

https://dspace.org/

Hospitalization among adultd resident in the Africa centre demographic surveillance area in Rural KwaZulu Natal: South Africa

Azindow, Irene Tampuri

2017
https://hdl.handle.net/10539/25669

Downloaded from a DSpace repository. https://dspace.org/



TITLE: Hospitalization among adults resident in the Africa Centre Demographic Surveillance area in Rural KwaZulu-Natal: South Africa

Irene Tampuri Azindow

Student Number: 705316

MSc Research Report submitted to the Faculty of Health Sciences

University of the Witwatersrand, Johannesburg in partial fulfillment of the requirements for

Master of Science degree in Population based field epidemiology

November, 2017

Internal supervisor: **Prof Kerstin Klipstein-Grobusch** (Wits SPH)

External supervisor: **Dr. Portia Mutevedzi** (National Institute for Communicable Diseases)

DECLARATION

I, **Irene Tampuri Azindow,** declare that this is my own work submitted to the University of the Witwatersrand, Johannesburg for the Master of Science in Epidemiology in the field of Population Based Field Epidemiology degree. It has not been submitted previously for any degree or examination at this or any other University.

Signature: 

Date: 2nd November, 2017

DEDICATION

I humbly dedicate this work to the Almighty God who has showed me immeasurable grace. I am nothing without Him and all that I am and would be, I owe to Him. I would not have come this far in life and in my educational career without Him who has always made a way whenever I felt all hope was lost.

ABSTRACT

Background

South Africa bears a quadruple disease burden: communicable and non-communicable diseases, as well as perinatal and maternal and injury related disorders. Serious morbidity resulting in hospitalizations are costly to the individual, to the health sector and society. Adults constitute more than half of the population in SSA and survival of children depends to a large extent on the health of the adults. In this analysis, hospital and population based data was used to describe the causes of and factors associated with hospitalization among adults 15 years and older resident in the Africa Centre Demographic Surveillance area.

Methods

All resident adults of Africa Centre Demographic Information System (ACDIS) as at 1st January, 2011 and followed till 31st December, 2013 were eligible for inclusion in the study. Cause of hospitalization was based on discharge diagnosis based on ICD10 coding. Factors associated with hospitalization were assessed using Cox proportional hazard regression model.

Results

The cohort consisted of a total of 41,477 individuals with 24,068 (58.03%) females and a median age of 29 years (Inter quartile range 20-45). 1,172 (2.83%) individuals contributed to 1,375 episodes of hospitalization. The top five causes of hospitalization for the period were maternal conditions 335(24.96%), tuberculosis 248(18.48%), injuries 126(9.39%), infectious and parasitic diseases 104(7.75%) and cardiovascular diseases 88(6.56%) with variations in causes of hospitalization by gender. The risk of hospitalization for males increased with age with the exception of the 20-24 year age group. The risk of hospitalization for males increased by 72% among participants on disability

(aHR 1.72 95%CI: 1.15-2.56)) compared to those who did not receive grants whilst married males had a 48% reduction in the risk of hospitalization compared to unmarried males (aHR 0.52 95%CI: 0.38-0.73). Females on disability grant had a 55% (aHR 1.55 95%CI: 1.13-2.12) increase in the risk of hospitalization whilst those on old age pension had a 65% (aHR 1.65 95%CI: 1.15-2.37) increased risk of hospitalization compared to those whose did not receive grants. There was a protective effect in the risk of hospitalization among married (aHR 0.57 95%CI: 0.44-0.73) and widowed (aHR 0.68 95%CI: 0.52-0.90) compared to unmarried females whilst females in the poor (aHR 1.37 95%CI: 1.07-1.76) wealth index had increased risk of hospitalization in comparison to those in the poorest wealth index. Exclusion of maternal causes slightly altered the risk of hospitalization estimates for the above factors in addition to which there were varied increases in the risk for age with the exception of the 20-24 year age group

Conclusion

The analysis suggest that maternal conditions, tuberculosis, injuries and infectious and parasitic as well as cardiovascular disease were the main causes of hospitalization during the study period. Age, grants and marriage was associated with the risk of hospitalization among males whilst grants, marriage and wealth index was associated with the risk of hospitalization among females. Exclusion of maternal causes slightly altered the risk of hospitalization estimates in addition to which age was associated with increased risk of hospitalization. These should be considered for efficient planning and implementation of health programs to reduce morbidity.

ACKNOWLEDGEMENTS

First and fore mostly, I am most grateful to the God Almighty for His grace upon my life, and seeing me through my MSc programme. It has been nothing but the hand of God. I am also highly indebted to the INDEPTH network for the financial support to pursue this degree.

Additionally, I wish to extend my profound appreciation to my supervisors Prof. Kerstin Klipstein-Grobusch of the School of Public Health, University of Witwatersrand and Dr. Portia Mutevedzi formerly of the Africa Centre for Health and Population Studies and currently of the National Institute for Communicable Diseases for their time, excellent supervision, patience and support throughout this research. I am also grateful to my lecturers at the school of Public Health, University of the Witwatersrand for impacting knowledge and course administrator, Mrs. Angeline Zwane and Dr. Gill Nelson for their support.

Also, I wish to acknowledge the Director and staff of the African Centre for Health and Population Studies for hosting me during my field attachment and providing me with the datasets for my research. Worth mentioning is Dr. Kobus Herbst who extracted the data I needed and was available for clarifications pertaining to the data. I am also grateful to Dickman Gareta and Natsayi Chimbindi for their suggestions and inputs during the course of this research and the residents of Africa Centre Demographic Information System (ACDIS) who contributed data for this research.

Furthermore, I am full of commendation for the immense support I have enjoyed from a very special father and mentor; the director of Kintampo Health Research Centre (KHRC) Dr. Seth Owusu-Agyei. His instrumentality in my choice of programme, facilitation of the application process and support during the course of my studies cannot be overemphasized. My sincere thanks also goes to the training committee of KHRC for granting me study leave to pursue this programme and special

thanks to Mr. Emmanuel Nashiru Mahama and Mr. Felix Oppong Boakye for discussions and inputs to this report.

Again I wish to express my profound gratitude to my husband, team mate and best friend, Mr. Kwame Kesse Adjei for the endless support I enjoyed before and during the period of my studies. My heartfelt gratitude also goes to my families; the Tampuri family, the Azindow family and the Adjei family(especially Prof Sam Adjei of blessed memory) for their love, support, patience and prayers all these years and for making me feel at home even when I was miles away. Finally to all those who have played various roles behind the scenes or contributed in one way or the other to bring me this far I say, “God richly bless you”.

TABLE OF CONTENT

DECLARATION i
DEDICATION ii
ABSTRACT iii
ACKNOWLEDGEMENTS v
TABLE OF CONTENT vii
LIST OF FIGURES ix
LIST OF TABLES x
LIST OF APPENDICES xi
ACRONYMNS xii
CHAPTER 1: INTRODUCTION 1
1.1 Background 1
1.2 Problem statement 3
1.3 Justification 5
1.4 Literature review 7
1.4.1 Causes of hospitalization 7
1.4.2 Factors associated with hospitalization 11
1.5 Research question 14
CHAPTER 2: METHODS 15
2.1 Introduction 15
2.2 Study setting 15
2.3 Study design 16
2.4 Study population and size 16
2.4.1 Inclusion criteria 17
2.4.2 Exclusion criteria 17
2.5 Study variables 17
2.6 Data sources 18
2.7 Data management and processing 19
2.7.1 Data management 19
2.7.2 Data analysis 19
2.8 Ethical considerations 21

CHAPTER 3: RESULTS 22
3.1 Introduction 22
3.2 Study participants 22
3.3 Socio-demographic characteristics of general population 24
3.4 Socio-demographic characteristics of population by hospitalization status 27
3.5 Hospitalizations 30
3.6 Causes of hospitalization 31
3.7 Leading immediate causes of hospitalization 32
3.8 Immediate causes of hospitalization 33
3.9 Leading underlying causes of hospitalization 35
3.10 Underlying causes of hospitalization 37
3.11 Leading immediate causes of hospitalization with no underlying cause 39
3.12 Immediate causes of hospitalization with no underlying cause 40
3.13 Cause of hospitalization among those who died during hospitalization 42
3.14 Time to hospitalization 43
3.15 Hospitalization rates 44
3.16 Factors associated with hospitalization among males 46
3.17 Factors associated with hospitalization among females 49
3.18 Factors associated with hospitalization among females excluding maternal causes. 52
CHAPTER 4: DISCUSSION 55
4.1 Introduction 55
4.2 Causes of hospitalization 55
4.3 Hospitalization rates 58
4.4 Factors associated with hospitalization 58
4.5 Limitations 62
4.6 Strengths 62
CHAPTER 5: CONCLUSION AND RECOMMENDATIONS 64
5.1 Conclusion 64
5.2 Recommendations 65
Appendices 66
REFERENCES 83

LIST OF FIGURES

Figure 2.1: Map showing the location of the study area in South Africa 16
Figure 3.1: A flow chart of the cohort included in the analysis of hospitalization among adults 15 years and older resident in the Africa Centre DSA. 23
Figure 3.2: Discharge status of hospitalized adults 15 years and older resident in the DSA from 2011-2013 30
Figure 3.3: Top 15 immediate causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 33
Figure 3.4: Immediate causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 34
Figure 3.5: Immediate causes of hospitalization by gender among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 35
Figure 3.6: Top 10 underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 36
Figure 3.7: Underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 37
Figure 3.8: Underlying causes of hospitalization by gender among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 38
Figure 3.9: Top 10 immediate causes of hospitalization with no underlying cause among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 40
Figure 3.10: Immediate with no underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 41
Figure 3.11: Immediate with no underlying cause of hospitalization by gender among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 41
Figure 3.12: Cause of hospitalization among adults 15 years and older resident in the DSA from 2011-2013 who died during hospitalization. 42
Figure 3.13: Nelson-Aalen cumulative hazard estimates by sex for adults 15 years and older resident in Africa Centre DSA from 2011 to 2013. 43
Figure 3.14: Nelson-Aalen cumulative hazard estimates by sex for adults 15 years and older in the Africa Centre DSA from 2011 to 2013 excluding maternal causes of hospitalization. 44

LIST OF TABLES

Table 3.1: Baseline socio-demographic characteristics of cohort included in the analysis of hospitalization among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013. 25
Table 3.2: Baseline socio-demographic characteristics of cohort by hospitalization status included in the analysis of hospitalization among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013 28
Table 3.3: Hospitalization rates among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013. 45
Table 3.4: Hospitalization rates excluding maternal causes among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013 45
Table 3.5: Factors associated with hospitalization among male adults 15 years and older resident in the DSA from 2011 to 2013. 48
Table 3.6: Factors associated with hospitalization among female adults 15 years and older, resident in the DSA from 2011 to 2013. 51
Table 3.7: Factors associated with hospitalization excluding maternal causes among female adults 15 years and older resident in the DSA from 2011 to 2013. 54

LIST OF APPENDICES

Appendix 1: Plagiarism declaration. 66
Appendix 2: Data use agreement from Africa Centre for conduct of analysis 67
Appendix 3: Ethical clearance from the University of the Witwatersrand for conduct of analysis. 68
Appendix 4: ICD10 codes and description of causes of hospitalization classified as CMPN that occurred during analysis period. 69
Appendix 5: ICD10 codes and description of causes of hospitalization classified as HIV/AIDS that occurred during analysis period. 71
Appendix 6: ICD10 codes and description of causes of hospitalization classified as Injuries that occurred during analysis period. 72
Appendix 7:ICD10 codes and description of causes of hospitalization classified as NCD that occurred during analysis period. 74
Appendix 8: ICD10 codes and description of causes of hospitalization classified as tuberculosis that occurred during analysis period. 78
Appendix 9: ICD10 codes and description of causes of hospitalization classified as unspecified that occurred during analysis period. 79
Appendix 10: Leading immediate causes of hospitalization among adults 15 years and above resident in Africa Centre DSA for 2011, 2012 and 2013. 80
Appendix 11: Leading underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA for 2011, 2012 and 2013. 81
Appendix 12: Leading immediate causes of hospitalization with no underlying cause among adults 15 years and above resident in Africa Centre DSA for 2011, 2012 and 2013. 82

ACRONYMNS

AC	Africa Centre for Health and Population Studies
ACDIS	Africa Centre Demographic Information System
ART	Antiretroviral Therapy
CMPN	Communicable, maternal, perinatal and nutritional conditions
DSA	Demographic Surveillance Area
DSS	Demographic Surveillance System
HIS	Hospital Information System
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICD10	International statistical Classification of Disease and related health problems 10th revision
LTFU	Lost To Follow Up
NCD	Non-Communicable Diseases
PCA	Principal Component Analysis
SASSA	South African Social Security Agency
SQL	Structured Query Language
SSA	sub-Saharan Africa
STD	Sexually Transmitted Diseases

CHAPTER 1: INTRODUCTION

1.1 Background

The global health landscape has undergone rapid transformation since 1990 with many countries making progress in reducing child mortality and people living longer (1, 2). The leading causes of disease and death globally have shifted from communicable, maternal, perinatal and nutritional causes to non-communicable diseases (NCD) in adults (1, 3). This transformation could be partly driven by population aging (1) and the demographic and epidemiologic transition where long-term changes in the pattern of health, diseases and mortality are attributed to lifestyle and modernization (4, 5). These global trends however are not universal and differ by regions with sub- Saharan Africa (SSA) being the region with the most striking contrast (1).

SSA has not made as much progress in terms of health outcomes as the other developing world. It faces the double burden of disease with continuing morbidity and mortality from communicable disease and increasing NCDs (1, 6). The Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) epidemic, maternal deaths and child mortality due to infectious diseases and malnutrition have also contributed to the slow progress made in SSA compared to other developing countries (1). However in all regions in SSA adult mortality has begun to decline since 2005 (7) and some African countries have made encouraging strides in reductions in child mortality and mortality from HIV/AIDS and maternal conditions (1). The scale up of antiretroviral therapy (ART) and increased availability of artemisinin combination therapy and insecticide-treated bed nets have contributed to these declines (1).

In South Africa the ongoing health transition is characterized by the persistence of epidemic infectious diseases and a rise in NCDs coupled with a heavy burden of maternal and perinatal disorders, violence and injury (8, 9). The burden of maternal conditions in South Africa has resulted in an increase in caesarean section rates which has been on a steady rise from 12.70% in 2001/2002 to 22.70% in 2012/2013 (10, 11) with resource implications for the health sector. The second national burden of disease estimates from 1997 to 2012 for South Africa, shows the persistence of the quadruple burden of disease with declines in mortality from HIV/AIDS and tuberculosis since 2006 (12) which can be attributed to intensified ART roll-out among adults (13, 14). Additionally a decline in mortality due to injuries was also observed with a decline in NCDs from 2003 associated with a decrease in tobacco related conditions (12). The nine provinces in South Africa however have unique disease profiles reflecting the various states of the health transition and differential health services provided in the provinces (12).

With the growing aging population globally (1, 2) and in South Africa (14, 15) with increase in demand for chronic disease care requiring long term clinical management, (15, 16) health problems are increasingly defined by morbidity and not mortality (1). The increase in the population of adults and consequently the changes in population health issues as a result of this demographic shift has not received much focus with regards to the health and survival of adults (7). However, the survival of children depends to a large extent on the health of adults (17) who are the economically and socially active group (18).

1.2 Problem statement

Health related research and provision of health services targeting the general adult population has been a neglected area in SSA despite the fact that adults constitute more than half of the population in this region (18). This is coupled with the fact that the survival of children is dependent on the health of the adults (17) and economic development lies heavily on the adult population (19). One of the key areas where health related research amongst adults has been neglected is hospitalization among the adult population with limited data on causes of hospitalization among adults (20).

Evidence from a systematic review of descriptive studies of hospital admission in SSA between 1950 and 2010 suggest that studies on causes of hospitalization among adults have been clustered among a few countries notable South Africa, Nigeria and Ethiopia with the latest study from South Africa in that review conducted from 2001 to 2003 (20). A few studies on causes of hospitalization among adults have been conducted recent years (19, 21). Studies of causes of hospitalization have mainly been from hospital records from teaching hospitals and/or urban areas (22-27). Additionally the systematic review of hospital admissions suggested that a few (26.67%) studies were prospective in nature with the most recent among them conducted in 1995 and more than half of these studies conducted in university teaching hospitals in urban areas. The authors however acknowledged that these facilities are mostly managed by consultants which could trigger publications from those facilities therefore biasing the sample of results included in the review (20). Also, referral hospitals have a mix of patients from different areas including referrals from other populations and some facilities may have specialized units for some diseases. Consequently, the catchment population is not well defined so that the causes of hospitalization may not necessarily reflect the causes of hospitalization of the population in the area in which these facilities are located. Additionally, two thirds of the

studies on causes of hospitalization failed to use standardized case definitions and the International statistical classification of disease and related health problems 10th revision (ICD10) guidelines for classifying illness thus complicating comparison of causes of hospitalization between studies (20). Furthermore, although there are several advantages to the use of electronic data capture compared to paper-based systems for hospital admissions, logistical challenges resulting in incomplete data capture has been a setback for some studies that have used electronic data capture (28).

1.3 Justification

Morbidity is high in developing countries and even higher in South Africa with its quadruple burden of disease: communicable diseases and non-communicable diseases as well as perinatal and maternal and injury related disorders (8, 15). Worth mentioning is the high burden of HIV and tuberculosis in South Africa which are the main drivers of morbidity and mortality (29, 30) with KwaZulu-Natal province the worst hit with regards to HIV prevalence (31, 32). For instance in a hospital survey that aimed to determine the burden of hospitalization from 1998 to 2002 in KwaZulu-Natal, AIDS was found to be the leading (12.00%) cause of hospitalizations however the burden of HIV/AIDS could be under represented since only a few patients were tested for HIV and the conservative diagnostic criteria for AIDS used then could also result in an under estimation of AIDS admissions (33). Another study that examined trends in medical admissions in the Hlabisa hospital observed about three-fold increase in admissions with the increase being mainly infectious disease such as tuberculosis, diarrheal illnesses and lower respiratory tract infection due to HIV (34). However these are data prior to the scale up of the HIV programme; the situation is expected to be different after the introduction of ARTs necessitating an updated analysis.

Morbidity data is an essential resource for the effective planning and delivery of health care (28) and vital in identifying gaps that need to be addressed in the population in order to improve health status (8). Serious morbidity resulting in hospitalizations are costly to both the individual, the health care system and to society (35, 36). In South Africa although healthcare in the public sector is provided free of charge, patients bear other health related cost such as transportation, travel time to and from a health facility as well as long waiting times (37-40) which could lead to delayed health seeking behaviours culminating in increase or severe morbidity. There is therefore the need to understand causes of hospitalization and factors

associated with hospitalization for efficient patient monitoring and planning health programs to reduce morbidity. It is against this background that this study taking advantage of available population-based data linked to hospital admissions seeks to describe the causes of and factors associated with hospitalization among adults in a rural population.

1.4 Literature review

1.4.1 Causes of hospitalization

Non-communicable disease

Non-communicable diseases are increasingly becoming an issue of concern not only for developed countries but also for developing countries (1). Studies on hospitalization among adults in Africa show a high burden of NCD. For instance NCDs accounted for 71.80% of total hospitalization in a study in Sudan (41), studies in Nigeria have had hospitalization due to NCDs ranging from 47.99% to 64.6% (22, 25, 42-45), with 48.00% in Ethiopia (27) and 22.00% and 29.34% respectively for studies in South Africa (21, 24) in a review of studies from 2000 to 2014.

In a study of 1,853 cases of NCDs diseases in Nigeria from 2000 to 2004, cardiovascular diseases 35.70%, endocrine 18.50% and renal disorders 16.80% were the common NCDs with hypertension, diabetes mellitus and renal disorders respectively being the common in each of the three common categories of NCDs observed (22). Also, in a retrospective hospital based study from July 2012 to June 2013 among 1,247 patients in Nigeria, congestive heart failure 17.40%, stroke 14.03% and diabetes mellitus 12.99% were the prevalent admissions due to NCDs (43). Additionally a review of medical records at Ekiti State University Teaching hospital in Nigeria from January, 2008 to December, 2012 also suggested NCDs particularly stroke 21.00%, diabetes 18.00%, systemic hypertension 13.00% and heart failure 11.00% constituted majority of the hospitalizations (25). Similar patterns of admissions due to NCDs were observed in other studies in Nigeria (42, 44-46).

However, in a study of admissions in a teaching hospital from July 2009 to February, 2010 in Sudan NCDs did not account for a high proportion of admissions as evident the previous

studies. Stroke accounted for 7.50% whilst hypertension and diabetes mellitus accounted for 7.10% and 6.60% respectively (47). Nevertheless in another study in a teaching hospital in Sudan from August, 2013 to July 2014 involving 2,614 patients, NCDs such as cardiovascular diseases (16.40%), gastritis (9.80%), urinary tract infection (7.20%) and diabetes mellitus (6.90%) among others accounted for majority (71.80%) of the hospital admissions (41) giving an indication that even within the same country there could be variations in the spectrum of morbidity. These variations could among others be as a result of some hospitals being referral centres for some disease conditions (41, 42), facilities where these studies were carried out located being located in urban areas or have majority of their patients coming from urban areas (22, 41) coupled with lifestyle modification of people which puts them at risk of certain disease conditions.

Several studies on causes of hospitalization among adults in South Africa were conducted several decades ago (48-52) and since the 1990s (33, 34, 53-55), however there have been few (21) published studies on causes of hospitalization in South Africa in recent years. In a study that sort to determine the pattern of admissions from 2001 to 2003 in GF Jooste Hospital in Cape Town (South Africa), circulatory disease accounted for 22.00% of admissions. The common circulatory diseases were hypertensive heart diseases, heart failure, stroke and angina pectoris (24). This is in line with some studies conducted decades ago that highlighted the emerging burden of NCDs in South Africa (33, 51) Also, results from analysis of multifaceted outreach visits to seven district hospitals from 2013 to 2014 in western KwaZulu-Natal suggested cardiovascular disease was the commonest (29.34%) diagnostic category for all patients (21). However, there was a striking difference in disease category with respect to those seen as outpatients and those admitted. Whilst 52.15% of the outpatients were diagnosed as having cardiovascular disease, 9.27% of inpatients were diagnosed of having cardiovascular

disease. The bookings for the outreach were however determined by the local doctors and might not necessarily reflect the distribution of disease among the population (21).

Communicable disease

Communicable diseases have always been and continues to be a burden in developing countries (1). Hospitalization due to communicable diseases have ranged from 39.30% to 43.80% (22, 43, 44) for studies in Nigeria, 49.00% in Ethiopia (27), 19.00% (41) and 44.30% (47) in Sudan and 19.00% (24) and 22.15% (21) in South Africa in studies from 2000 to 2014.

