death were 10.164 times (95%CI: 1.912-18.62) among those diagnosed with cancer at the end, compared to other infections.

Table 4. Univariate and multiple logistic regression analyses to identify factors associated with mortality.

Variable	Crude OR (95%CI)	Adjusted OR (95%CI)
Level of education		
Primary	1 (reference)	1 (reference)
Secondary/tertiary	0.469 (0.136-1.623)	1.565 (0.246-9.982)
Unknown	1.463 (0.499-4.287)	**6.942 (1.186-40.626)**
Gender		
Male	1 (reference)	1 (reference)
Female	**0.447 (0.206-0.967)**	**0.120 (0.031-0.448)**

(Table 4) contd.....

Variable	Crude OR (95%CI)	Adjusted OR (95%CI)
Marital status	1 (reference)	1 (reference)
Divorced	1.591 (0.095-26.761)	0.276 (0.005-18.799)
Single	0.234 (0.111-0.493)	**0.192 (0.054-0.684)**
Widowed	1.414 (0.475-4.212)	1.737 (0.382-7.901)
Employment status		
No	1 (reference)	1 (reference)
Yes	2.116 (0.681-6.571)	**8.315 (1.709-18.443)**
Not specified	2.606 (0.869-7.805)	**6.086 (1.307-12.342)**
Pensioners	**3.216 (1.411-7.329)**	1.313 (0.388-4.435)
Hospital stay duration		
0-1 days	1 (reference)	1 (reference)
2-3 days	0.388 (0.131-1.149)	**0.139 (0.027-0.714)**
Four days and above	0.619 (0.305-1.255)	0.355 (0.115-1.097)
Referred		
No	1 (reference)	1 (reference)
Yes	1.454 (0.749-2.821)	**3.021 (1.081-8.44)**
HIV/AIDS results		
Negative	1 (reference)	1 (reference)
Positive	**0.228 (0.100-0.519)**	0.107 (0.006-2.058)
Unknown	0.428 (0.168-1.091)	**0.174 (0.041-0.751)**
Admissions and emergency hospital: Second opinion not sought		
No	1 (reference)	1 (reference)
Yes	1.173 (0.462-2.973)	**0.093 (0.019-0.448)**
WHO HIV clinical staging		
HIV negative	1 (reference)	1 (reference)
I/II	**0.205 (0.079-0.531)**	**5.309 (0.315-89.53)**
III/IV	0.296 (0.062-1.407)	**10.13 (8.74-12.28)**
HIV/AIDS CPT prophylaxis		
HIV negative	1 (reference)	
Current	**0.171 (0.612-0.472)**	
Ever	0.296 (0.062-1.408)	
Never	0.456 (0.194-1.072	
HIV/AIDS INH prophylaxis		
HIV negative	1 (reference)	
Current	**0.216 (0.077-0.605)**	
Ever	0.355 (0.073-1.723)	
Unknown	0.469 (0.199-1.106)	
HIV/AIDS on ART		
HIV negative	1 (reference)	
Current	0.237 (0.91-6.17)	
Ever	0.409 (0.108-1.549)	
Unknown	0.414 (0.163-1.052)	
Diagnosis at death		
Other infections	1 (reference)	1 (reference)
Tuberculosis	0.921 (0.355-2.384)	1.967 (0.439-8.799)
Cerebrovascular disease	2.077 (0.656-6.572)	1.618 (0.314-8.342)
Cancer	**12.00 (3.885-37.061)**	**10.164 (1.912-18.62)**
Cardiac failure	1.286 (0.359-4.602)	1.773 (0.362-8.671)

Abbreviations: CPT; Cotrimoxazole prophylactic therapy, INH; Isoniazid, ART; Antiretroviral therapy.

4. DISCUSSION

This retrospective study investigated demographic and clinical causes of in-patient death at a district hospital in South Africa. The key findings of the study revealed advanced HIV stage, prolonged hospital stay, TB infection, cancer, and cardiac failure conditions to be major predictors of in-patient mortality. These findings have clinical and public health implications and underscore the need for strategic interventions to reduce patient mortality at a district hospital in South Africa.

Our findings found that 39.3% were HIV positive, and among these, 28.4% were in WHO clinical stage III/IV, with TB infection being the primary cause of death, followed by cancer and heart failure. Notably, TB is still one of the leading causes of death in South Africa, alongside heart disease and cancer [40]. Our finding of tuberculosis-associated mortality is consistent with other studies reporting high inpatient mortality among HIV-positive people in South Africa [29, 36, 37] and elsewhere [10, 30, 38, 39, 46]. In 2019, approximately 360,000 persons were diagnosed with tuberculosis in South Africa; of these, 58% were HIV-positive and 17% died [35]. Nonetheless, a considerable percentage of HIV-positive patients were hospitalised [47]. We found that HIV-negative participants were 77.8% less likely than HIV-positive participants to die from other associated illnesses. A prior study found that HIV-positive patients were more likely to die from diseases, like influenza, than HIV-negative patients [29]. Similarly, other studies [48-51] have documented HIV/TB co-morbidities in rural hospital settings. This underscores the importance of addressing the socio-economic determinants of health, which influence the health outcomes of patients living and working in different socio-economic and environmental contexts. In addition, interventions to enhance the behaviour and health of HIV-positive individuals should focus on health education and lifestyle changes. Aside from antiretroviral therapy coverage, HIV-patients are vulnerable to morbidity and co-morbidities while hospitalised. The quality of inpatient healthcare provided to them while in the hospital, early diagnosis and management of HIV defaulter treatment and TB, and accessibility of healthcare resources are likely factors that could impact the mortality of inpatient hospitalisation among HIV-positive patients [38]. As a result, efforts to reduce tuberculosis transmission should be intensified significantly. These include strengthening TB health advocacy and education campaigns and the need for improved TB screening protocols or strategies to reduce delays in seeking care.

