The Trend of Communicable and Non-Communicable Diseases in East African Community (EAC) Countries: Case Study of Burundi, Rwanda, and Uganda - 1990 to 2013

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The Trend of Communicable and Non-Communicable Diseases in East African Community (EAC) Countries: Case Study of Burundi, Rwanda, and Uganda - 1990 to 2013

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I am grateful to God the Almighty, for his everlasting love

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## Table of Contents

Abstract ........................................................................................................................................... 4  
Introduction ..................................................................................................................................... 5  
Literature Review ............................................................................................................................ 7  
  Global Burden of Communicable and Non-Communicable Disease ................................. 7  
  Non-Communicable Diseases in East Africa ...................................................................... 9  
  Communicable Diseases in East Africa ............................................................................ 16  
  Double Burden of Disease ................................................................................................. 22  
  Health Care Systems ......................................................................................................... 24  
Data Collection and Research Methodology ................................................................................ 25  
  Data Source: The Global Burden of Disease (GBD) Study .............................................. 26  
  Data Compilation .............................................................................................................. 26  
  Data Analysis and Visualization ....................................................................................... 27  
Results ........................................................................................................................................... 29  
  Overall Trends: Change in Mortality Rates from 1990 to 2013 ....................................... 29  
  Developed Countries vs. Developing Countries ............................................................... 30  
  Mortality Rates Comparison across the Three EAC Countries ........................................ 32  
  Comparing Mortality Rate of the Three EAC Countries to Developing Countries ....... 32  
Discussion ..................................................................................................................................... 34  
Strength and Limitations ............................................................................................................... 37  
Conclusion .................................................................................................................................... 38  
References ..................................................................................................................................... 39  
Appendix A: List of Competencies Met in CE ..............................................................................46
Abstract

Background: In low and middle-income countries (LMICs), non-communicable diseases (NCDs) are rapidly emerging alongside a well-documented persistence of communicable diseases (CDs) in fragile health care systems. In sub-Saharan Africa, chronic NCDs are expected to overtake CDs as the leading cause of death. The aim of this study was to compare mortality rates due to CDs and NCDs between developed countries, developing countries, Burundi, Rwanda, and Uganda from 1990 to 2013.

Methods: A descriptive study with longitudinal and cross-sectional analyses of mortality rates was conducted using the global burden of disease (GBD) study data. Tableau Public 9.3 software was utilized to obtain graphical presentations of analyses. Mortality rate ratios and annualized rate of decline in NCD mean mortality rate of CD and NCD were computed and compared.

Results: From 1990 to 2013, mortality rates for both NCDs and CDs decreased in developed and developing countries overall, and across the three EAC countries. Rwanda had the highest annualized rate of decline in mean mortality rate for both CD and NCDs. Since 2010, NCDs overtook CDs as the leading cause of death in Burundi, Rwanda, and Uganda.

Conclusion: From 1990 to 2013, the three EAC countries experienced a decline in mortality rates with higher magnitudes of decline in CDs-related deaths than developing countries in general. Even though NCDs are the major contributor to the mortality burden of disease, CDs are still responsible for a relatively large portion of the mortality disease burden.

Keywords: double burden of diseases, infectious diseases, diseases trends, Sub-Saharan Africa
The Trend of Communicable and Non-Communicable Diseases in East African Community (EAC) Countries: Case Study of Burundi, Rwanda, and Uganda - 1990 to 2013

Low and middle-income countries (LMIC) are facing the challenge of double burden of disease where communicable diseases and chronic non-communicable diseases are increasing in parallel (Sarah, 2004). The World Health Organization (WHO) (1999) defines double burden of disease as a combination of “first, the emerging epidemics of non-communicable diseases and injuries, which are becoming more prevalent in industrialized and LMICs alike, and second, some major infectious diseases which survived the 20th century – part of the unfinished health agenda” (p. 14).