In a review of case notes at the Jimma University Specialized Hospital in Ethiopia in 2008 among 1,400 patients, diseases of the respiratory system constituted the highest cause of admission accounting for 26.90% followed by infectious and parasitic infections which accounted for 16.40% of the admissions (27). Severe community acquired pneumonia 22.80%, meningitis 13.10%, malaria 8.50% and tuberculosis 5.40% were the main single causes of hospitalization (27). Additionally admissions among 3,750 patients at the Ekiti State university teaching hospital from January 2008 to December 2012 suggested that HIV/AIDS 21.00%, pulmonary tuberculosis 16.00% and malaria 13.00% were the main causes of admissions due to communicable disease (25). Although the study facility is located in an state where HIV and tuberculosis prevalence is among the lowest, the authors acknowledged that the high proportion of hospitalization due to these conditions could be partly explained by the fact that the facility was a major screening and treatment centre for HIV (25). Also in an analysis of medical admissions among 1,247 patients from July 2012 to June 2013 in Nigeria, the common communicable diseases were HIV/AIDS 13.63%, hepatic diseases 9.38% and tuberculosis 4.57% (43). Tuberculosis was also the third leading cause of admission accounting for 8.5% of total admissions to a teaching hospital from 2005 to 2007 in Nigeria (42).

In a study from July 2009 to February 2010 involving 438 patients admitted at the Al Ban Jadeed teaching hospital (Sudan), communicable disease was the main cause of hospitalization particularly gastrointestinal disease (24.40%), pneumonia (9.10%) and malaria (6.6%) (47). However results from another study in Sudan from 2013 to 2014 among adults suggested that malaria (11.30%), pneumonia (6.90%), gastroenteritis (3.30%) and tuberculosis (2.60%) were the common communicable disease (41).

Similarly, infectious and parasitic infections constituted 19.00% of hospital admissions in Cape Town (South Africa). HIV and pulmonary tuberculosis were the main infectious disease constituting 61.00% and 57.00% respectively of the infectious and parasitic infections (24). Although in general pregnancy related conditions was not among the five common causes of hospitalization it was the commonest (42.00%) cause of admission among females in the surgical ward (24). Also, communicable diseases accounted for 22.15% of the total diagnosis of 1,377 patients in an outreach programme in selected hospitals in KwaZulu-Natal and was more common (51.72%) among inpatients dominated by HIV and tuberculosis (21). Other studies in South Africa have highlighted the high burden of hospitalizations due to HIV/AIDS and tuberculosis (56, 57). These findings highlight the continued burden of HIV and tuberculosis in South Africa.

Injuries

Some studies of the burden of injuries have mostly looked at mortality records (58, 59) with a high burden of injuries in South Africa (58, 59). Causes of hospitalization in five government run health facilities in rural Bangladesh from 1997 to 2001 involving 75,598 patients suggested that injuries was the second leading (17.70%) cause of hospitalization (60). Similarly, in a retrospective study from a sample of 462 admissions from 2001 to 2003 in Cape Town (South

Africa), injuries were the leading (23%) cause of admissions particularly open wounds to the thorax, head injury and fractures (24).

1.4.2 Factors associated with hospitalization

Identifying the factors associated with hospitalization among adults is essential to guide the planning and implementation of interventions to reduce morbidity. Some factors found to be associated with hospitalization among adults include gender, age, socio-economic status and marriage (25, 43, 47, 61, 62).

Gender

Male dominance has been found in some studies in Africa on causes of hospitalization (25, 27, 42-44, 46). Male predominance was also found in a study assessing pattern of admissions for NCDs in Nigeria. Although tobacco use and excessive alcohol consumption are risk factors that could account for the male predominance, there were twice as many male beds as females beds in the hospital which limited the number of females that could be admitted (22). Also males formed majority (55.00%) of hospitalized patients from seven district hospitals in KwaZulu-Natal (South Africa). This representation could however be artificial depending on the preparedness of particular wards for each outreach visit since the referral choice for the outreach was determined by doctors at the hospital where the outreach was to take place (21).

However, females formed the majority (53.90%) among 438 patients admitted at a referral hospital in Sudan from July 2009 to February 2010 (47). Although low educational status, limited access to and control of resources in certain parts of Africa could explain the male dominance in hospitalization (43), the services rendered in particular teaching hospitals could also guide the type of disease conditions referred to those facilities. Additionally health seeking

behaviours whereby females seek medical care early whereas males would only visit hospital when the conditions are severe meriting hospitalization could contribute to the male dominance in hospitalization as seen in the studies above. This could explain in part why there are more females seen as outpatients in some studies and the vice versa for inpatients (21).

Age

Evidence from literature suggest that age is associated with hospitalization among adults. For instance, over 70.00% of patients admitted to a teaching hospital in Nepal from January 2010 to June 2010 were over 25 years old (63). Similarly 81.72% of patients admitted to a tertiary health centre in Nigeria were 30 years and above with majority (20.05%) of the hospitalized patients in the 60-69 age group (43). Also, in a study among 2,614 hospitalized patients from August 2013 to July 2014 in Sudan over 80.00% of the patients were 26 years and older with majority (19.40%) in the 56 to 65 years age group (41). In another study among 7,399 patients over a five year period in Nigeria, more than half (52.50%) of the patients were 30 years and above with the highest hospitalization among the 41 to 50 year age group (18.00%) and 51 to 60 year age group (18.80%) (44). The authors reported that there was a progressive increase in the number of admissions with each increasing age group up to the 51 to 60 year a group and then a decline (44). Other studies in Nigeria have found hospitalizations common among adults with older age groups (25, 42)

However, in a study among 610 patients admitted to a specialized hospital in Ethiopia, majority (36.00%) of the patients were in the 21-30 year age group with 85.5.% of the patients being 21 years and above (27). Also in a study among 438 patients in a referral hospital in Sudan, although about 90.00% of the patients were 20 years and above the dominating (22.40%) age group consisted of the 20-29 year age group (47). Again in a study in South Africa, majority

(56.00%) of hospitalized patients were less than 40 years with many patients less than 25 years primarily due to communicable diseases (21).

The variations in the age groups of hospitalized patients could be due to the differences in the age structures of the populations where these studies were carried out (47) as well as the spectrum of diseases prevalent in the population with communicable diseases common among younger ages and NCDs among older ages (21, 25).

Socio-economic status

Some studies have found socio-economic status to be associated with hospitalization. One of such studies conducted amongst the aged (older than 74 years) showed that lower socio-economic status, more than the age of patients, was associated with hospitalization (64). Patients in the lowest socio-economic group of this study were also hospitalized for longer periods as compared with those in higher socio-economic groups (64). In another study carried using a longitudinal study design amongst adult Ghanaians (18 and above) with special emphasis on those 50 years and above, socioeconomic status was associated with hospitalization. The authors of that study concluded that Ghanaians who were financially sound were in a better state of health because they could care for themselves compared with those in the lower financial bracket (65). It is suggested that adherence to treatment is higher among affluent patients and patients with higher educational attainment which could reduce their risk of hospitalization (61).

Marital status

Evidence from some studies show that marriage has a protective effect on hospitalization among persons with certain disease conditions (62, 66). Findings from one such study carried out amongst patients with acute exacerbation of chronic obstructive pulmonary disease showed

that unmarried patients had increased risk of readmissions. After adjusting for age and sex in this study, patients who were unmarried had an 18.00% higher readmission rate compared with patients who had supporting spouses (67).

1.5 Research question

What are the causes of hospitalization and the factors associated with hospitalization among adults in the Africa centre demographic surveillance area?

Primary objective

- To describe the causes of and factors associated with hospitalization among adults 15 years and older resident in the Africa Centre Demographic Surveillance area from, 1st January, 2011 to 31st December, 2013.

Secondary objectives

- To describe the causes of hospitalizations among adults aged 15 years and older in the Africa Centre Demographic Surveillance area from, 1st January, 2011 to 31st December, 2013.
- To describe the trends in hospitalizations among adults aged 15 years and older in the Africa Centre Demographic Surveillance area from, 1st January, 2011 to 31st December, 2013.
- To assess factors associated with hospitalization among adults aged 15 years and older in the Africa Centre Demographic Surveillance area from, 1st January, 2011 to 31st December, 2013.

CHAPTER 2: METHODS

2.1 Introduction

This chapter gives an overview of the materials and methods used in the conduct of the research. It outlines the study setting, study design and population. It also gives a description of the measurement and data sources, data management and processing as well as ethical considerations that were taken into account in the conduct of the analysis.

2.2 Study setting

This secondary analysis was conducted using data from the Africa Centre for Health and Population Studies (AC). The Africa Centre for Health and Population Studies was established in 1997 as a collaboration between the University of KwaZulu-Natal and the South African Medical Research Council with funds from the Wellcome Trust, UK. A demographic surveillance system (DSS) was set up in AC to provide high quality longitudinal data to monitor the substantial changes and to evaluate interventions to curb the impact of the HIV epidemic in the population (68). The DSS known as Africa Centre Demographic Information System (ACDIS) which has been operational since 2000, is located near the market town of Mtubatuba in the uMkhanyakude District of northern KwaZulu-Natal and occupies an area of 438km^2 (69). The ACDIS surveillance area is predominantly rural with informal peri-urban settlements as well as an urban township with an almost exclusively Zulu speaking population. Waged employment and state pensions are the main source of income of households (69).

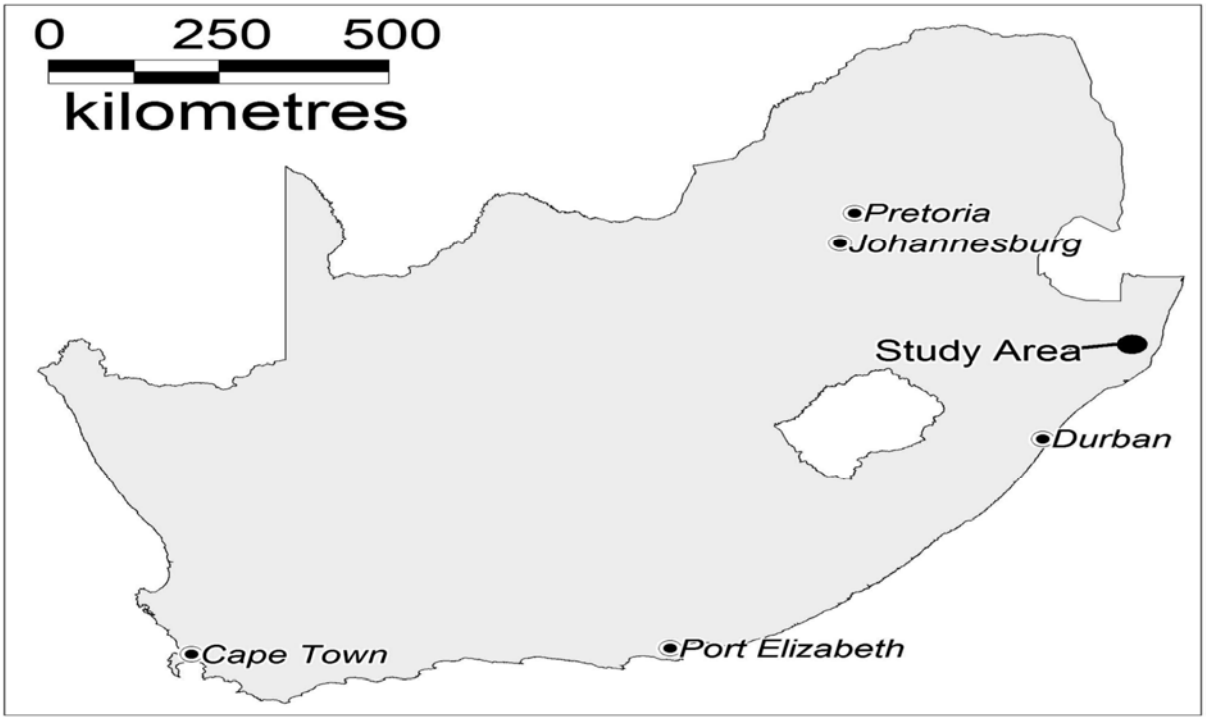


Figure 2.1: Map showing the location of the study area in South Africa

2.3 Study design

This was a secondary data analysis from longitudinal data collected from ACDIS. A prospective cohort design was adopted for all adults 15 years and older resident in AC as at 1st January, 2011 and followed until 31st December, 2013.

2.4 Study population and size

The ACDIS cohort consisted of about 85,000 individuals belonging to approximately 11,000 households with an average of about 8 people per household. The cohort was made up of both resident and non-resident members with about 33% being non-resident (69). The study population consisted of all adults 15 years and older who were resident members under AC surveillance as at 1st January, 2011. This consisted of a total of 41,479 participants who met the following criteria:

2.4.1 Inclusion criteria

- All men and women aged 15 years and older and resident in the AC surveillance area as at 1st January, 2011.

2.4.2 Exclusion criteria

- Hospitalization of adult women for normal vaginal deliveries.

2.5 Study variables

Hospitalization was the outcome of the study. Hospitalization was a binary variable coded as "Yes" for those who had an episode of hospitalization and "No" for individuals who had never been hospitalized during the study period.

The exposure variables that were assessed included socio-demographic variables such as age, sex, marital status, employment, level of education, residence, grants, household size and socioeconomic status at baseline. Socioeconomic status was measured using Principal Component Analysis (PCA) based on assets ownership and assets indicators. These measures were combined into a wealth index and using weights derived from PCA and divided into 5 quintiles; poorest, poor, average, rich and richest.

To the best of our knowledge at the time of the analysis there was no published literature on factors associated with hospitalization in a general adult population hence the variables were selected based factors for hospitalization among specific groups of people such as the aged (70) individuals with specific disease conditions (66, 71, 72) and availability of data.

2.6 Data sources

Data from two sources in AC was used for the analysis. Baseline socio-demographic characteristics of the cohort was obtained from the individual and household surveillance of ACDIS. Hospitalization information of individuals in the cohort who had been hospitalized during the study period was obtained from the Hospital Information System (HIS). The two datasets were linked using the ACDIS unique individual identification numbers.

Data from ACDIS is collected by fieldworkers administering a set of questionnaires every 6 months (69) and since 2012 every 4 months (73) to key informants in each household after consent sought. ACDIS collects data at both household and individual level in order to allow for the examination of the impact of interventions or illness at these levels. This includes information on key attributes and events relating to physical structures, individuals and households and their relationship to each other (69, 74). In addition to that, modules that collect data on household and individual socio-economic data and general health and health seeking behaviors of individual 15 years and older are included periodically (74). Health infrastructure in the sub-district includes a community hospital that offers a wide range of curative and emergency services and 16 fixed nurse-run clinics which among others offer treatment for non-communicable disease which includes hypertension and diabetes, and communicable diseases including HIV, tuberculosis and sexually transmitted diseases (STDs) (74).

The hospital information system is an electronic data capture of admissions at the Hlabisa hospital; a local district hospital with 296 beds (75). This includes admission and discharge date, cause of admission based on ICD10 classification and length of stay. Hospitalization for normal vaginal deliveries are however not captured in HIS (73).

2.7 Data management and processing

2.7.1 Data management

The ACDIS database is built on a Structured Query Language (SQL) (69, 74) platform and data was transferred to STATA version 12 (STATA Corporation, College Station, TX) software package for statistical analysis.

Data was cleaned to check for duplicates and inconsistencies. Data quality checks were also performed to identify any outliers and missing values. Missing data for categorical variables was coded as unknown in describing the baseline socio-demographic characteristics of the population and multiple imputation using chained equation was performed for the inferential analysis.

2.7.2 Data analysis

Both descriptive and inferential analysis was performed. Baseline socio-demographic characteristics of the cohort was assessed using Chi-squared test to compare difference in proportions for categorical variables and Wilcoxon ranksum for continuous variables and presented in tables. Factors associated with hospitalization were assessed using Cox proportional hazard regression taking into account multiple episodes of hospitalization. There was significant interaction between sex and age group, coupled with the gender differences in the causes of hospitalization hence the factors associated with hospitalization were assessed by gender. A large proportion of some baseline socio-demographic variables were missing and multiple imputation using chained equations was performed based on the assumption that data was missing at random. All statistical analysis were performed at a 95% significance level.

Objective 1:

Causes of hospitalization were based on discharge diagnosis. These included the immediate causes, underlying causes and immediate causes of hospitalizations which had no underlying cause. These were described as numbers and percentages of total hospitalization for the period of study and for each calendar year and presented in graphs and tables. The causes of hospitalization were described based on the top 10 to 15 leading causes of hospitalization as well as broad groupings adapted from the global burden of disease estimates (8, 76).

Objective 2:

Trends in hospitalization were described using rates in person years due to the longitudinal nature of the data. Rates of hospitalization were computed as the number of hospitalizations per total person time contributed by each participant within the DSS over the period of time. This was calculated for the period of analysis and tabulated for each calendar year.

Objective 3:

Factors associated with hospitalization in the general cohort were assessed using the Cox proportional hazard regression model. This was deemed appropriate as censored data and time to event are considered taking into account attrition, delayed entry and temporal bias. Participants were censored when they had an episode of hospitalization, moved out or died. Those who did not experience any such event were censored on 31st December, 2013. The model was used to estimate the hazard ratios for multiple episodes of hospitalization using robust standard errors to account for within patient correlation. Variables with a p-value of less than 0.25 in the univariable analysis were entered into the multivariable model. Multiple imputations using chained equations was used to impute missing data since this accounts for missing data uncertainty and several exposure variables had missing data. Due to the difference

in causes of hospitalization by gender and large proportion of maternal causes of hospitalization, factors associated with hospitalization were assessed for both genders and was also assessed for females excluding maternal causes. The proportional hazard assumption for each model was assessed using Scoenfeld residual test. Hazard ratios with 95% confidence intervals were calculated.

2.8 Ethical considerations

Ethical approval was sought from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal's Ethics Committee for all data collected from the AC cohort (69) with annual re-certification. Permission was obtained from AC to use their data for this analysis (appendix 2). Ethical approval for this analysis was obtained from the University of Witwatersrand Human Research Ethics Committee (Medical) (appendix 3). Data used for this analysis did not contain personal identifiers. All participants were identified by unique identifiers and thus analyzed anonymously. The datasets were stored on a password controlled laptop, accessible to members of the study team.

CHAPTER 3: RESULTS

3.1 Introduction

This chapter presents study results, beginning with a participant flow diagram outlining study inclusion and exclusion criteria. The chapter also gives a description of the baseline socio-demographic characteristics as well as the causes and yearly trends of hospitalization of the cohort. Additionally, the factors associated with hospitalization for males and females are outlined. Due to the large proportion of maternal causes of hospitalization among the cohort, factors associated with hospitalization were also assessed for females excluding maternal (pregnancy related) causes of hospitalization.

3.2 Study participants

As shown in figure 3.1, the cohort consisted of a total of 41,479 individuals aged 15 years and older and resident in the DSA. Two males were excluded because they were coded as hospitalized for maternal causes. Out of the 41,477 individuals included in the analysis, 1,172(2.83%) individuals were hospitalized, contributing to a total of 1,375 episodes of hospitalization. At the end of the analysis period 28,489(68.69%) of the cohort was still under follow up, 1,458(3.52%) had died, 9,849(23.75%) had migrated out of the study area whilst 1,681(4.05%) were lost to follow up (LTFU). LTFU in this context refers to individuals whose status with regards being under surveillance, migrated out or died was not known.

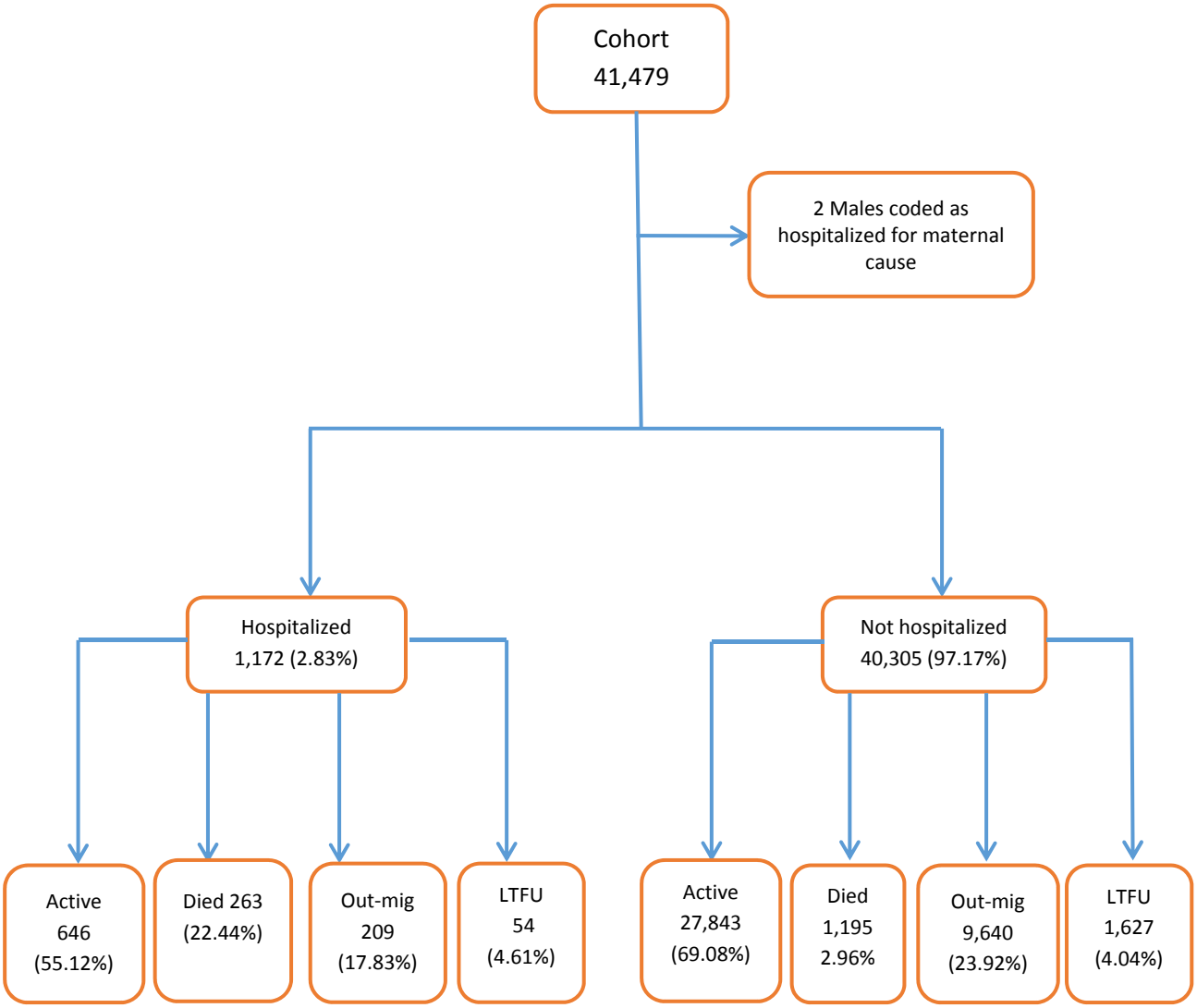


Figure 3.1: A flow chart of the cohort included in the analysis of hospitalization among adults 15 years and older resident in the Africa Centre DSA.