Cancer and heart failure were also significant causes of inpatient mortality in the hospital studied in our study. Other studies in South Africa [52] and other countries [11, 46, 53] have found these diseases to be the leading cause of inpatient mortality. In Africa, inpatient mortality due to heart failure is between 9 to 12.5% [54]. In developed nations, research has indicated circulatory, respiratory, and cancer disorders to be the leading causes of death [32]. There is a need for early detection and care of non-communicable diseases, as well as modifying lifestyle behaviours to promote improved health and minimise mortality and the burden associated with cancer and health failure. Patients presenting with cancer and heart failure may die because of delayed diagnosis and other underlying illnesses. However, these were outside the purview of our study and were hence not examined. It is worth noting that rural, distant, and underserved people often have restricted access to health care due to poverty, a lack of education, and geographic accessibility, all of which have a constraining effect on their timely or health-seeking activity. Improving the rural-urban divide in the provision of healthcare services is crucial to maintaining the health of rural areas, which are sometimes neglected in health and other infrastructural facilities. This, in turn, can improve poor health outcomes and lower mortality and morbidity rates [55]. According to Ngene *et al*. [55], there is a wide disparity between rural and urban settings in South Africa, with stark disparities in health facility indicators, such as drug and medical supply availability, overcrowding, transportation barriers, poor/lack of emergency medical services, and a shortage of health workers. Furthermore, additional efforts are needed to enhance preventive healthcare to enhance cardiovascular health, which is influenced by several factors, including obesity, cigarette smoking, drug abuse, and inadequate comorbidity control.

Furthermore, people with cancer were 10.16 times more likely to die than those with other diseases. Similar studies have found a higher mortality rate among cancer patients [56, 57]. Breast, cervical, prostate, liver, and colorectal cancers accounted for 45% of deaths in South Africa [58]. Notably, cancer is the main cause of death worldwide [59], and in SSA, the growing cancer mortality necessitates immediate action [60] due to a projected large increase from 520348 mortality annually in 2020 to about 1 million deaths per year by 2030 [61]. Interventions, such as lifestyle changes, increased awareness of risk factors, early cancer detection and treatment, as well improved access to quality health care, are critical in reducing cancer mortality and, ultimately, reducing the burden on the health system, particularly in less-developed and resource-constrained countries, such as South Africa.

Our findings also showed that advanced WHO HIV clinical staging (III and IV) was a stronger predictor of mortality in patients than lower clinical HIV staging (WHO stages I and II). Other studies in Cameroon [62], Ethiopia [63, 64], East Africa and Nigeria [65], Iran [66], and Malawi [67] have found advanced WHO HIV clinical disease stages to be a predictor of mortality. The advancement in WHO HIV clinical staging puts an HIV patient at risk of developing and recurrent opportunistic infection, which could result in death. Despite huge efforts, such as the massive antiretroviral medicine rollout, South Africa remains the world's second-leading country in terms of high HIV-related mortality [68].

According to our findings, inpatient admission deaths were more common among patients who spent four days or less than among patients who were admitted for less than 24 hours due to delayed presentation. Notably, significant comorbidities [2, 69], prolonged ICU stay [11, 70], and undernutrition [16] were related to increased length of stay and inpatient mortality. Several studies have reported that, regardless of the disease or health condition, a longer in-hospital stay of patients is associated with in-patient mortality [5, 6, 29, 31, 71]. Understanding the risk factors for a longer duration of stay is critical for developing methods to reduce hospitalisation stays and their associated negative effects [14]. Long-term hospitalisation is costly for the government, the patient, and the family.

5. LIMITATIONS

It is important to draw attention to the limitations of the study. First, the study was a retrospective study of deceased patients over 15 years old from 2015 to 2016 within a district hospital, limiting its applicability to other regional hospitals. Due to bias and the unverified nature of ICD-10 classifications, we utilised the actual diagnosis in the records and District Health Information System. Since the data was secondary, we cannot verify it. Third, we could not examine variables, like dietary status and vital health indicators, which may have affected patient death. However, the study is the first to characterise in-patient deaths at this South African regional hospital, suggesting health policy implications.

CONCLUSION

Our data demonstrated that patients diagnosed with TB/HIV, cancer, advanced WHO HIV clinical staging (III and IV), and prolonged hospital stay were predictors of in-patient death in this setting. Implementing interventions aimed at addressing the social determinants of health is necessary to enhance the health outcomes of individuals with various comorbidities. Offering health education and advocacy as a preventative strategy can achieve this, while simultaneously reducing the focus on the curative, hospital-based approach.

AUTHORS' CONTRIBUTION

S.L.K.: Study conception and design; S.L.K.: Data collection; S.L.K. and D.T.G.: Analysis and interpretation of results; U.B.O. and D.T.G.: Drafting of the manuscript. All authors have reviewed the results and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

AIDS	=	Acquired immune deficiency syndrome
AOR	=	Adjusted odd ratio
CPT	=	Cotrimoxazole prophylactic therapy
CI	=	Confidence interval
DHIS	=	District health information system
HIV	=	Human immuno-deficiency virus
ICD	=	International classification of diseases
ICU	=	Intensive care unit
INH	=	Isoniazid
LOS	=	Length of stay
TB	=	Tuberculosis

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the human research ethics committee of the University of Fort Hare, South Africa (FER021SPIT01) and permission was given by the Eastern Cape Provincial Department of Health.

HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

There was no physical interaction between the deceased patient and their family members. Therefore, the requirement for participant permission was waived. The deceased's medical records and the DHIS dataset were both kept strictly confidential.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data of current study are available from corresponding author, [U.B.O], on a reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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