Health care systems in LMICs such as countries of the East African Community (EAC) are fragile, and are overwhelmed with this double burden of disease. For example, the WHO predicts that in the next 20 years, the number of people who will be affected by diabetes in LMICs will double the current global prevalence of diabetes (Sarah, 2004). In Sub-Saharan Africa, chronic non-communicable diseases are expected to overtake communicable diseases as the leading cause of death (Siddharthan et al., 2015).

The EAC is a regional intergovernmental organization of five partner states, comprised of Burundi, Kenya, Rwanda, Tanzania, and Uganda (African Union, n.d.) (Figure 1), with an estimated population of 158 million people and an estimated gross domestic product of $169.5 billion (East African Community, n.d.). Besides being a political organization aiming for a common market and a shared currency, their populations have extraordinary similarities related to social factors including culture, language, religion, lifestyle, and diet. To some extent those similarities can explain comparable distribution of diseases, both communicable and non-
communicable. With the exception of a low middle-income Kenya, EAC countries are low-income countries.

Figure 1. Geographic location of East African Community (EAC) countries.

Source: Eurostat, n.d.

This study focused on three of the five EAC countries. The latest countries to join the EAC (Burundi, and Rwanda), and one of the founding-member of EAC (Uganda). To our knowledge there is limited research on the trend of communicable and non-communicable diseases in EAC countries.

This study used data from the Global Burden of Disease (GBD) study (1990 to 2013). The GBD enterprise started in the early 1990s with an initiative from the World Bank to measure death and disability from all identified causes worldwide. The GBD 1990 had a high impact on health-related political agendas worldwide as it shed light on neglected and hidden health
challenges like mental health and road traffic injuries (Institute for Health Metrics and Evaluation [IHME], 2016b).

GBD findings were institutionalized and updated continually by the WHO. The most recent version, GBD 2013, is the first update coordinated by the Institute for Health Metrics and Evaluation (IHME), a research institute at the University of Washington in the United States of America. The aim of that institution is “to create the most complete and up-to-date roadmap to help policymakers and donors determine which avenues to pursue to help people live longer, healthier lives” (IHME, 2016a, p. 1).

The aim of this research was to compare and contrast mortality due to communicable and non-communicable diseases:

1. between developed and developing countries;
2. between Burundi, Rwanda, and Uganda; and
3. between developing countries and each of Burundi, Rwanda, and Uganda.

Statistics of interest were the change in mortality rate from 1990 to 2013 and the most recent estimated mortality rate from 2013.

**Literature Review**

**Global Burden of Communicable and Non-Communicable Disease**

The burden of disease worldwide falls under three important categories: communicable diseases, non-communicable diseases, and injuries. This study is limited to communicable and non-communicable diseases.

Communicable diseases (CDs), often called infectious diseases, are defined as diseases caused by pathogens, such as bacteria, viruses, parasites, and fungi. Those diseases are either transmitted from person-to-person or animal-to-person (WHO, 2016a). The global burden of
CDs was considerably reduced with unique discoveries and innovative technologies like antibiotics, which are regarded as one of the most successful discoveries in the history of medicine (Aminov, 2010), along with vaccines and hand washing.

The current global burden of CDs is dominated by human immunodeficiency virus, acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis, neglected tropical diseases, malaria, and CDs outbreaks. The WHO lists Ebola virus, Middle East respiratory syndrome coronavirus (MERS-CoV), yellow fever, and Zika virus as the most recent CDs outbreaks (WHO, 2016b).

The WHO defines non-communicable diseases (NCDs) as diseases that are not passed from person to person, are of long duration, and progress slowly (WHO, 2015d). However, the primary distinction between communicable and non-communicable diseases is the non-infectious causes for NCDs, not necessarily the duration of the disease. NCDs are generally classified into four categories: cardiovascular diseases (e.g., stroke, heart attack), chronic respiratory diseases (e.g., asthma, chronic obstructive lung disease), cancer, and diabetes.