Note: LTFU-Lost To Follow-Up

3.3 Socio-demographic characteristics of general population

The baseline socio-demographic characteristics of the cohort is presented in table 3.1 More than half 24,068(58.03%) of the cohort consisted of females with an overall median age of 29 years (IQR 20-45). Majority 9,154(22.07%) of the cohort were in the 15-19 years age group with 4,675(11.27%) being aged (60 years and above). A small 9.22% (3,823) percentage of participants had no formal education with 20,572(49.60%) attaining secondary education. Majority 19,010(45.83%) of the cohort were unemployed, did not receive grants 27,106(65.35%) and were unmarried 23,081(55.65%). Electricity was available to most 24,227(58.41%) of the cohort majority 23,613(56.93%) of who lived in rural areas. More than half 22,850(55.09%) of them had access to piped borne water with 4,822(11.63%) not having toilet facilities and mostly 17,029(41.06%) living in households with more than 10 people.

Table 3.1: Baseline socio-demographic characteristics of cohort included in the analysis of hospitalization among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013.

Variable	Category	Number	Percentage
Sex	Male	17,409	41.97
	Female	24,068	58.03
Age group	15-19	9,154	22.07
	20-24	6,850	16.52
	25-29	5,350	12.90
	30-34	3,692	8.90
	35-39	3,070	7.40
	40-44	2,542	6.13
	45-49	2,408	5.81
	50-54	2,191	5.28
	55-59	1,545	3.72
	60 and above	4,675	11.27
Education	None	3,823	9.22
	Primary	4,294	10.35
	Secondary	20,572	49.60
	Tertiary	2,560	6.17
	Unknown	10,228	24.66
Employment	Unemployed	19,010	45.83
	Employed	7,540	18.18
	Unknown	14,927	35.99
Grants	None	27,106	65.35
	Child support/foster care	1,978	4.77
	Disability grant	1,477	3.56
	Old age pension	2,937	7.08
	Unknown	7,979	19.24
Marital status	Unmarried	23,081	55.65
	Married	5,587	13.47
	Separated/divorced	128	0.31
	Widowed	2,986	7.20
	Unknown	9,695	23.37
Electricity	No	6,983	16.84
	Yes	24,227	58.41
	Unknown	10,267	24.75

Variable	Category	Number	Percentage
Type of residence	Rural	23,613	56.93
	Peri-urban	14,064	33.91
	Urban	3,800	9.16
Source of drinking water	Pipe	22,850	55.09
	Borehole	1,567	3.78
	Other	6,869	16.56
	Unknown	10,191	24.57
Toilet type	None	4,822	11.63
	Flush toilet	3,036	7.32
	Ventilation Improved Pit	4,336	10.45
	Other	19,013	45.84
	Unknown	10,270	24.76
Household size	1-5	5,840	14.08
	6-10	14,265	34.39
	>10	17,029	41.06
	Unknown	4,343	10.47
Wealth index	Poorest	5,915	14.26
	Poor	6,124	14.76
	Average	6,423	15.49
	Rich	6,448	15.55
	Richest	6,025	14.53
	Unknown	10,542	25.42

3.4 Socio-demographic characteristics of population by hospitalization status

The baseline socio-demographic characteristics of the cohort participants by hospitalization status is presented in table 3.2. Majority of the 41,477 individuals were females in both the not hospitalized 23,209 (57.58%) and hospitalized 859(73.29%) groups, respectively (table 3.2). Majority 8,982 (22.29%) of those not hospitalized were in the 15-19 year age group whilst majority 183(15.61%) of those hospitalized were in the 25-29 year age group. The highest education attained by majority 20,034(49.71%) of the not hospitalized was secondary with tertiary education being the least 2,478(6.15%), most 18,398(45.65%) of them were unemployed with a few 6,175(15.32%) receiving grants. Similarly, most 538(45.90%) of the hospitalized participants had attained secondary education with a few 82(7.00%) attaining tertiary education. Majority 612(5. 2.14%) were unemployed with 217(18.52%) being recipients of grants. With regards to type of grants 2,820(7.00%) of those not hospitalized received old age pension, 1,409(3.50%) were on disability grants whilst 1,946(43%) were beneficiaries of child support or foster care grants. Amongst those hospitalized, 117(9.98%) were on old age pension, 68(5.80%) received disability grants, with 32(2.73%) receiving child support or foster care. Those not hospitalized consisted mostly 22,337(55.42%) of the unmarried, had electricity 23,519(58.35%) and piped water 22,194(55.07%). Similarly, among the hospitalized majority were unmarried 744(63.48%), had electricity 708(60.41%) and piped water 656(55.97%).

Table 3.2: Baseline socio-demographic characteristics of cohort by hospitalization status included in the analysis of hospitalization among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013

Variable	Category	Not Hospitalized Number (%)	Hospitalized Number (%)	P value
Sex	Male	17,096 (42.42)	313 (26.71)	<0.01
	Female	23,209 (57.58)	859 (73.29)	
Age group	15-19	8,982 (22.29)	172 (14.68)	<0.01
	20-24	6,705 (16.64)	145 (12.37)	
	25-29	5,167 (12.82)	183 (15.61)	
	30-34	3,537 (8.78)	155 (13.23)	
	35-39	2,952 (7.32)	118 (10.07)	
	40-44	2,472 (6.13)	70 (5.97)	
	45-49	2,339 (5.80)	69 (5.89)	
	50-54	2,135 (5.30)	56 (4.78)	
	55-59	1,507 (3.74)	38 (3.24)	
	60 and above	4,509 (11.19)	166 (14.16)	
Education	None	3,679(9.13)	144(12.29)	<0.01
	Primary	4,186 (10.39)	108 (9.22)	
	Secondary	20,034 (49.71)	538 (45.90)	
	Tertiary	2,478 (6.15)	82 (7.00)	
	Unknown	9,928 (24.63)	300 (25.60)	
Employment	Unemployed	18,398 (45.65)	612 (52.22)	<0.01
	Employed	7,337 (18.20)	203(17.32)	
	Unknown	14,570(36.15)	357(30.46)	
Grants	None	26,381(65.45)	725(61.86)	<0.01
	Child support/foster care	1,946(4.83)	32(2.73)	
	Disability grant	1,409(3.50)	68(5.80)	
	Old age pension	2,820(7.00)	117(9.98)	
	Unknown	7,749(19.23)	230(19.62)	
Marital status	Unmarried	22,337 (55.42)	744 (63.48)	<0.01
	Married	5,468 (13.57)	119 (10.15)	
	Separated/divorced	124 (0.31)	4 (0.34)	
	Widowed	2,889 (7.17)	97 (8.28)	
	Unknown	9,487 (23.54)	208 (17.75)	
Electricity	No	6,787 (16.84)	196 (16.72)	0.28
	Yes	23,519 (58.35)	708(60.41)	
	Unknown	9,999 (24.81)	268 (22.87)	

Variable	Category	Not Hospitalized Number (%)	Hospitalized Number (%)	P value
Type of residence	Rural	22,931(56.89)	682 (58.19)	0.45
	Peri-urban	13,670 (33.92)	394 (33.62)	
	Urban	3,704(9.19)	96 (8.19)	
Source of drinking water	Pipe	22,194(55.07)	656 (55.97)	0.20
	Borehole	1,530 (3.80)	37 (3.16)	
	Other	6,657(16.52)	212 (18.09)	
	Unknown	9,924(24.62)	267(22.78)	
Toilet type	None	4,669(11.58)	153(13.05)	0.44
	Flush toilet	2,951(7.32)	85(7.25)	
	Ventilation Improved Pit	4,213(10.45)	123(10.49)	
	Other	18,471(45.83)	542(46.25)	
	Unknown	10,001(24.81)	269(22.95)	
Household size	1-5	5,655(14.03)	185(15.78)	0.15
	6-10	13,876(34.43)	389(33.19)	
	>10	16,538(41.03)	491(41.89)	
	Unknown	4,236(10.51)	107(9.13)	
Wealth index	Poorest	5,745(14.25)	170(14.51)	<0.01
	Poor	5,909(14.66)	215(18.34)	
	Average	6,228(15.45)	195(16.64)	
	Rich	6,257(15.52)	191(16.30)	
	Richest	5,902(14.64)	123(10.49)	
	Unknown	10,264(25.47)	278(23.72)	

3.5 Hospitalizations

There were a total of 1,375 episodes of hospitalization among 1,172 individuals during the analysis period with 493(35.85%) of the total hospitalizations occurring in 2011, 448(32.58%) in 2012 and 434(31.56%) in 2013. Most 1,009(86.09) of the individuals hospitalized had one episode of hospitalization, 155(13.23%) had two to three episodes of hospitalization and 8(0.69%) were hospitalized four or more times.

As shown in figure 3.2, most 1,190(86.55%) of those hospitalized were discharged, 167(12.15%) died, 11(0.80%) were transferred to other hospitals and 7(0.51%) absconded. The median length of stay was 5 days (IQR 3-9days) for those hospitalized; 7 days (IQR 3-15 days) for males and 4 days (IQR 3-7 days) for females (p <0.01).

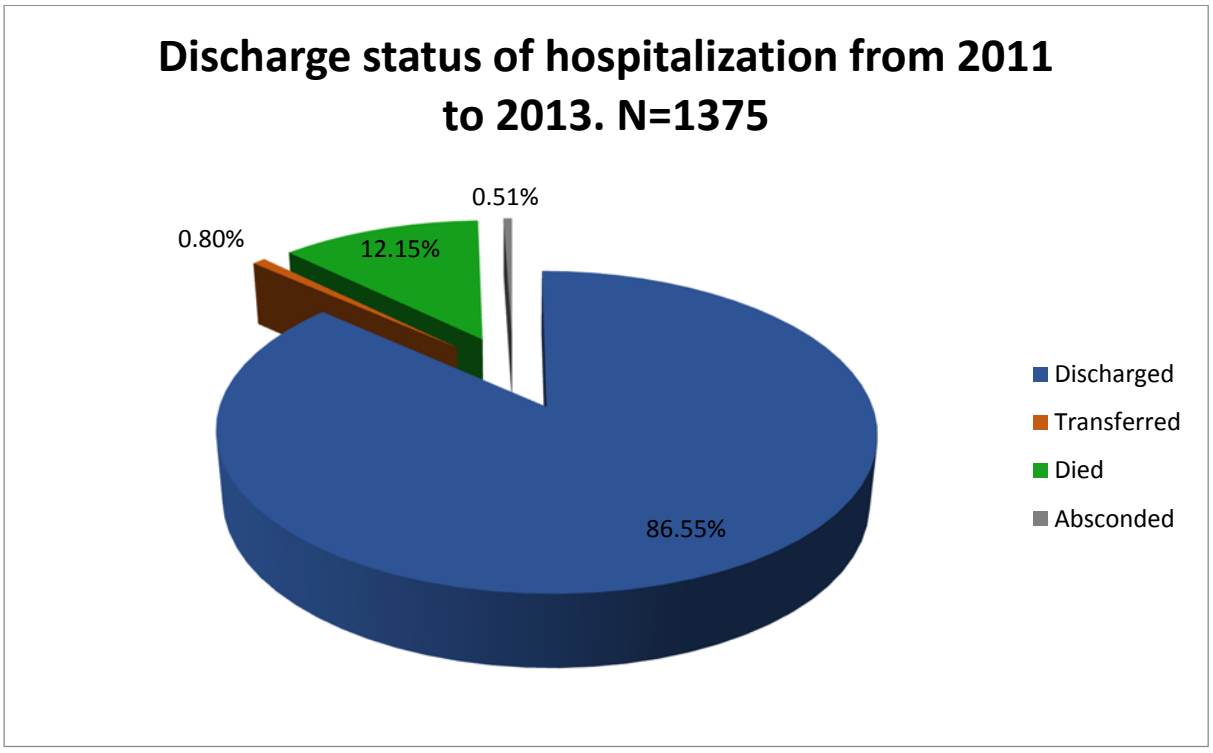


Figure 3.2: Discharge status of hospitalized adults 15 years and older resident in the DSA from 2011-2013

3.6 Causes of hospitalization

Out of the total of 1,375 episodes of hospitalizations among 1,172 individuals during the analysis period, more than half 859(73.29%) were females. The causes of hospitalization were presented per the International classification of diseases and classified into 6 broad categories adapted from the categories used in the burden of disease estimates for South Africa (8, 76). These were namely; HIV/AIDS, tuberculosis, other communicable, maternal, perinatal and nutritional conditions (CMPN), NCD, injuries and unspecified (appendix 4-9). HIV/AIDS and tuberculosis although communicable diseases were presented separately due to their high burden in South Africa and the province where the data was collected. CMPN consisted of infectious and parasitic diseases, respiratory infections, nutritional deficiencies, maternal conditions such as those related to pregnancy and child birth and perinatal conditions among others (appendix 4). HIV/AIDS as shown in appendix 5 among others included HIV disease resulting in mycobacterial, other bacterial or viral infection and acute HIV infection syndrome. Injuries included dislocation of the jaw, fractures, open wounds and toxic effect of unspecified substance (appendix 6). NCD among others included diabetes mellitus, cardiovascular diseases such as hypertension, congestive and unspecified heart failure (appendix 7). Tuberculosis included tuberculosis meningitis, tuberculosis of the bones and joints as well as drug resistant tuberculosis (appendix 8) whilst the unspecified category included hemoptysis, urine retention, urethral discharge and headache (appendix 9).

3.7 Leading immediate causes of hospitalization

There were 1,342 cases of hospitalization with an immediate diagnosis during the analysis period. Out of these, 463(34.50%) occurred in 2011, 446(33.23%) in 2012 and 433(32.27%) in 2013. Figure 3.3 shows the top 15 immediate causes of hospitalization among adults in the surveillance area ranked in ascending order. Maternal conditions and tuberculosis were the leading causes of hospitalization for the analysis period and when stratified by year. For 2011 to 2013 the top 5 causes of hospitalization were maternal conditions, tuberculosis, injuries, infectious and parasitic diseases and cardiovascular diseases. Maternal conditions accounted for 335(24.96%) of total hospitalizations with tuberculosis accounting for 248(18.48%), injuries accounted for 126(9.39%), infectious and parasitic diseases 104(7.75%) and cardiovascular disease 88(6.56%) of total hospitalizations (figure 3.3). The other causes of hospitalization each accounted for less than 5.00% of the total hospitalization. Similar patterns were observed when the data was stratified by calendar year (appendix 10) with the exception of HIV/AIDS which was recorded as an immediate cause of hospitalization only in 2011.

Among males the leading causes of hospitalization were tuberculosis accounting for 100(27.62%) of hospitalization, injuries accounted for 61(16.85%), infectious and parasitic diseases 28(7.73%) and cardiovascular disease 24(6.63). Maternal conditions accounted for majority 335(34.18%) of the hospitalization among females, this was followed by tuberculosis 148(15.10%), infectious and parasitic diseases 76(7.76%), injuries 65(6.63%) and cardiovascular disease 64(6.53%). The maternal causes of hospitalization were mainly 264(78.11%) due to caesarean section, 162(47.93%) were emergency caesarean sections, 65(19.23%) were spontaneous abortion incomplete without complications and 37 (10.95%) elective caesarean section.

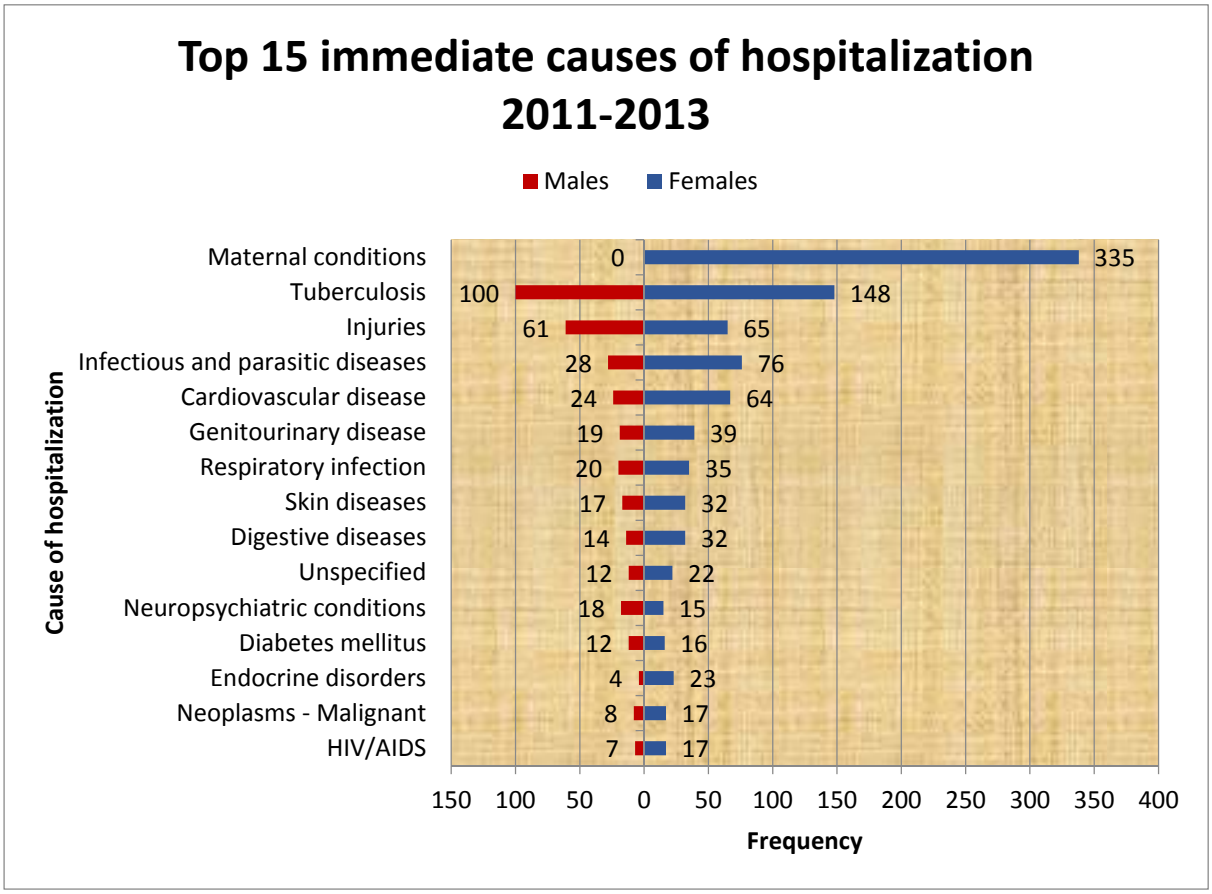


Figure 3.3: Top 15 immediate causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

3.8 Immediate causes of hospitalization

As shown in figure 3.4, CMPN was the main 509(37.93%) cause of hospitalization from 2011 to 2013. NCD accounted for 389(28.99%) of hospitalizations, with tuberculosis accounting for 248(18.48%), injuries 138(10.28%), whilst unspecified causes of hospitalization accounted for 34(2.53%) of hospitalizations. There were 24(1.79%) episodes of hospitalization due to HIV/AIDS during the period. HIV/AIDS was recorded as an immediate cause of hospitalization only in 2011 with none recorded in 2012 and 2013. With the exception of HIV/AIDS, similar patterns were noticed for each of the 3 years under study. As shown in figure 3.5. The main causes of hospitalization among males were NCD 129(35.64%),

tuberculosis 100(27.62%) and injuries 65(17.96%) whilst those of females were CMPN 460(46.94%), NCD 260(26.53%) and tuberculosis 148(15.10%) figure 3.5.

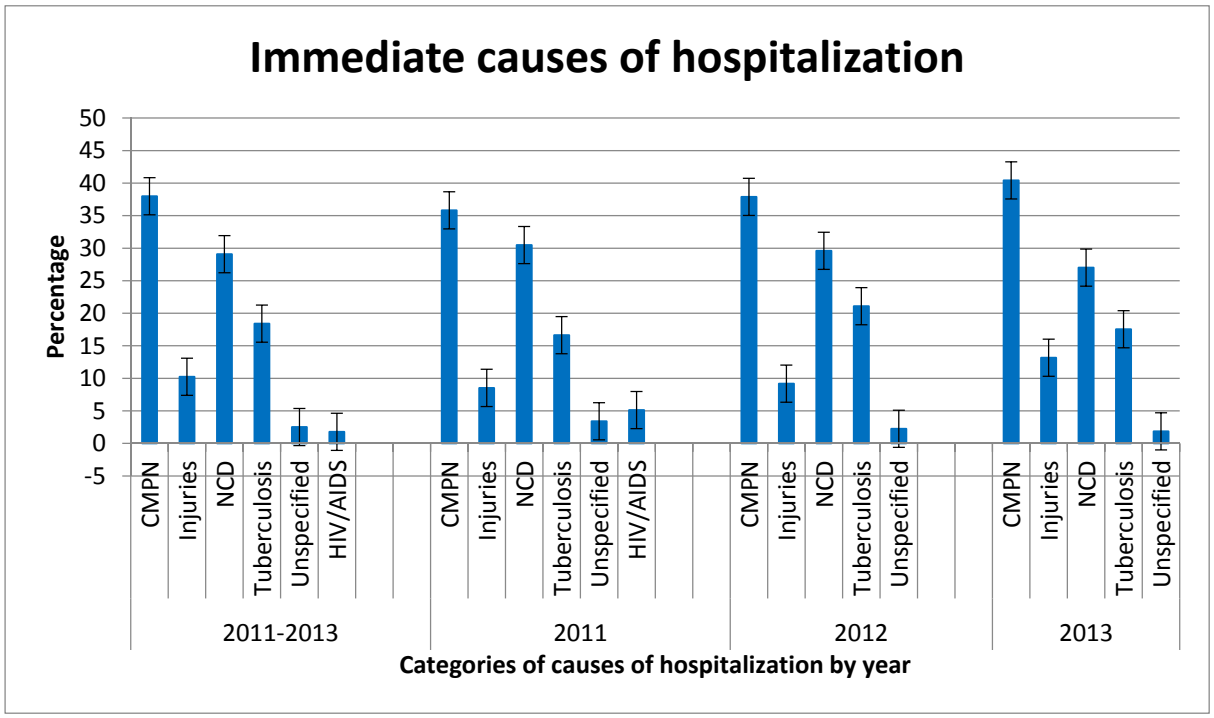


Figure 3.4: Immediate causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

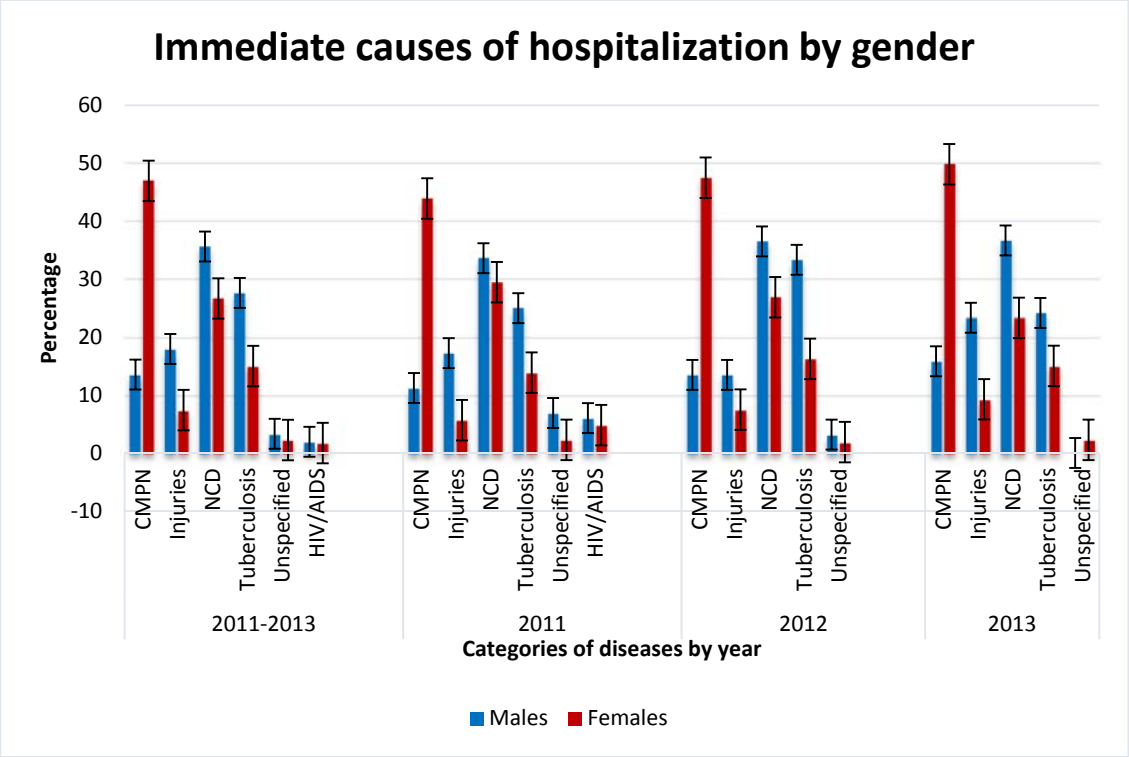


Figure 3.5: Immediate causes of hospitalization by gender among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

3.9 Leading underlying causes of hospitalization

There were 777 episodes of hospitalization during the analysis period with an underlying cause. Figure 3.6 shows the top 10 underlying causes of hospitalization among adults in the surveillance area ranked in ascending order. HIV/AIDS and maternal conditions were the leading underlying causes of hospitalization for the analysis period and also when stratified by year. For 2011 to 2013 the leading underlying causes of hospitalization were HIV/AIDS 305(39.25%) maternal conditions 191(24.58%), injuries-unintentional 97(12.48%) tuberculosis 70(9.01%), diabetes mellitus 38(4.89%) and cardiovascular disease 36(4.63%). The other causes of hospitalization each accounted for less than 2.00% of the total

hospitalizations with an underlying cause. Similar patterns were observed when the data was stratified by calendar year (appendix 11).

Among males the underlying causes of hospitalization were HIV/AIDS 102(45.74%), injuries-unintentional 49(21.97%), tuberculosis 32(14.35%), diabetes mellitus 14(6.28%) whilst cardiovascular disease and injuries intentional each accounted for 9(4.04%) of males hospitalizations. The main underlying causes of hospitalization among females were HIV/ADS 203(36.64%), maternal conditions 191(34.48%), injuries-unintentional 48(8.66%), tuberculosis 38(6.86%), cardiovascular disease 27(4.87%) and diabetes mellitus 24(4.33%).

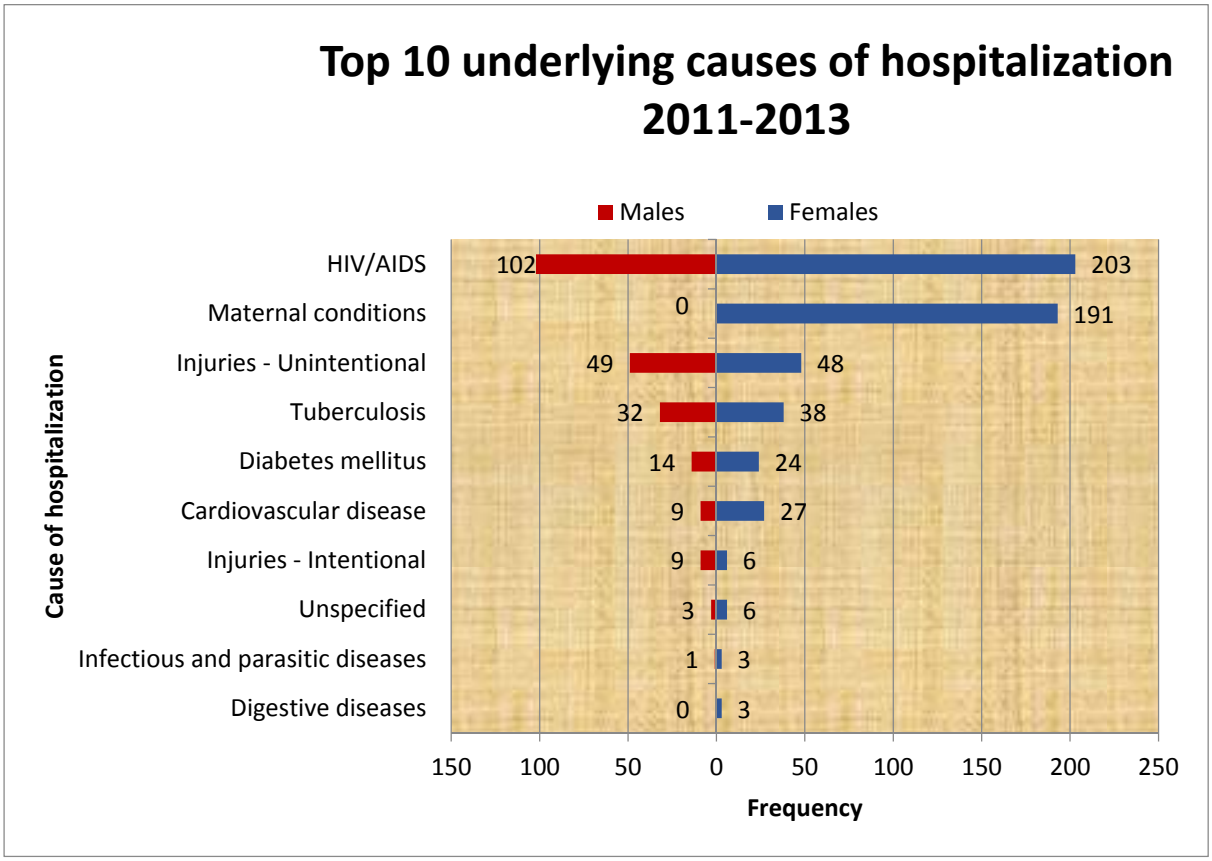


Figure 3.6: Top 10 underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

3.10 Underlying causes of hospitalization

Out of the 777 underlying causes of hospitalization, HIV/AIDS was the highest 305(39.25%) underlying cause of hospitalization during the analysis period (figure 3.7). CMPN accounted for 196(25.23%), injuries 114(14.67%) whilst NCD and tuberculosis accounted for 83(10.63%) and 70 (9.01%) of hospitalizations with an underlying cause respectively. Similar patterns were observed when stratified by calendar year (figure 3.7). Underlying causes by gender are presented in figure 3.8.

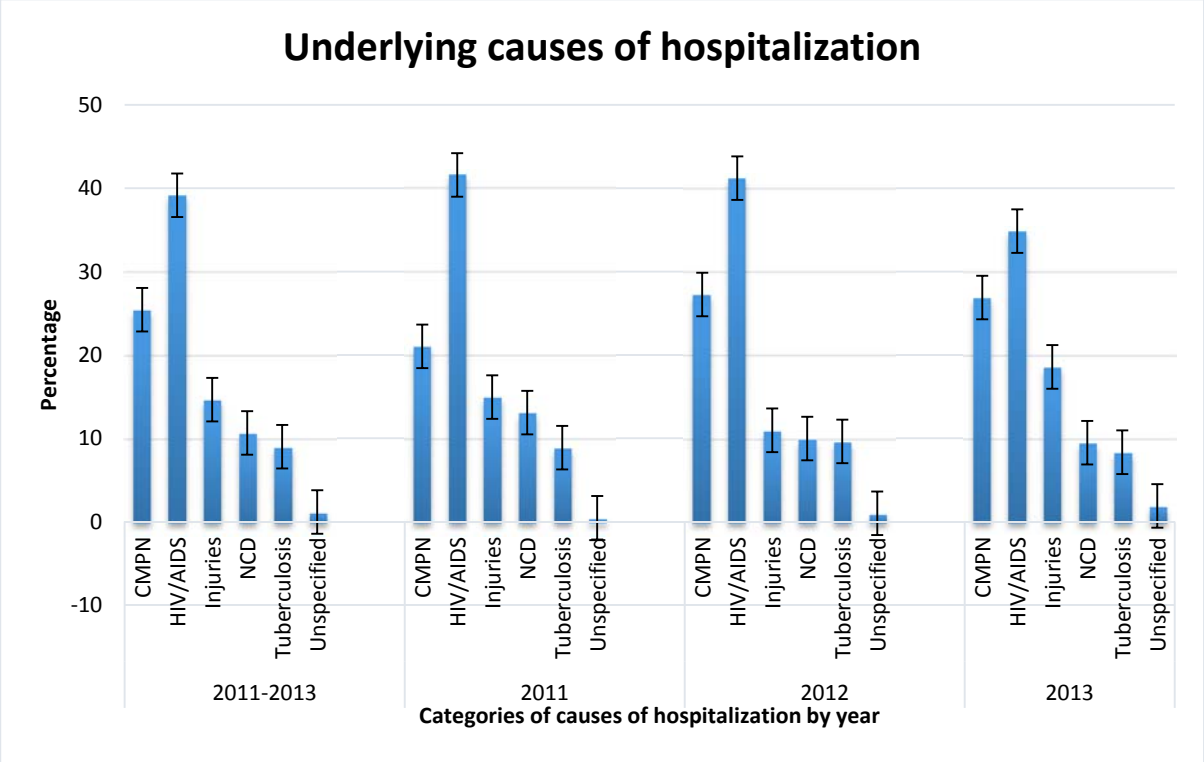


Figure 3.7: Underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

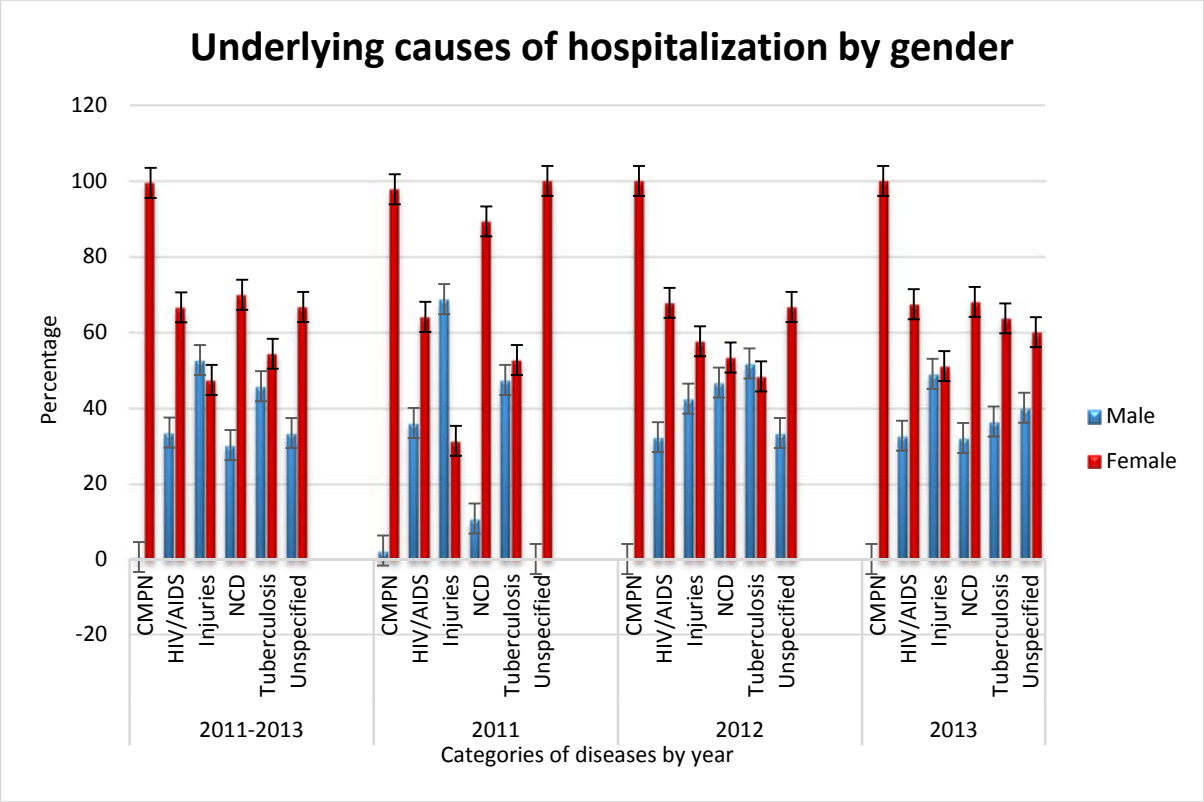


Figure 3.8: Underlying causes of hospitalization by gender among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

3.11 Leading immediate causes of hospitalization with no underlying cause

There were 581 episodes of hospitalization with an immediate cause but no underlying cause during the analysis period. The top 10 immediate causes of hospitalization with no underlying cause are shown in ascending order in figure 3.9. During the analysis period maternal conditions accounted for 143(24.44%), cardiovascular diseases 56(9.57%) and infectious and parasitic disease 46(7.86%) of immediate causes of hospitalizations no underlying cause. Tuberculosis and genitourinary disease both accounted for 38(6.50%) and skin diseases 37(6.32%). The leading causes of hospitalizations with immediate and no underlying cause stratified by calendar year are shown in appendix 12.

The leading immediate causes of hospitalization with no underlying cause among males were tuberculosis 18(12.08%), neuropsychiatric conditions 18(12.08%), cardiovascular disease 17(11.41%) and genitourinary disease and cardiovascular disease both accounted for 12(8.05%). Those among females were maternal conditions 143(32.80%), cardiovascular disease 39(8.94%), infectious and parasitic disease 34(7.80%) and genitourinary and skin disease both accounted for 26(5.96%).

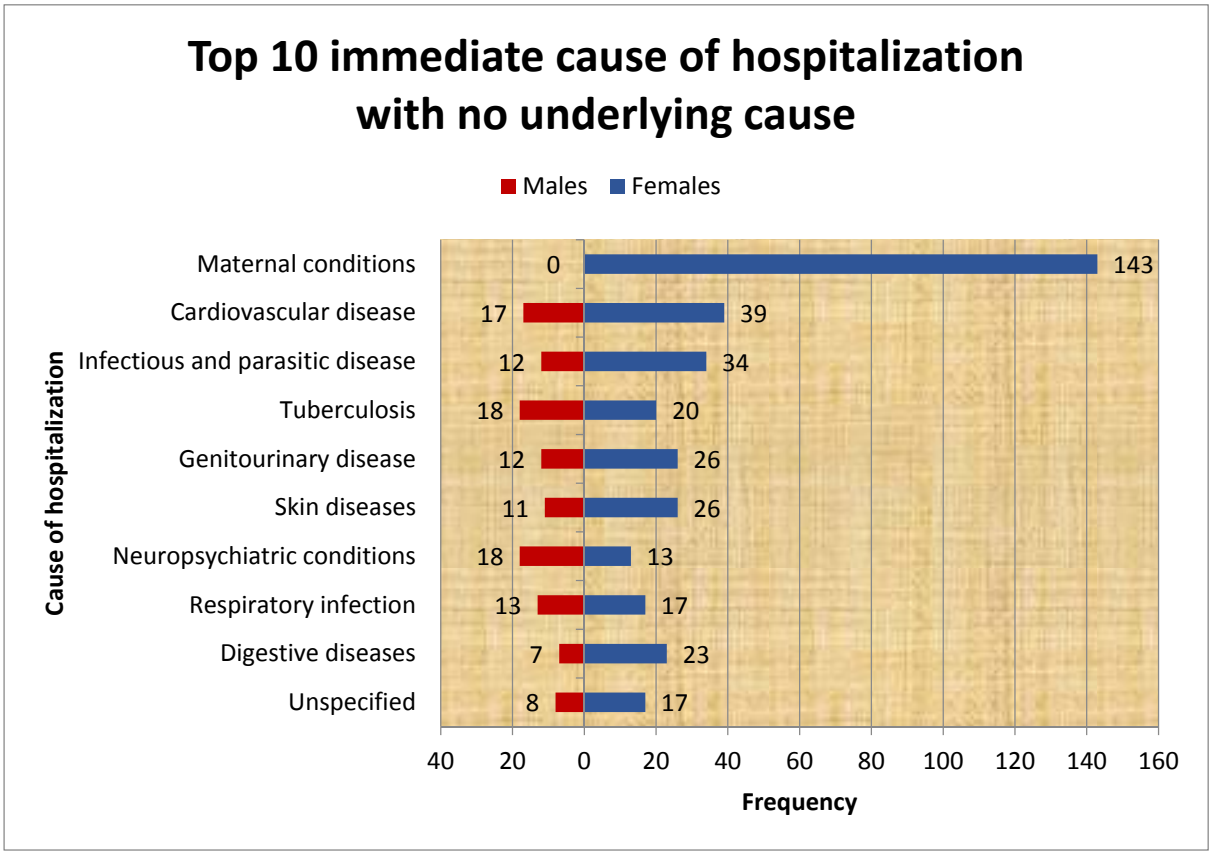


Figure 3.9: Top 10 immediate causes of hospitalization with no underlying cause among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

3.12 Immediate causes of hospitalization with no underlying cause

There were 581 episodes of hospitalization with an immediate cause but no underlying cause during the analysis period. Out of these, NCD accounted for 247(42.51%) CMPN 226(38.90%), tuberculosis 38(6.54%), unspecified 25(4.30%) injuries 24(4.13%) and HIV/AIDS 21(3.61%) from 2011-2013(figure 3.10) Similar patterns were observed when stratified by calendar year with the exception of HIV/AIDS which was recorded only in 2011 (figure 3.10). Immediate causes of hospitalization with no underlying cause by gender are presented in figure 3.11.

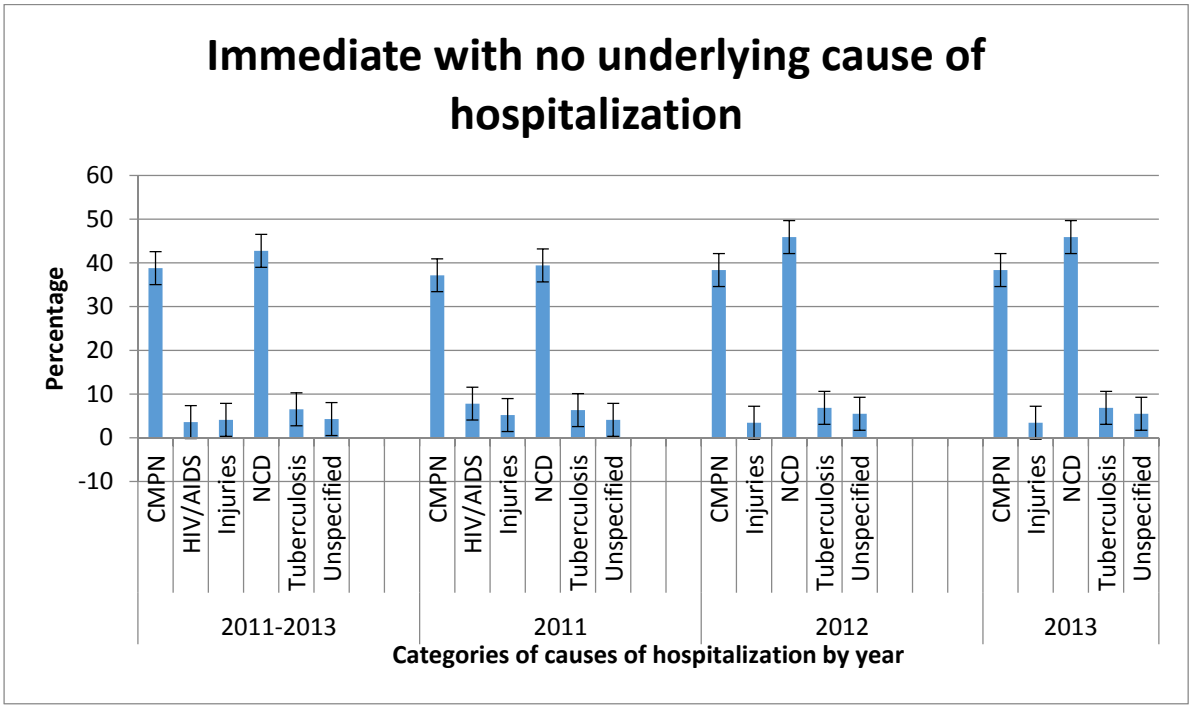


Figure 3.10: Immediate with no underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

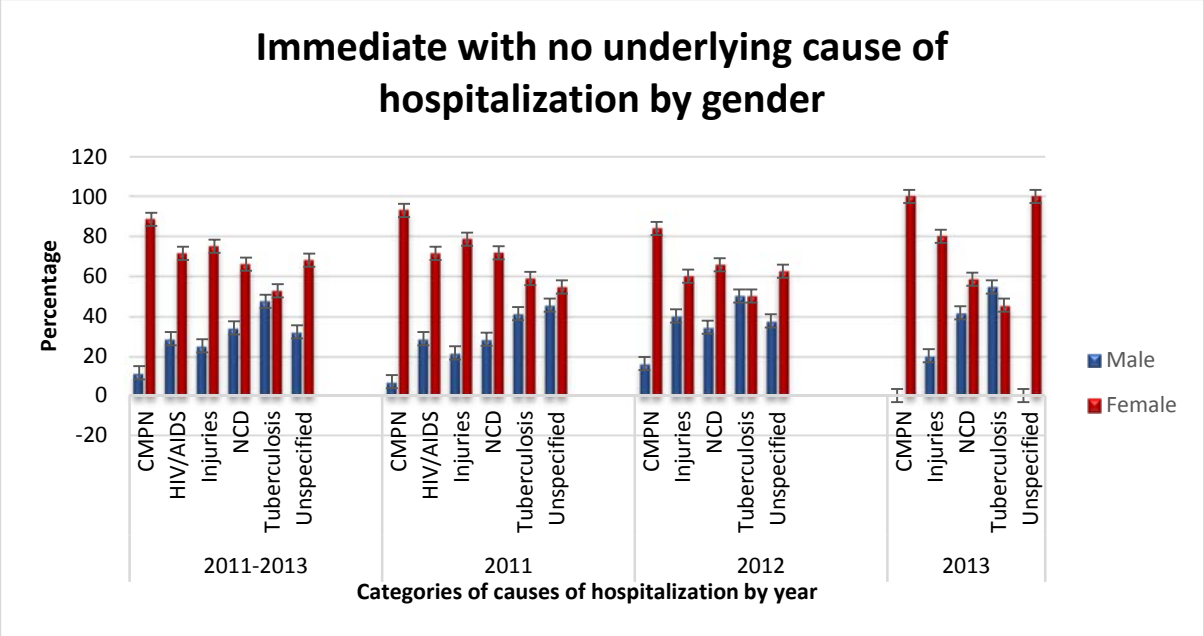


Figure 3.11: Immediate with no underlying cause of hospitalization by gender among adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

3.13 Cause of hospitalization among those who died during hospitalization

As shown in figure 3.12, among the 167 individuals who died during hospitalization, the immediate cause of hospitalization for most 59(35.33%) of the participants was non-communicable disease; 51(30.54%) were hospitalized due to tuberculosis and 39(23.35%) due to other communicable maternal, perinatal and nutritional conditions (CMPN).