Non-communicable diseases and their risk factors are largely preventable. Researchers found that 80% of NCDs-related deaths are preventable (Alleyne et al., 2013). Lifestyle behaviors such as smoking, alcohol consumption, unhealthy diet, and physical inactivity are associated with NCDs by causing overweight/obesity, high blood pressure, high cholesterol, and high blood glucose. Other risk factors for NCDs are aging, genetic predisposition, and exposure to environmental pollutants and hazardous materials (e.g., air pollution, chemicals).

NCDs are the number one cause of death and disability in high-income countries. In LMICs, NCDs have now overtaken communicable diseases as the leading cause of death (Temu, Leonhardt, Carter, & Thiam, 2014). In 2012, the WHO estimated that NCDs claim 68% of all
global deaths (~38 million per year), and three quarters of those deaths occur in LMICs (WHO, 2015d).

The epidemiology of NCDs has been changed by globalization, rapid urbanization, and adoption of western lifestyle in LMICs. NCDs are no longer affecting exclusively older populations in developed countries. Alleyne et al. (2013) reported that one in four deaths associated with NCDs is occurring in people younger than 60 years old. The age of onset and the severity of NCDs are more dependent on both the socio-economic status of the person and gross domestic product of the country.

A large portion of the global burden of NCDs is shouldered by LMICs. Alone, LMICs account for around 80% of all cardiovascular disease-related deaths (Sarah, 2004). While the global prevalence of diabetes is estimated to double from 171 million in 2000 to 366 million in 2030, the burden of diabetes in LMICs sub-Saharan Africa is predicted to increase more than two and a half times from seven million to 18.5 million in that time (Wild, Roglic, Green, Sicree, & King, 2004). The burden of NCDs in LMICs is growing and complex because these countries are still struggling with CDs, and there are insufficient financial resources. Locally generated data are lacking in LMICs, which makes effective planning and resource allocation for the health sector very challenging.

**Non-Communicable Diseases in East Africa**

In East African Community (EAC) countries located in sub-Saharan Africa, NCDs are rapidly emerging alongside a well-documented persistence of communicable diseases in fragile health care systems. The burden of NCDs in East Africa is compounded by war and violence sequelae (particularly in Rwanda, Burundi, and Uganda), road accidents, assaults injuries, and other injuries such as sliding and animal attack injuries.
In addition to the common NCDs – cardiovascular diseases, chronic respiratory diseases, cancer, and diabetes – East Africa also faces regionally important NCDs including rheumatic heart disease (RHD), hemoglobinopathies (in particular sickle cell disease), mental disorders, violence and injuries, road traffic accidents, disability, and oral and eye diseases (Siddharthan et al., 2015). In East Africa, NCDs are the leading cause of death, constituting 40% of total deaths in the region (Siddharthan et al., 2015).

The unique feature of NCDs in LMICs, and in East Africa in particular, is that NCDs are not entirely separate from communicable diseases. There are clear links between NCDs, communicable diseases and maternal and newborn health. In LMICs, 26% of cancers (particularly liver, cervical, urinary tract, and digestive tract cancers) are associated with communicable diseases (Boutayeb, 2006) and exposure and prevalence of Hericobacterium pylori – a well-known major cause of gastric cancer – is believed to be above 80% (Schulz, McBryde, Leder, & Biggs, 2014).

In Africa, 40% of children have nutritional stunting, which is associated with development of obesity later in life (East Africa NCD Alliance Initiative [EANCDAl], 2014). The findings of Suh, Ley, and Parsonnet (2012) confirmed that infections and nutritional deficiencies in infancy are associated with chronic diseases in later life. Additionally, 43% of all heart failure admissions in Kenya are associated with rheumatic heart disease (RHD), heart diseases with an infectious origin, making RHDs the leading cause of heart failure admissions (Yonga, 2012). In regards to NCDs-related knowledge and research, East Africa has numerous gaps (Siddharthan et al., 2015).