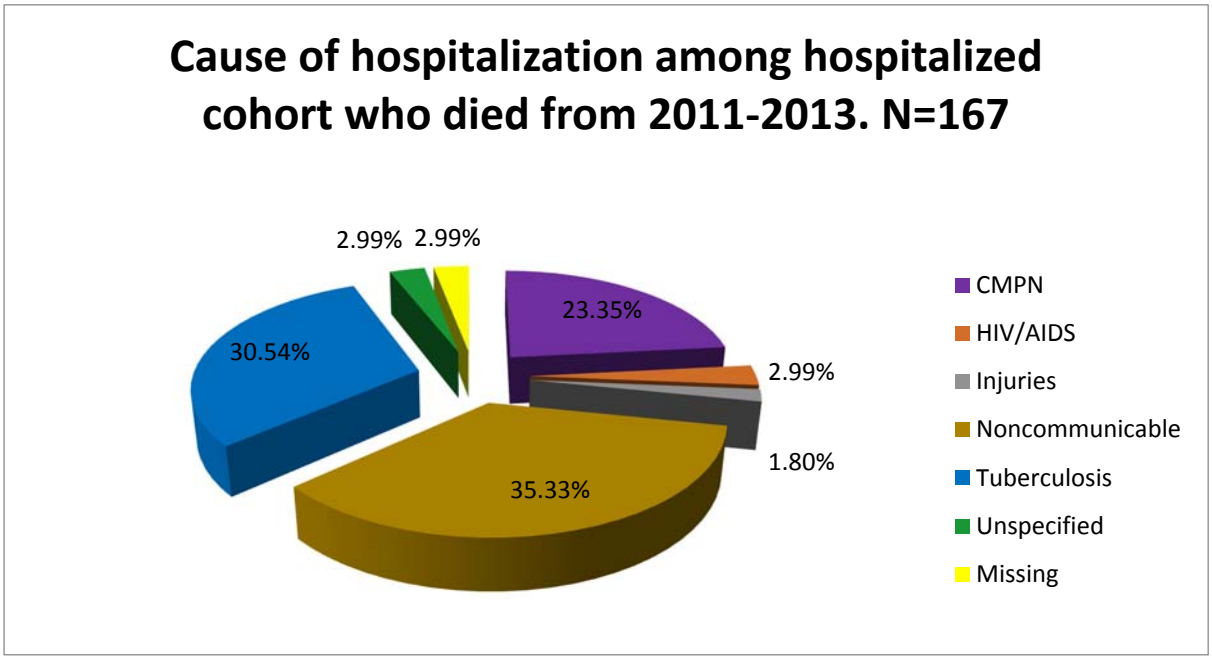


Figure 3.12: Cause of hospitalization among adults 15 years and older resident in the DSA from 2011-2013 who died during hospitalization.

3.14 Time to hospitalization

The risk of hospitalization increased gradually with time (analysis time) as can be seen in figure 3.13. Less than 5% of the cohort was hospitalized by the end of the analysis period. The risk of hospitalization was however higher among females compared to males. This observation remained after excluding maternal causes of hospitalization (figure 3.14). The log rank test for equality of the survival function ($p<0.01$) suggest that the risk of hospitalization among males and females was significantly different from each other.

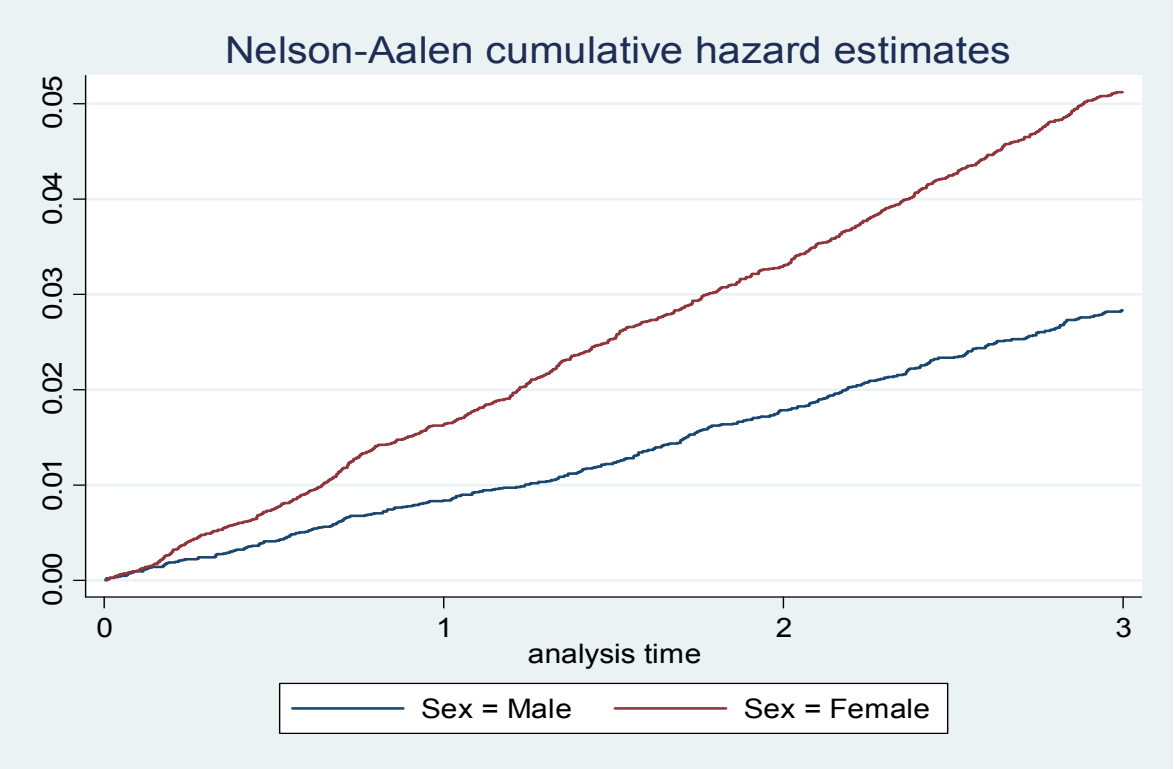


Figure 3.13: Nelson-Aalen cumulative hazard estimates by sex for adults 15 years and older resident in Africa Centre DSA from 2011 to 2013.

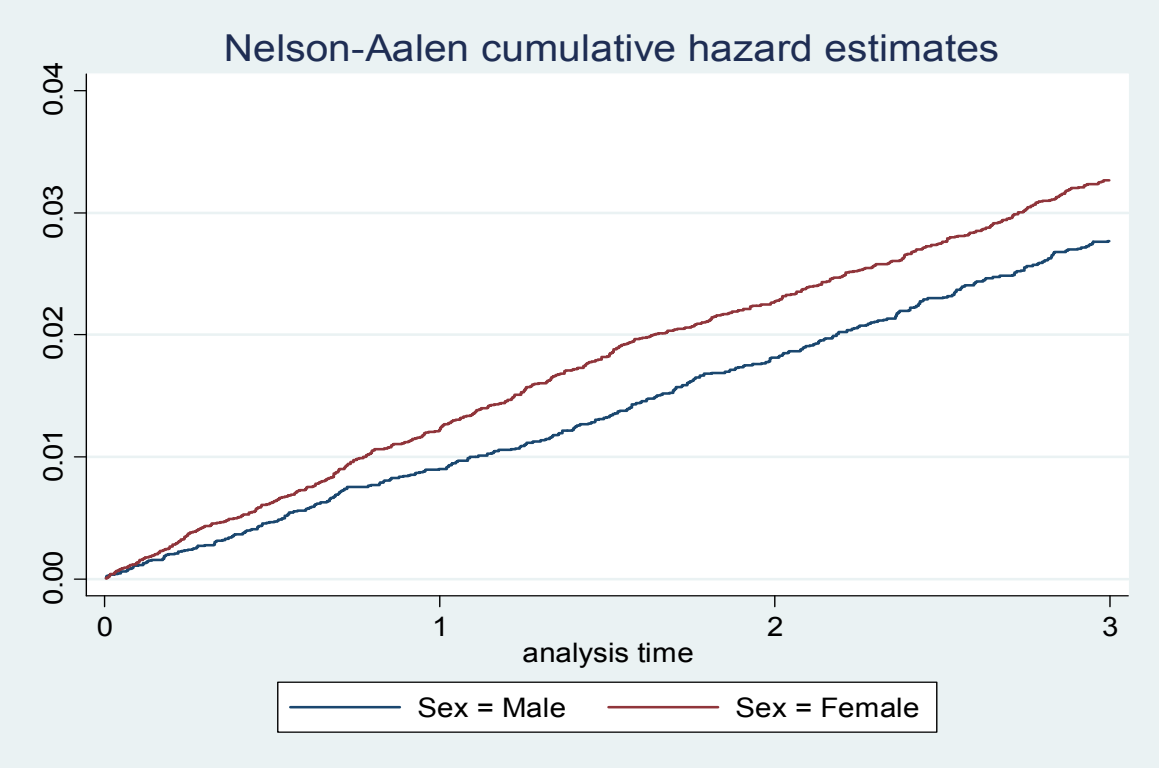


Figure 3.14: Nelson-Aalen cumulative hazard estimates by sex for adults 15 years and older in the Africa Centre DSA from 2011 to 2013 excluding maternal causes of hospitalization.

3.15 Hospitalization rates

Hospitalization rate for the period was 13.85 per 1000 person-years (95% CI 13.14-14.60) with a total person time of 99265.30 person years. Females had a rate of 17.01 per 1000 person years (95% CI: 15.98-18.09) and that of males was 9.31 per 1000 person years (95% CI: 8.42-10.30). The hospitalization rates stratified by year are presented in table 3.3. After excluding maternal causes of hospitalization the hospitalization rate for the period reduced to 10.29 per 1000 person-years (95% CI 9.68-10.94) and a total person time of 99445.57 person years. Hospitalization rate for females was still higher (11.02 per 1000 person years (95% CI: 10.21-11.91)) than that of males whilst the rate for males remained the same 9.22 per 1000 person

years (95% CI: 8.33-10.21). The hospitalization rate excluding maternal causes stratified by year is presented in table 3.4.

Table 3.3: Hospitalization rates among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013.

Year	**2011**		
	No. of events	**Rates per 1000 person years**	**95% CI**
Male	132	8.40	7.08 -9.96
Female	361	16.36	14.75 -18.13
Total	493	13.05	11.94 -14.25
Year	**2012**		
	No. of events	**Rates per 1000 person years**	**95% CI**
Male	119	8.88	7.42 - 10.63
Female	291	15.05	13.41 - 16.88
Total	410	12.52	11.37-13.80
Year	**2013**		
	No. of events	**Rates per 1000 person years**	**95% CI**
Male	106	11.88	9.82 – 14.37
Female	233	17.33	15.24 – 19.70
2013	339	15.15	13.62-16.86

Table 3.4: Hospitalization rates excluding maternal causes among adults 15 years and older resident in the Africa Centre DSA from 2011 to 2013

Year	**2011**		
	No. of events	**Rates per 1000 person years**	**95% CI**
Male	132	8.40	7.08 -9.96
Female	250	11.31	9.99-12.80
Total	382	10.10	9.13-11.16
Year	**2012**		
	No. of events	**Rates per 1000 person years**	**95% CI**
Male	119	8.88	7.42 - 10.63
Female	190	9.80	8.50-11.29
Total	309	9.42	8.43-10.53
Year	**2013**		
	No. of events	**Rates per 1000 person years**	**95% CI**
Male	106	11.88	9.82 – 14.37
Female	161	11.95	10.24-13.95
2013	267	11.92	10.58-13.44

3.16 Factors associated with hospitalization among males

Results of the unadjusted and adjusted hazard ratios of factors associated with hospitalization among males are presented in table 3.5. Results from univariable Cox proportional hazard model suggested that age, education, grants, marital status and household size were associated with the risk of hospitalization among adult males 15 years and above resident in the DSA from 2011 to 2013. With the exception of males in the 20-24 years age group, there were varied significant increases in the risk of hospitalization for all age groups compared to the 15-19 year age group. Males 60 years and older had the highest risk of hospitalization; an almost 12 fold increase in the risk compared to males 15-19 years (HR 11.65 95%CI: 7.27-18.68). In comparison to males with no education, those with primary education had a 41% reduced risk of hospitalization (HR 0.59 95%CI 0.38-0.91) whilst those with secondary education had a 64% reduced risk of hospitalization (HR 0.36 95% CI: 0.27-0.48) and a 45% reduction in risk of hospitalization was observed among males with tertiary education (HR 0.55 95% CI: 0.35-0.87). Receipients of child support grants had a 60% reduced risk of hospitalization (HR 0.40 95% CI: 0.19-0.82), however those on disability grants had an almost threefold increased risk of hospitalization (HR 2.71 95% CI: 1.86-3.96) and beneficiaries of old age pension grant had a threefold increased risk of hospitalization (HR 3.10 95% CI: 2.33-4.12) compared to male participants who did not receive grants. The risk of hospitalization among widowers increased by four fold (HR 4.20 95% CI: 2.70-6.53) compared to their unmarried males whilst male participants living in households with more than 10 people had a reduction in the risk of hospitalization by 28% (HR 0.72 95% CI: 0.54-0.95).

The multivariable analysis suggested that age groups, grants and marital status were associated with the risk of hospitalization among male adults. There were varied increased risk of hospitalization among males in the various age groups compared to the 15-19 year age group

with the exception of the 20-24 year age group with the highest risk among those 60 years and older (aHR 10.49 95%CI: 5.33-20.65). The risk of hospitalization increased by 72% (aHR 1.72 95%CI: 1.15-2.56) among males on disability grant compared to males who did not receive grants whilst married males had a 48% reduction in the risk of hospitalization compared to unmarried males (aHR 0.52 95%CI: 0.38-0.73).

Table 3.5: Factors associated with hospitalization among male adults 15 years and older resident in the DSA from 2011 to 2013.

Univariable				**Multivariable**	
Variable	**Category**	**Hazard ratio (95% CI)**	**P value**	**Adjusted Hazard ratio (95% CI)**	**P value**
Age group	15-19	1		1	
	20-24	1.26(0.67-2.37)	0.47	1.26(0.66-2.42)	0.48
	25-29	4.79(2.89-7.93)	<0.01	4.74(2.79-8.05)	<0.01
	30-34	9.21(5.69-14.95)	<0.01	9.24(5.56-15.38)	<0.01
	35-39	6.41(3.78-10.87)	<0.01	6.55(3.75-11.43)	<0.01
	40-44	8.05(4.75-13.65)	<0.01	8.68(4.93-15.28)	<0.01
	45-49	7.00(4.02-12.19)	<0.01	7.83(4.31-14.23)	<0.01
	50-54	6.36(3.54-11.41)	<0.01	6.86(3.61-13.04)	<0.01
	55-59	5.78(3.07-10.88)	<0.01	6.04(2.98-12.26)	<0.01
	60 and older	11.65(7.27-18.68)	<0.01	10.49(5.33-20.65)	<0.01
Education	None	1		1	
	Primary	0.59(0.38-0.91)	0.02	0.97(0.60-1.58)	0.91
	Secondary	0.36(0.27-0.48)	<0.01	0.88(0.60-1.30)	0.51
	Tertiary	0.55(0.35-0.87)	0.01	0.87(0.52-1.47)	0.60
Employment	Unemployed	1			
	Employed	1.00(0.78-1.28)	0.99		
Grants	None	1		1	
	Child support/foster care	0.40(0.19-0.82)	0.01	0.96(0.44-2.10)	0.93
	Disability	2.71(1.86-3.96)	<0.01	1.72(1.15-2.56)	<0.01
	Old age pension	3.10(2.33-4.12)	<0.01	1.52(0.96-2.42)	0.08
Marital status	Unmarried	1		1	
	Married	1.27(0.96-1.67)	0.09	0.52(0.38-0.73)	<0.01
	Separated/divorced	1.60(0.22-11.47)	0.64	0.64(0.09-4.60)	0.66
	Widowed	4.20(2.70-6.53)	<0.01	1.42(0.85-2.37)	0.17
Type of residence	Rural	1			
	Peri-urban	1.05(0.85-1.30)	0.64		
	Urban	0.93(0.63-1.37)	0.71		

Univariable				Multivariable	
Variable	**Category**	**Hazard ratio (95% CI)**	**P value**	**Adjusted Hazard ratio (95% CI)**	**P value**
Household size	1-5	1		1	
	6-10	0.75(0.56-1.00)	0.05	0.97(0.72-1.29)	0.83
	>10	0.72(0.54-0.95)	0.02	0.95(0.71-1.27)	0.71
Wealth index	Poorest	1			
	Poor	0.95(0.63-1.42)	0.79		
	Average	0.83(0.55-1.27)	0.38		
	Rich	0.89(0.56-1.40)	0.59		
	Richest	0.73(0.51-1.04)	0.08		

3.17 Factors associated with hospitalization among females

Factors associated with hospitalization among female adults are presented in table 3.6. Age, education, marital status and wealth index were found to be associated with the risk of hospitalization in the univariable analysis of hospitalization among female adults. The risk of hospitalization increased among some age groups. It increased by 48% among females in the 25-29 year age group (HR 1.48 95% CI: 1.18-1.84), by 47% among females in the 30-34 year age group (HR 1.47 95% CI: 1.15-1.86) and by 37% among females in the 35-39 year age group (HR 1.37 95% CI: 1.07-1.76) compared to those in the 15-19 year age group. The risk however decreased by 30% among females in the 40-44 year age group (HR 0.70 95% CI: 0.51-0.98) and by 31% among females in the 50-54 year age group (HR 0.69 95% CI: 0.50-0.96) compared to those in the 15-19 year age group. Participants with secondary education had a 24% (HR 1.24 95% CI:1.02-1.50) increased risk of hospitalization compared to those with no formal education Married participants risk of hospitalization reduced by 50% (HR 0.50 95% CI: 0.40-0.36) whilst that of widowed participants reduced by 34% (HR 0.66 95% CI:

0.53-0.81) compared to unmarried participants. Female participants in the poor wealth index had a 34% (HR 1.34 95% CI: 1.06-1.72) increased risk of hospitalization whilst those in the average wealth index had a marginally significant increase in the risk of hospitalization with reference to those in the poorest wealth index.

In the multivariable analysis age, grants, marital status and wealth index were associated with the risk of hospitalization. There were varied increases in the risk of hospitalization among age groups notable the 25-29 year age group, the 30-34 year age group as well as the 35 to 39 year age group (table 3.6). Beneficiaries of disability grant had a 55% (aHR 1.55 95% CI: 1.13-2.12) increase in the risk of hospitalization whilst the risk increased by 65% (aHR 1.65 95% CI: 1.15-2.37) among beneficiaries of the old age pension scheme compared to females who did not receive grants.

The results also suggested that marriage had a protective effect on hospitalization with married participants having the risk of hospitalization reduced by 43% (aHR 0.57 95% CI: 0.44-0.73) whilst that of widowed participants reduced by 32% (aHR 0.68 95% CI: 0.52-0.90) compared to those unmarried. Also, female participants in the poor wealth index had a 37% (aHR 1.37 95% CI: 1.07-1.76) increase in the risk of hospitalization compared to those in the poorest wealth index.

Table 3.6: Factors associated with hospitalization among female adults 15 years and older, resident in the DSA from 2011 to 2013.

Univariable				**Multivariable**	
Variable	**Category**	**Hazard ratio (95% CI)**	**P value**	**Adjusted Hazard ratio (95% CI)**	**P value**
Age group	15-19	1		1	
	20-24	1.20(0.96-1.51)	0.12	113(0.90-1.43)	0.29
	25-29	1.48(1.18-1.84)	<0.01	1.42(1.13-1.79)	<0.01
	30-34	1.47(1.15-1.86)	<0.01	1.47(1.14-1.89)	<0.01
	35-39	1.37(1.07-1.76)	0.01	1.47 (1.12-1.90)	<0.01
	40-44	0.70(0.51-0.98)	0.04	0.81(0.58-1.15)	0.24
	45-49	0.86(0.63-1.16)	0.32	1.00(0.71-1.40)	0.99
	50-54	0.69(0.50-0.96)	0.03	0.78(0.52-1.14)	0.20
	55-59	0.66(0.44-0.99)	0.04	0.70(0.43-1.10)	0.13
	60 and older	0.94(0.74-1.18)	0.58	0.85(0.55-1.32)	0.48
Education	None	1		1	
	Primary	0.98(0.74-1.28)	0.85	0.97(0.72-1.30)	0.85
	Secondary	1.24(1.02-1.50)	0.03	1.04(0.80-1.36)	0.75
	Tertiary	1.04(0.78-1.38)	0.79	1.02(0.72-1.42)	0.91
Employment	Unemployed	1		1	
	Employed	0.89(0.73-1.09)	0.25	0.92(0.75-1.12)	0.41
Grants	None	1		1	
	Child support/ foster care	0.75(0.54-1.05)	0.09	0.75(0.53-1.06)	0.11
	Disability	1.10(0.83-1.46)	0.50	1.55(1.13-2.12)	<0.01
	Old age pension	0.96(0.79-1.17)	0.71	1.65(1.15-2.37)	<0.01
Marital status	Unmarried	1		1	
	Married	0.50(0.40-0.63)	<0.01	0.57(0.44-0.73)	<0.01
	Separated/divorced	0.59(0.18-1.91)	0.38	0.67(0.20-2.26)	0.51
	Widowed	0.66(0.53-0.81)	<0.01	0.68(0.52-0.90)	<0.01
Type of residence	Rural	1			
	Peri-urban	1.02(0.89-1.17)	0.74		
	Urban	1.00(0.80-1.26)	0.96		
Household size	1-5	1			
	6-10	0.93(0.76-1.13)	0.46		
	>10	0.94(0.78-1.14)	0.55		
Wealth index	Poorest	1		1	
	Poor	1.34(1.06-1.72)	0.02	1.37(1.07-1.76)	0.02
	Average	1.23(1.00-1.51)	0.05	1.21(0.98-1.49)	0.07
	Rich	1.12(0.90-1.40)	0.32	1.12(0.89-1.40)	0.35
	Richest	0.87(0.66-1.13)	0.28	0.91(0.69-1.20)	0.50

3.18 Factors associated with hospitalization among females excluding maternal causes.

Factors associated with hospitalization among females excluding maternal causes of hospitalization are presented in table 3.7. In the univariable analysis, age group, education, grants, marital status and wealth index were found to be associated with hospitalization among females after excluding maternal causes. There were varied increases in the risk of hospitalization for all the age groups compared to the 15-19 year age group (table 3.7). In comparison to females with no education the risk of hospitalization reduced by 32% (HR 0.68 95% CI: 0.54-0.87) among participants with secondary education. The risk of hospitalization reduced by 50% (HR 0.50 95%CI: 0.29-0.88) among recipients of child support or foster care grants. However the risk increased by 45% (HR 1.55 95%CI: 1.14-2.10) among recipients of disability grants and increased by 50% (HR 1.50 95%CI: 1.22-1.86) among those on old age pension grant compared to those who did not receive grants. There was also a 44% reduction in the risk of hospitalization among married females (HR 0.66 95% CI: 0.52-0.84) compared to unmarried participants and the risk increased by 41% (HR 1.41 95% CI: 1.101-1.97) among participants in the poor wealth index whilst increasing by 42% (HR 1.42 95% CI: 1.04-1.95) among those in the average wealth index compared to those in the poorest wealth index

In the multivariable analysis there were varied increases in the risk of hospitalization in all the age groups compared to the 15-19 year age group with the exception of the 20-24 year age group. With reference to females who did not receive grants, the risk of hospitalization increased by 46% among female participants on disability grants (aHR 1.46 95% CI: 1.05-2.03) and increased by 51% (aHR 1.51 95% CI: 1.03-2.23) among females on old age pension grant. Also marriage had a protective effect on the risk of hospitalization with the risk reducing by 52% (aHR 0.48 95% CI: 0.37-0.66) among married females and 36% (aHR 0.64 95% CI:

0.49-0.85) among widowed participants compared to those unmarried. However wealth index was associated with an increased risk of hospitalization. With reference to the poorest wealth index, the risk of hospitalization increased by 45% (aHR 1.04 95% CI: 1.04-2.03) among females in the poor wealth index and 44% (aHR 1.44 95% CI: 1.06-1.97) among those in the average wealth index.

Table 3.7: Factors associated with hospitalization excluding maternal causes among female adults 15 years and older resident in the DSA from 2011 to 2013.

Univariable				**Multivariable**	
Variable	**Category**	**Hazard ratio (95% CI)**	**P value**	**Hazard ratio (95% CI)**	**P value**
Age	15-19	1		1	
	20-24	1.55(1.06-2.26)	0.02	1.48(1.00-2.18)	0.05
	25-29	2.55(1.80-3.62)	<0.01	2.46(1.71-3.54)	<0.01
	30-34	3.19(2.24-4.54)	<0.01	3.22(2.23-4.67)	<0.01
	35-39	3.45(2.42-4.92)	<0.01	3.71(2.55-5.39)	<0.01
	40-44	1.92(1.27-2.91)	<0.01	2.24(1.44-3.49)	<0.01
	45-49	2.76(1.89-4.03)	<0.01	3.23(2.12-4.96)	<0.01
	50-54	2.22(1.49-3.32)	<0.01	2.52(1.58-4.02)	<0.01
	55-59	2.12(1.34-3.37)	<0.01	2.25(1.32-3.85)	0.01
	60 and older	2.94(2.12-4.08)	<0.01	2.74(1.62-4.64)	<0.01
Education	None	1		1	
	Primary	0.80(0.59-1.08)	0.14	0.89(0.64-1.24)	0.49
	Secondary	0.68(0.54-0.87)	<0.01	0.89(0.62-1.27)	0.50
	Tertiary	0.74(0.51-1.08)	0.11	0.88(0.57-1.38)	0.58
Employment	Unemployed	1			
	Employed	0.97(0.80-1.18)	0.76		
Grants	No	1		1	
	Child support/foster care	0.50(0.29-0.88)	0.02	0.78(0.43-1.37)	0.37
	Disability	1.55(1.14-2.10)	<0.01	1.46(1.05-2.03)	0.02
	Old age pension	1.57(1.25-1.96)	<0.01	1.51(1.03-2.23)	0.04
Marital status	Unmarried	1		1	
	Married	0.66(0.52-0.84)	<0.01	0.48(0.37-0.66)	<0.01
	Separated/divorced	1.02(0.30-3.50)	0.97	0.70(0.21-2.33)	0.56
	Widowed	1.06(0.85-1.31)	0.63	0.64(0.49-0.85)	<0.01
Type of residence	Rural	1			
	Peri-urban	1.11(0.94-1.31)	0.24		
	Urban	1.15(0.88-1.50)	0.32		
Household size	1-5	1			
	6-10	0.89(0.70-1.13)	0.32		
	>10	0.83(0.66-1.04)	0.11		
Wealth index	Poorest	1		1	
	Poor	1.41(1.01-1.97)	0.04	1.45(1.04-2.03)	0.03
	Average	1.42(1.04-1.95)	0.03	1.44(1.06-1.97)	0.02
	Rich	1.19(0.87-1.63)	0.28	1.24(0.91-1.70)	0.18
	Richest	0.97(0.68-1.39)	0.87	1.08(0.77-1.53)	0.64

CHAPTER 4: DISCUSSION

4.1 Introduction

Data on the burden of disease in any region is crucial for policy decisions and health interventions however, a key barrier to public health decision making in Africa has been the scarcity of data on the burden of disease (77). Data from a longitudinal cohort in the AC surveillance area was utilized in identifying the causes of hospitalization as well as the factors associated with hospitalization among males and females. The results of the analysis as well as the strengths and limitations of the analysis are discussed in this chapter.

4.2 Causes of hospitalization

The key findings from this study conducted in a rural South African setting suggest that maternal conditions (24.96%), tuberculosis (18.48%), injuries (9.39%), infectious and parasitic infections (7.75%) as well as cardiovascular disease (6.56%) are the common immediate causes of hospitalization in the general population. This is in consonance with evidence from a systematic review of causes of hospitalization among adults which suggested that cardiovascular and infectious and parasitic diseases were the main causes of hospitalization in sub-Saharan Africa between 1950 and 2010, highlighting the burden of communicable and non-communicable diseases in Africa (20). However the burden of maternal conditions, tuberculosis and injuries as seen in the current analysis were not evident in the systematic review. This could be attributed to the fact that disease profile has changed over time and some of the studies available for the review were outdated with the most recent study conducted from 2005-2007. This is coupled with the fact that about two thirds of the studies reviewed did not use ICD coding systems (20).

In spite of that, findings from the present analysis with the exception of HIV/AIDS are in keeping with the disease profile for South Africa and KwaZulu-Natal where mortality data used to estimate the burden of disease suggested that HIV/AIDS, CMPN, NCD and injuries were the main causes of mortality (8, 76). Despite the fact that KwaZulu-Natal is the worst affected province with regards to the HIV epidemic with a prevalence of 29% (78) in the rural setting where this study was conducted, results from the current analysis suggest that there were no hospitalizations with HIV/AIDS or HIV related causes being the immediate cause in 2012 and 2013. This could be due to the fact that the coding practice for HIS changed and was more standardized in 2012. In addition to that, the national roll-out of ART in South Africa since 2004 (75) could have contributed to people being hospitalized for other immediate causes rather than HIV. However HIV/AIDS contributed to a large (305 (39.25%)) proportion of the underlying causes of hospitalization in the present analysis bringing to light the fact that there is a high prevalence of HIV among the study population.

Our findings on maternal, HIV/AIDs and injuries as causes of hospitalization are in line with results from a longitudinal study which identified pregnancy disorders, NCDs, HIV-related diseases and injuries as the main causes of hospitalization in rural Kenya (19). This is also in keeping with research that more than one third of women worldwide die as a result of maternal conditions such as pregnancy and childbirth with majority of these from Africa (79). The maternal cause of hospitalization in the current study were mainly (78.11%) due to caesarean section with 47.93% being emergency caesarean section along with majority of the participants hospitalized for maternal causes being adolescents. Adolescent pregnancy is a health problem worldwide and in developing countries (80, 81). Maternal morbidity is the second leading causes of death worldwide and in SSA among girls 15 to 19 years (82, 83) with increased risk of maternal and fetal health outcomes compared to females above 20 years (83-85). South Africa has a high burden of adolescent pregnancy (80, 86) with unprotected sex, multiple

sexual partners (80), early sexual debut and low contraceptive use being common among young people (87, 88). The cohort in our study could therefore have being at a high risk of teenage pregnancy and subsequent complication necessitating caesarean section for very young adolescents which should be taken into consideration in the allocation of resources for the hospitals. Additionally the reasons for the caesarean section should be assessed to in order to make focused interventions.

The underlying causes of hospitalization were HIV/AIDS 305(39.15%) maternal conditions 193(24.78%), injuries unintentional 97(12.45%), tuberculosis 70(8.99%), diabetes 38(4.88%) and cardiovascular 36(4.62%) suggesting that the underlying causes of hospitalization were similar to the immediate causes with the exception of HIV/AIDS and diabetes. The high HIV prevalence in the study area (78) as well as HIV/AIDS being the highest underlying causes of hospitalization and diabetes being among the leading underlying causes of hospitalization suggest that there is a growing demand for chronic disease care in the study area requiring long term clinical management which should be taken into consideration in allocation of resources for the health sector and should also serve as a guide for targeted interventions.

There were variations in the causes of hospitalization by gender. Whilst tuberculosis 100(27.62%), injuries 61(16.85%), infectious and parasitic infections 28(7.73%) and cardiovascular disease 24(6.63%) were the leading causes of hospitalization among males that of females were maternal condition 338(34.28%), tuberculosis, infectious and parasitic infections 76(7.71%), cardiovascular diseases 67(6.80%) and injuries 65(6.54%). The median length of stay was higher among men compared to women which could point to differences in severity of disease between men and women or differences in diseases affecting men and women. Variations in causes of hospitalization by gender was also observed in a study in rural

Kenya (19). The variations in the causes of hospitalization by gender should be taken into consideration when planning strategies and interventions to reduce morbidity in the study area.

4.3 Hospitalization rates

Few studies in Africa have estimated hospitalization rates in person years due to the absence of a population denominator (20). Hospitalization rate for the cohort in the current study was 13.61 per 1000 person years with females having a higher hospitalization rate compared to males. It could be argued that the high maternal causes of hospital could account for the variation in hospitalization by gender. However after excluding maternal cause of hospitalization the hospitalization rate for the cohort was 10.29 per 1000 person years with females still having a higher rate compared to males. The results however suggest that rates of hospitalization for men was increasing over the years. With the high prevalence of HIV in the study area and free rollout of ART, several studies have suggested that fewer men initiate ART relative to women (89-91). Also, ART initiation in comparison to ART need is higher among women compared to men (92) coupled with the fact that there is evidence to suggest that women on ART achieve better long-term immune response to ART having lower risk of AIDS related morbidity and mortality earlier than men (93). This could point to the increasing rates of hospitalization among men. Results from a similar study in rural Kenya also suggested variation in hospitalization rates by gender with females having higher rates (19).

4.4 Factors associated with hospitalization

Results from this study suggest that age, grants and marital status were associated with the risk of hospitalization among males. Among females grants, marital status and wealth index were

found to be associated with the risk of hospitalization. These factors persisted after excluding maternal causes of hospitalization in addition to which age was also found to be associated with the risk of hospitalization. However in general the risk estimates for males was higher than that of females. The age distribution of both genders could account for this in addition to that fact that hospitalization due to injuries was higher among males and common among the younger age groups and the aged.

With regards to age, results from this study suggested varied increases in the risk of hospitalization among males in all the age groups with the exception of the 20-24 year age group. Age was however not associated with the risk of hospitalization for females. The large proportion of maternal causes of hospitalization could have masked the effect of age on the risk of hospitalization among females since after excluding maternal causes there were varied increases in the risk of hospitalization for all age groups apart from those in the 20-24 year age group. Results from some studies also suggest that hospitalization is associated with age with hospitalization associated with older ages in facilities where admission due NCDs were the predominant (41, 43, 44, 63) and younger ages in populations with a high burden of communicable disease (21, 27). The high (35.64%) burden of NCDs among males and among females if maternal causes are excluded in the current study could partly explain the increased risk of hospitalization with increasing age group. It is however unclear why those in the 20-24 year age group were not associated with the risk of hospitalization.

Additionally, marriage was found to have a protective effect on the risk of hospitalization for both males and females. Married males had a reduced risk of hospitalization whilst among females the protective effect was evident among married and widowed participants which still existed after excluding maternal causes. This conforms to published literature on health and mortality outcomes which suggest that unmarried participants report poorer health outcomes

and have a higher risk of mortality compared to their married counterparts (94-98). The results on the protective effect of marriage from the current study is also in keeping with some studies which have found marriage to have a protective effect on hospitalization and mortality among persons with certain disease conditions (62, 66, 72, 99, 100). Although some mortality and health studies have found a stronger protective effect for males (101, 102) the risk of hospitalization did not differ much for men and women in the present study. After excluding maternal causes of hospitalization the protective effect of marriage was higher 55% among females compared to males 50%. Widowers were not associated with the risk of hospitalization however, widowed participants had a reduced risk of hospitalization. The choice of treatment and behaviours could be mediated by marriage (99) hence a plausibility could be that spouses could provide possible health benefits by encouraging their spouses to seek medical care early and encourage adherence to treatment. Additionally conjugal relationships come with higher degree of social connections through shared membership of households that individuals become part of which offers a greater protection against mortality (98) which could also account for the protective effect of married and widowed participants on hospitalization.

In addition to that grants was found to be associated with the risk of hospitalization among both males and females. Both males and females on disability and old age pension grant had an increased risk of hospitalization compared to those who did not receive grants although the risk for males was higher than that of females. The disability grant and the old age pension grants are two of seven social grants provided by the South African Social Security Agency (SASSA) to persons who meet certain criteria (103, 104). The disability grant is aimed at relieving living conditions of people with health constraints and disability (105) and plays a vital role in poverty reduction among HIV infected patients (106) whilst the old age pension grant is a means- test non-contributory government given to women 60 years and above and men 65 years and above (107). Grants play an integral role in the livelihood and survival of members of households

(106, 108) and studies suggest that there is improvement in perceived health and wellbeing among people in household with pensioners (108, 109). However from this study same cannot be said about the risk of hospitalization for recipients of disability and old age pension grant. Receiving a disability grant could be a proxy for ill health which in part explains the increased risk of hospitalization among recipients of disability grant as suggested in our study. Additionally evidence from literature suggest that the aged are vulnerable and have higher health risk (110). There is therefore an increase in demand of care for chronic disease requiring long term clinical management among older ages as a result of NCDs in South Africa (15) which speaks to the increased risk of hospitalization among recipients of old age pension.

Furthermore, wealth index was found to be associated with the risk of hospitalization and this was amongst females only. Wealth index was developed as a reliable way to capture socio-economic status based on asset ownership and household characteristics. Wealth is a known household characteristics that largely affects health with poor people having worse health outcomes (111, 112) and affected by multiple deprivations which result in higher levels of morbidity (111, 113). Even in some countries with universal health coverage higher socio-economic status is associated with decreased overall and cause specific mortality (114). Self-reported ill health in a study in South Africa was also found to be associated with people of lower socio-economic status (115). Similar to these findings, females in poor and average wealth index were associated with an increased risk of hospitalization.

4.5 Limitations

This was an analysis of secondary data and hence did not allow for analysis of some variables which were not collected as part of routine surveillance in the DSA.

Furthermore, data for routine surveillance is collected once every six months and since 2012 once every four months from key informants in the households. This may result in reporting bias since key informants may not accurately recall information for all members of the household.

Also, hospitalization data used gives information about participants who sort care from the hospital and does not include those who did not seek care from the hospital hence does not give a full understanding of morbidity in the area.

Additionally death is a competing risk for hospitalization and this was not assessed in this study.

4.6 Strengths

To our knowledge this is one of the few studies in Africa that have used population based data to identify causes of hospitalization (19) and the factors associated with hospitalization in a general population.

Additionally the use of population based data limits the issue of sampling bias which could have been introduced in hospital based studies.

Furthermore, the robust demographic surveillance system which captures vital demographic events (births, deaths and migration) longitudinally coupled with the large population under surveillance and the linkage of the hospitalization data for those hospitalized at the Hlabisa

hospital provided a unique platform for the calculation of hospitalization rates and assessing factors associated with hospitalization from rich and reliable data.

Also, the HIS which offers computerized data capture of hospitalizations at the Hlabisa hospital based on ICD10 coding serves as a rich source of data for understanding the causes of hospitalization.

Again, the use of data from one hospital could limit generalizability of the data, however in this rural South African setting with high unemployment and few people having private health insurance, most of them seek health care from one of the 17 PHC clinics in the district and are referred when necessary to the Hlabisa hospital the only one in the district and hence does not limit the generalizability of the results in this setting.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The analysis suggest the multiple burden of disease among the cohort. Maternal conditions, tuberculosis, injuries and infectious and parasitic as well as cardiovascular disease were the main causes of hospitalization during the study period. The causes varied by gender with tuberculosis, injuries, infectious and parasitic diseases as well as cardiovascular disease being the common causes among males whilst the common causes of hospitalization among females being maternal conditions, tuberculosis, infectious and parasitic diseases, cardiovascular and injuries. This adds to the growing body of knowledge on causes of hospitalization among adults.

Age, grants and marriage were associated with the risk of hospitalization among males whilst grants, marriage and wealth index was associated with the risk of hospitalization among females. Exclusion of maternal causes slightly altered the risk of hospitalization estimates in addition to which age was associated with increased risk of hospitalization. These should be taken in consideration for efficient planning and implementation of health programs to reduce morbidity in the study population. Additionally, although there are several non-governmental organizations, governmental and community-based agencies in South Africa working towards disease prevention, there is the need for these institutions to form strong links with each other and have a shared vision to reduce disease burden.

5.2 Recommendations

1. Gender should be taken into consideration in planning and implementing health policies and interventions since the causes of hospitalization vary by gender. For successful implementation of health policies available in South Africa, a multisectorial approach is essential.
2. The high proportion of hospitalization due to maternal causes highlights the need for interventions to reduce teenage pregnancy and essential obstetric care for women which should be taken into consideration in the allocation of resources for health facilities as well as the planning, monitoring and evaluation of safe motherhood programmes.
3. To the best of our knowledge this is the first study that assess factors associated with hospitalization in the general population of adults, others studies in South Africa and other countries is recommended.

Appendices

Appendix 1: Plagiarism declaration

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Irene Tampuri Azindow (Student number: 705316) am a student registered for the degree of Master of Science in Epidemiology (Population based field epidemiology in the academic year 2017.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature:  Date: 28rd November, 2017

Appendix 2: Data use agreement from Africa Centre for conduct of analysis





Africa Centre Demographic Information System (ACDIS)

Data Use Agreement

It is hereby agreed with Ms Irene Tampuri Azindow of the University of the Witwatersrand on 6th November 2013 that they will have access to the following ACDIS dataset(s) :

1. Individual……
2. General health ……
3. Hospital Information System ……
4. Household Socio Economic status (HSE) ……

The following conditions will apply:

1. The Data Users will neither release nor permit others to release the files or data therein to any person (including media and subcontractors) except with the written approval of the Africa Centre;
2. The Data Users will neither use nor permit others to use the data in any way other than listed in the original application (Analysis Plan) for access to the dataset;
3. The Data Users will ensure that the data are kept in a secured environment and that only authorized users have access to the data.
4. Every publication or report based on the data must carry an acknowledgement of the form:

   This Analysis is based on data collected by the Africa Centre in its Demographic Information System. The Africa Centre, including the surveillance is funded by the Wellcome Trust, Award No. 082384/Z/07/Z
5. The Data Users will not release or permit others to release any data that identifies persons, directly or indirectly;
6. When the data are to be made publicly available, then Africa Centre will be notified when and how this will happen.
7. Once the datasets have served their indicated purpose they are to be appropriately disposed of.

All datasets remain the property of the Africa Centre and the Africa Centre reserves the right to request the return of any datasets should any of the above conditions be violated.

The following documents **must** accompany this agreement:

1. A short description of the intended purpose and method of analysis of the data (Analysis Plan)
2. A list of the names and organizational affiliations of all those who will engage in this analysis. In the case of students, a statement by their supervisor that they will ensure that the student abides by these conditions.
3. A description of the means by which the Data Users will restrict access to confidential Africa Centre data.

Signed:

……
Data User

Date: 6th November, 2013.

……
Dr A J Herbst (Deputy Director)

Date: ……

Postal: PO Box 198, Mtubatuba 3935, South Africa
Physical: Africa Centre, R618 en route to Hlabisa, Somkhele Tel.: +27 (0)35 550 7500
Fax: +27 (0)35 550 7565
Email: info@africacentre.ac.za
Web: www.africacentre.com

wellcome trust

Appendix 3: Ethical clearance from the University of the Witwatersrand for conduct of analysis.

R14/49 Ms Irene Tampuri Azindow

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M131172

NAME: (Principal Investigator)	Ms Irene Tampuri Azindow
DEPARTMENT:	School of Public Health Africa Centre of Health and Population Studies, Kwazulu-Natal South Africa: INDEPTH HDSS Site
PROJECT TITLE:	Hospitalization among Adults in the Africa Centre Demographic Surveillance Site in Rural KwaZulu-Natal: South Africa
DATE CONSIDERED:	29/11/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof KK Grobusch
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	02/12/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 4: ICD10 codes and description of causes of hospitalization classified as CMPN that occurred during analysis period.

ICD10 code	DESCRIPTION
A09	Diarrhea and gastroenteritis of presumed infectious origin
A41.9	Septicemia, unspecified
A54.3	Gonococcal infection of eye
A63.0	Anogenital (venereal) warts
B01.9	Varicella without complications
B02.9	Zoster without complication
B16.9	Acute hepatitis B without delta-agent and without hepatic coma
B45.1	Cerebral cryptococcosis
B50.9	Plasmodium falciparum malaria, unspecified
B59	Pneumocystosis
D64.9	Anemia, unspecified
G00.9	Bacterial meningitis, unspecified
G03.9	Meningitis, unspecified
H66.4	Suppurative otitis media, unspecified
J18.1	Lobar pneumonia, unspecified
J18.9	Pneumonia, unspecified
J22	Unspecified acute lower respiratory infection
N73.9	Female pelvic inflammatory disease, unspecified
O00.1	Tubal pregnancy
O00.8	Other ectopic pregnancy
O00.9	Ectopic pregnancy, unspecified
O02.0	Blighted ovum and nonhydatidiform mole
O03.4	Incomplete, without complication
O03.5	Complete or unspecified, complicated by genital tract and pelvic infection
O03.6	Complete or unspecified, complicated by delayed or excessive hemorrhage
O07.1	Failed medical abortion, complicated by delayed or excessive hemorrhage
O08.0	Genital tract and pelvic infection following abortion and ectopic and molar pregnancy
O08.3	Shock following abortion and ectopic and molar pregnancy
O13	Gestational [pregnancy-induced] hypertension without significant proteinuria
O15.1	Eclampsia in labor
O15.2	Eclampsia in the puerperium
O15.9	Eclampsia, unspecified as to time period
O16	Unspecified maternal hypertension
O20.0	Threatened abortion
O21.0	Mild hyperemesis gravidarum
O30	Multiple gestation
O32.2	Maternal care for transverse and oblique lie
O32.9	Maternal care for malpresentation of fetus, unspecified

O33.4	Maternal care for disproportion of mixed maternal and fetal origin
O33.5	Maternal care for disproportion due to unusually large fetus
O33.9	Maternal care for disproportion, unspecified
O34.2	Maternal care due to uterine scar from previous surgery
O34.6	Maternal care for abnormality of vagina
O36.3	Maternal care for signs of fetal hypoxia
O36.9	Maternal care for fetal problem, unspecified
O44.1	Placenta previa with hemorrhage
O45.9	Premature separation of placenta, unspecified
O61.9	Failed induction of labor, unspecified
O62.0	Primary inadequate contractions
O62.8	Other abnormalities of forces of labor
O63.9	Long labor, unspecified
O66.9	Obstructed labor, unspecified
O69.0	Labor and delivery complicated by prolapse of cord
O72.0	Third-stage hemorrhage
O80.0	Spontaneous vertex delivery
O82.0	Delivery by elective caesarean section
O82.1	Delivery by emergency caesarean section
O83.1	Other assisted breech delivery
O84.2	Multiple delivery, all by caesarean section
O85	Puerperal sepsis
O86.0	Infection of obstetric surgical wound
P02.4	Newborn affected by prolapsed cord
P24.0	Neonatal aspiration of meconium

Appendix 5: ICD10 codes and description of causes of hospitalization classified as HIV/AIDS that occurred during analysis period.

ICD10 CODE	DESCRIPTION
B20.0	HIV disease resulting in mycobacterial infection
B20.1	HIV disease resulting in other bacterial infections
B20.3	HIV disease resulting in other viral infections
B20.4	HIV disease resulting in candidiasis
B20.5	HIV disease resulting in other mycoses
B20.6	HIV disease resulting in Pneumocystis carinii pneumonia
B20.8	HIV disease resulting in other infectious and parasitic diseases
B20.9	HIV disease resulting in unspecified infectious or parasitic disease
B21.0	HIV disease resulting in Kaposi's sarcoma
B21.3	HIV disease resulting in other malignant neoplasms of lymphoid, hematopoietic, and related tissue
B21.8	HIV disease resulting in other malignant neoplasms
B21.9	HIV disease resulting in unspecified malignant neoplasm
B22.0	HIV disease resulting in encephalopathy
B22.2	HIV disease resulting in wasting syndrome
B23.0	Acute HIV infection syndrome
B23.2	HIV disease resulting in hematological and immunological abnormalities, not elsewhere classified
B23.8	HIV disease resulting in other specified conditions
B24	Unspecified human immunodeficiency virus [HIV] disease

Appendix 6: ICD10 codes and description of causes of hospitalization classified as Injuries that occurred during analysis period.

ICD10 CODE	DESCRIPTION
S03.0	Dislocation of jaw
S27.2	Traumatic haemopneumothorax
S30.9	Superficial injury of abdomen, lower back and pelvis, part unspecified
S31.4	Open wound of vagina and vulva
S42.4	Fracture of lower end of humerus
S72.0	Fracture of neck of femur
S81.9	Open wound of lower leg, part unspecified
S82.8	Fractures of other parts of lower leg
S88.0	Traumatic amputation at knee level
S95.9	Injury of unspecified blood vessel at ankle and foot level
T09.3	Injury of spinal cord, level unspecified
T09.4	Injury of unspecified nerve, spinal nerve root and plexus of trunk
T30.0	Burn of unspecified body region, unspecified degree
T65.81	Herbal enema
T65.9	Toxic effect of unspecified substance
T75.4	Effects of electric current
T78.3	Angioneurotic oedema
T78.4	Allergy, unspecified
T81.0	Haemorrhage and haematoma complicating a procedure, not elsewhere classified
T88.9	Complication of surgical and medical care, unspecified
V01.1	Traffic accident
V03.0	Non traffic accident
V03.1	Traffic accident
V10.0	Driver injured in non traffic accident
V18.2	Unspecified pedal cyclist injured in non traffic accident
V40.1	Passenger injured in non traffic accident
V40.6	Passenger injured in traffic accident
V40.9	Unspecified car occupant injured in traffic accident
V50.6	Passenger injured in traffic accident
V86.1	Passenger of all-terrain or other off-road motor vehicle injured in traffic accident
V88.8	Person injured in other specified non collision transport accidents involving motor vehicle, non traffic
V89.9	Person injured in unspecified vehicle accident
W01	Fall on same level from slipping, tripping, and stumbling
W01.04	Fall on same level from slipping, tripping and stumbling, home, while resting, sleeping, eating or engaging in other vital activities

W01.09	Fall on same level from slipping, tripping and stumbling, home, during unspecified activity
W01.30	Fall on same level from slipping, tripping and stumbling, sports and athletics area, while engaged in sports activity
W10	Fall on and from stairs and steps
W15.40	Fall from cliff, street and highway, while engaged in sports activity
W15.49	Fall from cliff, street and highway, during unspecified activity
W17	Other fall from one level to another
W17.28	Other fall from one level to another, school, other institution and public administrative area, while engaged in other specified activities
W20.62	Struck by thrown, projected or falling object, industrial and construction area, while working for income
W26	Contact with knife, sword, or dagger
W26.49	Contact with knife, sword or dagger, street and highway, during unspecified activity
W34	Discharge from other and unspecified firearms
W45	Foreign body or object entering through skin
W49	Exposure to other and unspecified inanimate mechanical forces
W50.00	Hit, struck, kicked, twisted, bitten or scratched by another person, home, while engaged in sports activity
W50.49	Hit, struck, kicked, twisted, bitten or scratched by another person, street and highway, during unspecified activity
W54.48	Bitten or struck by dog, street and highway, while engaged in other specified activities
W54.49	Bitten or struck by dog, street and highway, during unspecified activity
X09	Exposure to unspecified smoke, fire, and flames
X09.09	Exposure to unspecified smoke, fire and flames, home, during unspecified activity
X12.00	Contact with other hot fluids, home, while engaged in sports activity
X20	Contact with venomous snakes and lizards
X20.04	Contact with venomous snakes and lizards, home, while resting, sleeping, eating or engaging in other vital activities
X20.48	Contact with venomous snakes and lizards, street and highway, while engaged in other specified activities
X20.49	Contact with venomous snakes and lizards, street and highway, during unspecified activity
X23	Contact with hornets, wasps, and bees
X99	Assault (homicide) by sharp object
Y00	Assault (homicide) by blunt object
Y00.49	Assault by blunt object, street and highway, during unspecified activity
Y00.49	Assault by blunt object, street and highway, during unspecified activity
Y08.88	Assault by other specified means, other specied places, while engaged in other specified activities
Y29	Contact with blunt object, undetermined intent

Appendix 7: ICD10 codes and description of causes of hospitalization classified as NCD that occurred during analysis period.

ICD10 CODE	DESCRIPTION
C15.9	Esophagus, unspecified
C22.9	Liver, unspecified
C32.9	Larynx, unspecified
C34.9	Bronchus or lung, unspecified
C49.4	Connective and soft tissue of abdomen
C53.9	Cervix uteri, unspecified
C76.5	Lower limb
D25.9	Leiomyoma of uterus, unspecified
D59.0	Drug-induced autoimmune hemolytic anemia
D61.9	Aplastic anemia, unspecified
D64.8	Other specified anemias
D69.9	Hemorrhagic condition, unspecified
E05.0	Thyrotoxicosis with diffuse goiter
E10	Insulin-dependent diabetes mellitus
E10.7	With multiple complications
E11	Noninsulin-dependent diabetes mellitus
E11.1	With ketoacidosis
E11.5	With peripheral circulatory complications
E16.2	Hypoglycemia, unspecified
E86	Volume depletion
E87.6	Hypokalemia
F06.8	Other specified mental disorders due to brain damage and dysfunction and to physical disease
F19.5	Psychotic disorder
F20.8	Other schizophrenia
F20.9	Schizophrenia, unspecified
F23	Acute and transient psychotic disorders
F23.3	Other acute predominantly delusional psychotic disorders
F23.9	Acute and transient psychotic disorder, unspecified
F32.9	Depressive episode, unspecified
F43.1	Posttraumatic stress disorder
F53.1	Severe mental and behavioral disorders associated with the puerperium, not elsewhere classified
G30.1	Alzheimer's disease with late onset
G40.9	Epilepsy, unspecified
G41.9	Status epilepticus, unspecified
G44.2	Tension-type headache

G47.8	Other sleep disorders
G62.9	Polyneuropathy, unspecified
G81.9	Hemiplegia, unspecified
H05.0	Acute inflammation of orbit
I10	Essential (primary) hypertension
I25.6	Silent myocardial ischemia
I42.9	Cardiomyopathy, unspecified
I50.0	Congestive heart failure
I50.9	Heart failure, unspecified
I51.6	Cardiovascular disease, unspecified
I80.2	Phlebitis and thrombophlebitis of other deep vessels of lower extremities
J45.9	Asthma, unspecified
J84.9	Interstitial pulmonary disease, unspecified
J90	Pleural effusion, not elsewhere classified
K12.2	Cellulitis and abscess of mouth
K22.0	Achalasia of cardia
K27.3	Acute without hemorrhage or perforation
K27.9	Unspecified as acute or chronic, without hemorrhage or perforation
K29.5	Chronic gastritis, unspecified
K35	Acute appendicitis
K35.0	Acute appendicitis with generalized peritonitis
K37	Unspecified appendicitis
K40.9	Unilateral or unspecified inguinal hernia, without obstruction or gangrene
K52.9	Noninfective gastroenteritis and colitis, unspecified
K56.2	Volvulus
K56.4	Other impaction of intestine
K61.0	Anal abscess
K63.0	Abscess of intestine
K71	Toxic liver disease
K74.6	Other and unspecified cirrhosis of liver
K75.9	Inflammatory liver disease, unspecified
K80.2	Calculus of gallbladder without cholecystitis
K81.9	Cholecystitis, unspecified
K83.1	Obstruction of bile duct
K85	Acute pancreatitis
L02.1	Cutaneous abscess, furuncle, and carbuncle of neck
L02.2	Cutaneous abscess, furuncle, and carbuncle of trunk
L02.9	Cutaneous abscess, furuncle, and carbuncle, unspecified
L03.0	Cellulitis of finger and toe
L03.1	Cellulitis of other parts of limb
L03.2	Cellulitis of face
L03.9	Cellulitis, unspecified

L04.9	Acute lymphadenitis, unspecified
L08.9	Local infection of skin and subcutaneous tissue, unspecified
L30.9	Dermatitis, unspecified
L51.1	Bullous erythema multiforme
L60.0	Ingrowing nail
L73.9	Follicular disorder, unspecified
L89	Decubitus ulcer
L97	Ulcer of lower limb, not elsewhere classified
M01.1	Tuberculous arthritis
M06.9	Rheumatoid arthritis, unspecified
M10.9	Gout, unspecified
M13.9	Arthritis, unspecified
M43.1	Spondylolisthesis
M49.0	Tuberculosis of spine
M49.0	Tuberculosis of spine
M54.5	Low back pain
M79.2	Neuralgia and neuritis, unspecified
M79.5	Residual foreign body in soft tissue
M86.9	Osteomyelitis, unspecified
N10	Acute tubulo-interstitial nephritis
N12	Tubulo-interstitial nephritis, not specified as acute or chronic
N13.3	Other and unspecified hydronephrosis
N17	Acute renal failure
N19	Unspecified renal failure
N21.0	Calculus in bladder
N30.0	Acute cystitis
N39.0	Urinary tract infection, site not specified
N40	Hyperplasia of prostate
N45.9	Orchitis, epididymitis, and epididymo-orchitis without abscess
N47	Redundant prepuce, phimosis, and paraphimosis
N61	Inflammatory disorders of breast
N63	Unspecified lump in breast
N75.1	Abscess of Bartholin's gland
N75.9	Disease of Bartholin's gland, unspecified
N76.2	Acute vulvitis
N76.4	Abscess of vulva
N82.3	Fistula of vagina to large intestine
N82.9	Female genital tract fistula, unspecified
N89.8	Other specified noninflammatory disorders of vagina
N92.0	Excessive and frequent menstruation with regular cycle
N92.1	Excessive and frequent menstruation with irregular cycle
N93.9	Abnormal uterine and vaginal bleeding, unspecified

N94.9	Unspecified condition associated with female genital organs and menstrual cycle
Q35.9	Cleft palate, unspecified
Q61.0	Congenital single renal cyst

Appendix 8: ICD10 codes and description of causes of hospitalization classified as tuberculosis that occurred during analysis period.

ICD10 CODE	DESCRIPTION
A15.0	Tuberculosis of lung, confirmed by sputum microscopy with or without culture
A16.2	Tuberculosis of lung, without mention of bacteriological or histological confirmation
A16.5	Tuberculous pleurisy, without mention of bacteriological or histological confirmation
A17.0	Tuberculous meningitis
A18.0	Tuberculosis of bones and joints
A18.3	Tuberculosis of intestines, peritoneum, and mesenteric glands
A19.9	Miliary tuberculosis, unspecified
U50.0	Multi-drug resistant tuberculosis (MDR TB)
U50.5	Drug resistant TB, resistant to at least rifampicin & INH from first line anti-TB drugs in addition to resistance to any fluoroquinolone, and to at least 1 of 3 injectable 2nd-line anti-TB drugs(capreomycin, kanamicin & amikacin)(XDR-TB)
U50.50	Drug resistant TB, primary resistance to at least rifampicin & INH from first line anti-TB drugs in addition to resistance to any fluoroquinolone, and to at least 1 of 3 injectable 2nd-line anti-TB drugs(capreomycin,kanamicin&amikacin)(XDR-TB)

Appendix 9: ICD10 codes and description of causes of hospitalization classified as unspecified that occurred during analysis period.

ICD10 CODE	DESCRIPTION
R02	Gangrene, not elsewhere classified
R04.0	Epistaxis
R04.2	Hemoptysis
R10.3	Pain localized to other parts of lower abdomen
R10.4	Other and unspecified abdominal pain
R16.0	Hepatomegaly, not elsewhere classified
R18	Ascites
R22.4	Localized swelling, mass, and lump, lower limb
R33	Retention of urine
R36	Urethral discharge
R51	Headache
R56.8	Other and unspecified convulsions
Z30.2	Sterilization
Z34.9	Supervision of normal pregnancy, unspecified
Z46.5	Fitting and adjustment of ileostomy and other intestinal appliances
Z89.6	Acquired absence of leg above knee
Z91.5	Personal history of self-harm

Appendix 10: Leading immediate causes of hospitalization among adults 15 years and above resident in Africa Centre DSA for 2011, 2012 and 2013.

Causes of hospitalization 2011	Number	Percentage
Maternal conditions	109	23.54
Tuberculosis	78	16.85
Cardiovascular disease	37	7.99
Injuries	36	7.78
Infectious and parasitic disease	31	6.70
HIV/AIDS	24	5.18
Respiratory infection	21	4.54
Genitourinary disease	19	4.10
Neuropsychiatric condition	18	3.89
Digestive diseases	17	3.67
Causes of hospitalization 2012	**Number**	**Percentage**
Maternal conditions	114	25.56
Tuberculosis	94	21.08
Injuries	37	8.30
Infectious and parasitic diseases	34	7.62
Cardiovascular disease	27	6.05
Genitourinary disease	25	5.61
Digestive diseases	17	3.81
Respiratory infection	15	3.36
Skin diseases	14	3.14
Endocrine disorders	13	2.91
Causes of hospitalization 2013	**Number**	**Percentage**
Maternal conditions	112	25.87
Tuberculosis	76	17.55
Injuries	52	12.01
Infectious and parasitic diseases	39	9.01
Cardiovascular disease	25	5.77
Respiratory infection	19	4.39
Skin diseases	19	4.39
Genitourinary disease	14	3.23
Digestive diseases	12	2.77
Neoplasms - Malignant	12	2.77

Appendix 11: Leading underlying causes of hospitalization among adults 15 years and older resident in Africa Centre DSA for 2011, 2012 and 2013.

2011		
Cause	**Number**	**Percentage**
HIV/AIDS	89	41.98
Maternal conditions	40	18.87
Injuries – Unintentional	27	12.74
Tuberculosis	19	8.96
Diabetes mellitus	14	6.60
Cardiovascular disease	9	4.25
Injuries – Intentional	4	1.89
Digestive diseases	2	0.94
Infectious and parasitic disease	2	0.94
2012		
Cause	**Number**	**Percentage**
HIV/AIDS	121	41.20
Maternal conditions	80	26.58
Injuries – Unintentional	29	9.63
Tuberculosis	29	9.63
Cardiovascular disease	16	5.32
Diabetes mellitus	12	3.99
Injuries – Intentional	3	1.00
Unspecified	3	1.00
Infectious and parasitic disease	2	0.66
2013		
Cause	**Number**	**Percentage**
HIV/AIDS	92	34.85
Maternal conditions	71	26.89
Injuries – Unintentional	41	15.53
Tuberculosis	22	8.33
Diabetes mellitus	12	4.55
Cardiovascular disease	11	4.17
Injuries – Intentional	8	3.03
Unspecified	5	1.89

Appendix 12: Leading immediate causes of hospitalization with no underlying cause among adults 15 years and above resident in Africa Centre DSA for 2011, 2012 and 2013.

Cause of hospitalization 2011	Number	Percentage
Maternal conditions	68	25.66
Cardiovascular disease	22	8.30
HIV/AIDS	21	7.92
Infectious and parasitic disease	17	6.42
Neuropsychiatric conditions	17	6.42
Tuberculosis	17	6.42
Genitourinary disease	15	5.66
Skin diseases	15	5.66
Digestive diseases	12	4.53
Injuries	12	4.53
Cause of hospitalization 2012	**Number**	**Percentage**
Maternal conditions	33	22.60
Genitourinary disease	16	10.96
Infectious and parasitic disease	13	8.90
Cardiovascular disease	12	8.22
Tuberculosis	10	6.85
Skin diseases	9	6.16
Digestive diseases	8	5.48
Neoplasms – Malignant	8	5.48
Respiratory infection	8	5.48
Unspecified	8	5.48
Cause of hospitalization 2013	**Number**	**Percentage**
Maternal conditions	41	24.12
Cardiovascular disease	19	11.18
Infectious and parasitic disease	16	9.41
Skin diseases	13	7.65
Respiratory infection	12	7.06
Tuberculosis	11	6.47
Digestive diseases	10	5.88
Genitourinary disease	7	4.12
Neoplasms – Malignant	7	4.12
Neuropsychiatric condition	7	4.12

REFERENCES

1. Institute for Health Metrics and Evaluation. The Global burden of Disease: Generating Evidence, Guiding Policy. Seatle: IHME, 2013.
2. Naghavi M, Wang H, Lozano R, Davis A, Liang X, Zhou M, Vollset SE, Ozgoren AA, Abdalla S, Abd-Allah F. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015;385(9963):117-71.
3. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS medicine. 2006;3(11):e442.
4. Dean T Jamison RGF, Malegapuru W Makgoba, Eduard R Bos, Florence K Baingana, Karen J Hofman, and Khama O Rogo. Disease and mortality in sub-Saharan Africa. 2nd edition ed. Washinton (DC): World Bank; 2006.
5. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1659-724.
6. Maher D, Smeeth L, Sekajugo J. Health transition in Africa: practical policy proposals for primary care. Bull World Health Organ. 2010;88(12):943-8.
7. Rajaratnam JK, Marcus JR, Levin-Rector A, Chalupka AN, Wang H, Dwyer L, Costa M, Lopez AD, Murray CJ. Worldwide mortality in men and women aged 15-59 years from 1970 to 2010: a systematic analysis. Lancet. 2010;375(9727):1704-20.
8. Bradshaw D, Groenewald P, Laubscher R, Nannan N, Nojilana B, Norman R, Pieterse D, Schneider M, Bourne DE, Timaeus I. Initial burden of disease estimates for South Africa, 2000. South African Medical Journal. 2008;93(9):682.
9. Tollman SM, Kahn K, Sartorius B, Collinson MA, Clark SJ, Garenne ML. Implications of mortality transition for primary health care in rural South Africa: a population-based surveillance study. The Lancet. 2008;372(9642):893-901.
10. Massyn N, Peer N, Padarath A, Barron P, Day C. District Health Barometer 2014/15. Durban: Health Systems Trust, 2015. 2013.
11. Massyn N, Day C, Dombo M, Barron P, English R, Padarath A. District health barometer 2012/13. Durban: Health Systems Trust. 2013:1-420.
12. Pillay-van Wyk V, Msemburi W, Laubscher R, Dorrington RE, Groenewald P, Glass T, Nojilana B, Joubert JD, Matzopoulos R, Prinsloo M, Nannan N, Gwebushe N, Vos T, Somdyala N, Sithole N, Neethling I, Nicol E, Rossouw A, Bradshaw D. Mortality trends and differentials in South Africa from 1997 to 2012: second National Burden of Disease Study. The Lancet Global health. 2016;4(9):e642-53.
13. Larson E, O'Bra H, Brown JW, Mbengashe T, Klausner JD. Supporting the massive scale-up of antiretroviral therapy: the evolution of PEPFAR-supported treatment facilities in South Africa, 2005-2009. BMC Public Health. 2012;12:173.
14. Bor J, Herbst AJ, Newell ML, Barnighausen T. Increases in adult life expectancy in rural South Africa: valuing the scale-up of HIV treatment. Science (New York, NY). 2013;339(6122):961-5.
15. Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. The burden of non-communicable diseases in South Africa. The Lancet. 2009;374(9693):934-47.
16. Quinn TC. HIV epidemiology and the effects of antiviral therapy on long-term consequences. Aids. 2008;22 Suppl 3:S7-12.

17. Clark SJ, Kahn K, Houle B, Arteche A, Collinson MA, Tollman SM, Stein A. Young children's probability of dying before and after their mother's death: a rural South African population-based surveillance study. PLoS medicine. 2013;10(3):e1001409.
18. Cohen B, Menken J. Aging in Sub-Saharan Africa: recommendations for furthering research: National Academies Press; 2006.
19. Etyang AO, Munge K, Bunyasi EW, Matata L, Ndila C, Kapesa S, Owiti M, Khandwalla I, Brent AJ, Tsofa B, Kabibu P, Morpeth S, Bauni E, Otiende M, Ojal J, Ayieko P, Knoll MD, Smeeth L, Williams TN, Griffiths UK, Scott JA. Burden of disease in adults admitted to hospital in a rural region of coastal Kenya: an analysis of data from linked clinical and demographic surveillance systems. The Lancet Global health. 2014;2(4):e216-24.
20. Etyang AO, Scott JA. Medical causes of admissions to hospital among adults in Africa: a systematic review. Glob Health Action. 2013;6:1-14.
21. Caldwell RI, Gaede B, Aldous C. The value of internal medicine outreach in rural KwaZulu-Natal, South Africa. S Afr Med J. 2016;106(3):259-62.
22. Unachukwu C, Agomuoh D, Alasia D. Pattern of non-communicable diseases among medical admissions in Port Harcourt, Nigeria. Nigerian Journal of Clinical Practice. 2008;11(1):14-7.
23. Ndjeka N, Ogunbanjo G. Disease patterns in the medical wards of a rural South African hospital. South African Family Practice. 2003;45(4):14-5.
24. Marszalek J, De Villiers PJ. Morbidity profile of admissions to GF Jooste Hospital, Manenberg, Cape Town. South African Family Practice. 2006;48(6):15.
25. Adeoti AO, Ajayi EA, Ajayi AO, Dada SA, Fadare JO, Akolawole M, Adekeye KA, Raimi TH. Pattern and Outcome of Medical Admissions in Ekiti State University Teaching Hospital, Ado-Ekiti-A 5 Year Review. 2015.
26. Ezeala-Adikaibe B, Aneke E, Orjioke C, Ezeala-Adikaibe N, Mbadiwe N, Chime P, Okafor U. Pattern of medical admissions at enugu state university of science and technology teaching hospital: a 5 year review. Annals of medical and health sciences research. 2014;4(3):426-31.
27. Ali E, Woldie M. Reasons and outcomes of admissions to the medical wards of Jimma University Specialized Hospital, southwest Ethiopia. Ethiopian journal of health sciences. 2010;20(2).
28. SanJoaquin MA, Allain TJ, Molyneux ME, Benjamin L, Everett DB, Gadabu O, Rothe C, Nguipdop P, Chilombe M, Kazembe L, Sakala S, Gonani A, Heyderman RS. Surveillance Programme of IN-patients and Epidemiology (SPINE): implementation of an electronic data collection tool within a large hospital in Malawi. PLoS medicine. 2013;10(3):e1001400.
29. UNAIDS. Global AIDS updates. 2016.
30. WHO. Global tuberculosis report. Geneva: World Health Organization, 2016.
31. Tanser F, Barnighausen T, Grapsa E, Zaidi J, Newell ML. High coverage of ART associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa. Science (New York, NY). 2013;339(6122):966-71.
32. Iwuji CC, Orne-Gliemann J, Larmarange J. Uptake of Home-Based HIV Testing, Linkage to Care, and Community Attitudes about ART in Rural KwaZulu-Natal, South Africa: Descriptive Results from the First Phase of the ANRS 12249 TasP Cluster-Randomised Trial. 2016;13(8):e1002107.
33. KwaZulu-Natal Epidemiology Unit. An analysis of the hospital admissions in KwaZulu-Natal between 1998 and 2002. Pietermaritzburg: KwaZulu-Natal Department of Health;, 2004.
34. Reid A, Dedicoat M, Lalloo D, Gilks CF. Trends in adult medical admissions in a rural South African hospital between 1991 and 2002. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2005;40(1):53-6.

35. Guinness L, Arthur G, Bhatt SM, Achiya G, Kariuki S, Gilks CF. Costs of hospital care for HIV-positive and HIV-negative patients at Kenyatta National Hospital, Nairobi, Kenya. AIDS. 2002;16(6):901-8.
36. Tawfik L, Kinoti S. The impact of HIV/AIDS on health systems and the health workforce in sub-Saharan Africa. Washington (DC): SARA Project, USAID Bureau for Africa. 2003.
37. Stellenberg EL. Accessibility, affordability and use of health services in an urban area in South Africa. Curationis. 2015;38(1).
38. Rosen S, Ketlhapile M, Sanne I, DeSilva MB. Cost to patients of obtaining treatment for HIV/AIDS in South Africa. S Afr Med J. 2007;97(7):524-9.
39. Tanser F, Gijsbertsen B, Herbst K. Modelling and understanding primary health care accessibility and utilization in rural South Africa: an exploration using a geographical information system. Soc Sci Med. 2006;63(3):691-705.
40. Chimbindi NZ, Barnighausen T, Newell ML. An integrated approach to improving the availability and utilisation of tuberculosis healthcare in rural South Africa. S Afr Med J. 2013;103(4):237-40.
41. Noor SK, Elmadhoun WM, Bushara SO, Ahmed MH. The Changing Pattern of Hospital Admission to Medical Wards: Burden of non-communicable diseases at a hospital in a developing country. Sultan Qaboos University medical journal. 2015;15(4):e517-22.
42. Okunola OO, Akintunde AA, Akinwusi PO. Some emerging issues in medical admission pattern in the tropics. Niger J Clin Pract. 2012;15(1):51-4.
43. Eze CO, Agu CE, Kalu UA, Maduanusi CA, Nwali ST, Igwenyi C. Pattern of Medical Admissions in a Tertiary Health Centre in Abakaliki South-East Nigeria. Journal of Biology, Agriculture and Healthcare. 2013;3(12):90-4.
44. Ike SO. The pattern of admissions into the medical wards of the University of Nigeria Teaching Hospital, Enugu (2). Niger J Clin Pract. 2008;11(3):185-92.
45. Odenigbo CU, Oguejiofor OC. Pattern of medical admissions at the Federal Medical Centre, Asaba-a two year review. Niger J Clin Pract. 2009;12(4):395-7.
46. Osuji CU, Onwubuya EI, Ahaneku GI, Omejua EG. Pattern of cardiovascular admissions at Nnamdi Azikiwe University Teaching Hospital Nnewi, South East Nigeria. The Pan African Medical Journal. 2014;17:116.
47. El Bingawi H, Hussein M, Bakheet M. Characteristics of patients admitted to medical ward of a referral hospital in a developing country. Int J Sci Basic Appl Res. 2014;14:86-92.
48. Griffiths ML. A comparison of admissions to a semirural hospital between the years 1959/1960 and 1977/1978. S Afr Med J. 1981;59(27):983-6.
49. Edginton ME, Hodkinson J, Seftel HC. Disease patterns in a South African rural Bantu population, including a commentary on comparisons with the pattern in urbanized Johannesburg Bantu. S Afr Med J. 1972;46(28):968-76.
50. Reeve P, Falkner M. Disease patterns in a rural black population. South African medical journal. 1986;69(9):551-2.
51. Dean MP, Gear JS. Medical admissions to Hillbrow Hospital, Johannesburg, by discharge diagnosis. S Afr Med J. 1986;69(11):672-3.
52. Benatar SR, Saven A. Morbidity trends in the medical wards at Groote Schuur Hospital--1971 and 1982. S Afr Med J. 1985;67(24):968-74.
53. Walker AR, Walker BF, Dunn MJ, Dunn SE. Causes of admissions of rural African patients to Murchison Hospital, Natal, South Africa. Journal of the Royal Society of Health. 1994;114(1):33-8.
54. Kakembo AS, Walker BF, Walker AR. Causes of admission of African patients to Gelukspan Hospital, North West Province, South Africa. East African medical journal. 1996;73(11):746-51.

55. Floyd K, Reid RA, Wilkinson D, Gilks CF. Admission trends in a rural South African hospital during the early years of the HIV epidemic. JAMA: the journal of the American Medical Association. 1999;282(11):1087-91.
56. Burch V, Benatar S. Rational planning for health care based on observed needs. 2006.
57. de Vries E, Raubenheimer P, Kies B, Burch VC. Acute hospitalisation needs of adults admitted to public facilities in the Cape Town Metro district. S Afr Med J. 2011;101(10):760-4.
58. Norman R, Bradshaw D, Schneider M, Pieterse D, Groenewald P. Revised burden of disease estimates for the comparative risk factor assessment, South Africa 2000. Cape Town: Medical Research Council. 2006.
59. Norman R, Matzopoulos R, Groenewald P, Bradshaw D. The high burden of injuries in South Africa. Bulletin of the World Health Organization. 2007;85(9):695-702.
60. Ahmed S, Siddique A, Iqbal A, Rahman FN, Islam MN, Sobhan MA, Islam MR, Sack R. Causes for hospitalizations at Upazila health complexes in Bangladesh. Journal of health, population, and nutrition. 2010;28(4):399.
61. Mojtabai R, Olfson M. Medication costs, adherence, and health outcomes among Medicare beneficiaries. Health affairs (Project Hope). 2003;22(4):220-9.
62. Kravdal H, Syse A. Changes over time in the effect of marital status on cancer survival. BMC Public Health. 2011;11:804.
63. Pokharel B, Humagain S, Pant P, Gurung R, Koju R, Bedi T. Spectrum of diseases in a medical ward of a teaching hospital in a developing country. Journal of College of Medical Sciences-Nepal. 2012;8(2):7-11.
64. Antonelli-Incalzi R, Ancona C, Forastiere F, Belleudi V, Corsonello A, Perucci CA. Socioeconomic status and hospitalization in the very old: a retrospective study. BMC Public Health. 2007;7:227-.
65. Saeed BI, Xicang Z, Yawson AE, Nguah SB, Nsowah-Nuamah NN. Impact of socioeconomic status and medical conditions on health and healthcare utilization among aging Ghanaians. BMC Public Health. 2015;15:276.
66. Mor A, Ulrichsen SP, Svensson E, Berencsi K, Thomsen RW. Does marriage protect against hospitalization with pneumonia? A population-based case-control study. Clin Epidemiol. 2013;5:397-405.
67. Wong AW, Gan WQ, Burns J, Sin DD, van Eeden SF. Acute exacerbation of chronic obstructive pulmonary disease: influence of social factors in determining length of hospital stay and readmission rates. Canadian respiratory journal. 2008;15(7):361-4.
68. Solarsh G, Benzler J, Hosegood V, Tanser F, Vanneste A. Hlabisa DSS, South Africa. *Population, Health and Survival at INDEPTH Sites*. Ottawa: IDRC, 2002. pp. 213-20.
69. Tanser F, Hosegood V, Barnighausen T, Herbst K, Nyirenda M, Muhwava W, Newell C, Viljoen J, Mutevedzi T, Newell ML. Cohort Profile: Africa Centre Demographic Information System (ACDIS) and population-based HIV survey. Int J Epidemiol. 2008;37(5):956-62.
70. Stephan Y, Sutin AR, Terracciano A. Feeling older and risk of hospitalization: Evidence from three longitudinal cohorts. Health psychology : official journal of the Division of Health Psychology, American Psychological Association. 2016;35(6):634-7.
71. Izadnegahdar M, Singer J, Lee MK, Gao M, Thompson CR, Kopec J, Humphries KH. Do younger women fare worse? Sex differences in acute myocardial infarction hospitalization and early mortality rates over ten years. J Womens Health (Larchmt). 2014;23(1):10-7.
72. Osborne C, Ostir GV, Du X, Peek MK, Goodwin JS. The influence of marital status on the stage at diagnosis, treatment, and survival of older women with breast cancer. Breast cancer research and treatment. 2005;93(1):41-7.

73. Africa Centre for Health and Population Studies. Datasets: Africa Centre Demographic Information System (ACDIS) [22 April, 2014]. Available from: http://www.africacentre.ac.za/Default.aspx?tabid=69.
74. Muhwava W, Nyirenda M, Mutevedzi T, Herbst K, Hosegood V. Operational and Methodological Procedures of the Africa Centre Demographic Information System. Monograph Series No. 1: Africa Centre for Health and Population Studies Somkhele South Africa, 2007.
75. Houlihan CF, Bland RM, Mutevedzi PC, Lessells RJ, Ndirangu J, Thulare H, Newell ML. Cohort profile: Hlabisa HIV treatment and care programme. Int J Epidemiol. 2011;40(2):318-26.
76. Bradshaw D, Nannan N, Laubscher R, Groenewald P, Joubert J, Nojilana B, Norman R, Pieterse D, Schneider M. South African national burden of disease study 2000: Estimates of provincial mortality. KwaZulu Natal province. Cape Town: South African Medical Research Council. 2004.
77. Cooper RS, Osotimehin B, Kaufman JS, Forrester T. Disease burden in sub-Saharan Africa: what should we conclude in the absence of data? Lancet. 1998;351(9097):208-10.
78. Welz T, Hosegood V, Jaffar S, Batzing-Feigenbaum J, Herbst K, Newell ML. Continued very high prevalence of HIV infection in rural KwaZulu-Natal, South Africa: a population-based longitudinal study. AIDS. 2007;21(11):1467-72.
79. UNICEF. The State of the World's Children 2009. Maternal and Newborn Health.
80. Jonas K, Crutzen R, van den Borne B, Sewpaul R, Reddy P. Teenage pregnancy rates and associations with other health risk behaviours: a three-wave cross-sectional study among South African school-going adolescents. Reproductive health. 2016;13(1):50.
81. Sedgh G, Finer LB, Bankole A, Eilers MA, Singh S. Adolescent Pregnancy, Birth, and Abortion Rates Across Countries: Levels and Recent Trends. Journal of Adolescent Health. 2015;56(2):223-30.
82. Neal S, Matthews Z, Frost M, Fogstad H, Camacho AV, Laski L. Childbearing in adolescents aged 12-15 years in low resource countries: a neglected issue. New estimates from demographic and household surveys in 42 countries. Acta Obstet Gynecol Scand. 2012;91(9):1114-8.
83. Ganchimeg T, Ota E, Morisaki N, Laopaiboon M, Lumbiganon P, Zhang J, Yamdamsuren B, Temmerman M, Say L, Tuncalp O, Vogel JP, Souza JP, Mori R. Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multicountry study. Bjog. 2014;121 Suppl 1:40-8.
84. Magadi MA, Agwanda AO, Obare FO. A comparative analysis of the use of maternal health services between teenagers and older mothers in sub-Saharan Africa: evidence from Demographic and Health Surveys (DHS). Soc Sci Med. 2007;64(6):1311-25.
85. Chen XK, Wen SW, Fleming N, Demissie K, Rhoads GG, Walker M. Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. Int J Epidemiol. 2007;36(2):368-73.
86. McHunu G, Peltzer K, Tutshana B, Seutlwadi L. Adolescent pregnancy and associated factors in South African youth. African health sciences. 2012;12(4):426-34.
87. Jewkes R, Vundule C, Maforah F, Jordaan E. Relationship dynamics and teenage pregnancy in South Africa. Soc Sci Med. 2001;52(5):733-44.
88. Kaufman CE, Clark S, Manzini N, May J. Communities, opportunities, and adolescents' sexual behavior in KwaZulu-Natal, South Africa. Studies in family planning. 2004;35(4):261-74.
89. Braitstein P, Boulle A, Nash D, Brinkhof MW, Dabis F, Laurent C, Schechter M, Tuboi SH, Sprinz E, Miotti P. Gender and the use of antiretroviral treatment in resource-constrained

settings: findings from a multicenter collaboration. Journal of women's health. 2008;17(1):47-55.
90. Muula AS, Ngulube TJ, Siziya S, Makupe CM, Umar E, Prozesky HW, Wiysonge CS, Mataya RH. Gender distribution of adult patients on highly active antiretroviral therapy (HAART) in Southern Africa: a systematic review. BMC public health. 2007;7(1):1.
91. Hawkins C, Chalamilla G, Okuma J, Spiegelman D, Hertzmark E, Aris E, Ewald T, Mugusi F, Mtasiwa D, Fawzi W. Sex differences in antiretroviral treatment outcomes among HIV-infected adults in an urban Tanzanian setting. Aids. 2011;25(9):1189-97.
92. Johnson LF. Access to antiretroviral treatment in South Africa, 2004-2011. Southern African Journal of HIV Medicine. 2012;13(1).
93. Maman D, Pujades-Rodriguez M, Subtil F, Pinoges L, McGuire M, Ecochard R, Etard JF. Gender differences in immune reconstitution: a multicentric cohort analysis in sub-Saharan Africa. PLoS One. 2012;7(2):e31078.
94. Robards J, Evandrou M, Falkingham J, Vlachantoni A. Marital status, health and mortality. Maturitas. 2012;73(4):295-9.
95. Hu YR, Goldman N. Mortality differentials by marital status: an international comparison. Demography. 1990;27(2):233-50.
96. Jaffe DH, Manor O, Eisenbach Z, Neumark YD. The protective effect of marriage on mortality in a dynamic society. Ann Epidemiol. 2007;17(7):540-7.
97. Berntsen KN. Trends in total and cause-specific mortality by marital status among elderly Norwegian men and women. BMC Public Health. 2011;11(1):1-10.
98. Channon M, Hosegood V, McGrath N. A longitudinal population-based analysis of relationship status and mortality in KwaZulu-Natal, South Africa 2001-2011. J Epidemiol Community Health. 2016;70(1):56-64.
99. Quinones PA, Kirchberger I, Heier M, Kuch B, Trentinaglia I, Mielck A, Peters A, von Scheidt W, Meisinger C. Marital status shows a strong protective effect on long-term mortality among first acute myocardial infarction-survivors with diagnosed hyperlipidemia--findings from the MONICA/KORA myocardial infarction registry. BMC Public Health. 2014;14:98.
100. Kposowa AJ. Marital status and HIV/AIDS mortality: evidence from the US National Longitudinal Mortality Study. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2013;17(10):e868-74.
101. Rendall MS, Weden MM, Favreault MM, Waldron H. The protective effect of marriage for survival: a review and update. Demography. 2011;48(2):481-506.
102. Ploubidis GB, Silverwood RJ, DeStavola B, Grundy E. Life-Course Partnership Status and Biomarkers in Midlife: Evidence From the 1958 British Birth Cohort. Am J Public Health. 2015;105(8):1596-603.
103. South African Social Security Agency. Types of Grants and Their Qualifying Requirements. 2012.
104. South African Social Security Agency. You and Your Grants 2016/2017 [16 September, 2016]. Available from: www.sassa.gov.za/index.php/knowledge-centre/grant-booklets?download...grants.
105. Mitra S. Disability Cash Transfers in the Context of Poverty and Unemployment: The Case of South Africa. World Development. 2010;38(12):1692-709.
106. Booysen F. Social grants as safety net for HIV/AIDS-affected households in South Africa. SAHARA J : journal of Social Aspects of HIV/AIDS Research Alliance / SAHARA , Human Sciences Research Council. 2004;1(1):45-56.
107. Stewart F, Yermo J. Pensions in Africa; Organisation for Economic Co-operation and Development. Paris, France: 2009 1993-6397.
108. Case A, Deaton A. Large cash transfers to the elderly in South Africa. The Economic Journal. 1998;108(450):1330-61.

109. Case A. Does money protect health status? Evidence from South African pensions. Perspectives on the Economics of Aging: University of Chicago Press; 2004. p. 287-312.
110. Goswami AK, Gupta SK, Kalaivani M, Nongkynrih B, Pandav CS. Burden of Hypertension and Diabetes among Urban Population Aged >/= 60 years in South Delhi: A Community Based Study. Journal of clinical and diagnostic research : JCDR. 2016;10(3):Lc01-5.
111. Wagstaff A. Poverty and health sector inequalities. Bulletin of the World Health Organization. 2002;80(2):97-105.
112. Pollack CE, Chideya S, Cubbin C, Williams B, Dekker M, Braveman P. Should health studies measure wealth? A systematic review. Am J Prev Med. 2007;33(3):250-64.
113. Gwatkin DR. Health inequalities and the health of the poor: what do we know? What can we do? Bull World Health Organ. 2000;78(1):3-18.
114. Weires M, Bermejo JL, Sundquist K, Sundquist J, Hemminki K. Socio-economic status and overall and cause-specific mortality in Sweden. BMC Public Health. 2008;8:340.
115. Ataguba JE, Akazili J, McIntyre D. Socioeconomic-related health inequality in South Africa: evidence from General Household Surveys. International journal for equity in health. 2011;10:48.