In addition to global common risk factors associated with NCDs, in East Africa household air pollution (HAP) from solid fuels and some infections are important risk factors for
NCDs (EANCDAI, 2014). For example, Human papilloma virus (HPV) is associated with cervical cancer, Helicobacter pylori is associated with stomach cancer, and Hepatitis B and C viruses are associated with liver cancer. HAP is more significant in women and young children due to continuous exposure to indoor smoke because of the cultural norms; in EAC countries women are responsible for cooking, and taking care of the young children.

**Burundi.** According to country data organized by the WHO, age standardized death rates and premature mortality due to NCDs rapidly and steadily increased in Burundi from 2000 to 2012 (WHO, 2014d). Country-specific data from the GBD study 2013 show that NCD-related deaths increased from 45% (95% C. I [40.8% - 48.6%]) of total deaths in 1990 to 49% (95% C. I [45.7% - 52.3%]) in 2013 (IHME, 2015). Cardiovascular diseases are the most prevalent of NCDs and accounted for 25.09% and 26.03% of total deaths in 1990 and 2013, respectively (IHME, 2015). Figures 2 and 3 portray proportional mortality in Burundi from 1990 and 2013, respectively, as reported by the GBD study 2013.

![1990 Mortality Proportions in Burundi](image)

*Figure 2. 1990 mortality proportions in Burundi, by the GBD study 2013, by specific NCDs.*

Source: IHME, 2015
**Figure 3.** 2013 Mortality proportions in Burundi, by the GBD study 2013, by specific NCDs.

Source: IHME, 2015

**Rwanda.** Rwanda, a landlocked country in the center of East Africa, has been making efforts to tackle NCDs. In 2013, the Rwandan ministry of health noted that an improvement of household cooking stove, a sustainable and appropriate treatment and care of NCDs patients, and an implementation of NCDs synergies Network are some of the steps taken by the Rwandan government in the fight against NCDs (Republic of Rwanda Ministry of Health, 2013). Marshall et al. (2015) reported a prevalence of 16.4 (95% CI 14.6 – 18.4)/100 000 and an incidence of 2.7 (95% CI 2.0 – 3.7)/100 000 for clinically cognized type one diabetes in youth and adolescents, both lower than the USA and most other African countries.

According to the 2014 WHO Rwanda health profile data, age-standardized death rates for cancer and cardiovascular diseases have been declining from 2000 to 2012 in Rwanda (WHO, 2014b). GBD study 2013 data for Rwanda show that NCD-related deaths increased from 47.6% (95% C. I [44.3% - 50.8%]) of total deaths in 1990, to 52.8% (95% C. I [48.1% - 58%]) of total deaths in 2013 (IHME, 2015). Cardiovascular diseases are the most prevalent of NCDs and their
mortality remained constant at an estimate of 28% of total deaths in 1990, as well as in 2013 (IHME, 2015). Figures 4 and 5 portray proportional mortality in Rwanda from 1990 and 2013, respectively, as reported by the GBD study 2013.

---

**Figure 4.** 1990 Mortality proportions in Rwanda, by the GBD study 2013, by specific NCDs.

**Source:** IHME, 2015

**Figure 5.** 2013 Mortality proportions in Rwanda, by the GBD study 2013, by specific NCDs.

**Source:** IHME, 2015
Rwanda made remarkable progress fighting cervical cancer in young women. Cervical cancer affects poor populations disproportionately; 77% of new cases and 88% of deaths attributable to cervical cancer occur in LMICs (Binagwaho et al., 2013).

Rwanda was the first African nation to implement a complete nationwide cervical cancer prevention, treatment and control strategic plan. Cervical cancer is the deadliest cancer, and the most common cancer among women (Binagwaho et al., 2013). The country vaccinated young girls against HPV, where three-dose coverage rates of 93.2% and 96% were achieved in 2011 and 2012, respectively (Binagwaho et al., 2013).

Following the 1994 genocide and subsequent wars and conflicts in Rwanda, mental health illnesses such as depression and Post-Traumatic Stress Disorder (PTSD) became major causes of disability. In Rwanda, PTSD prevalence is estimated to be 25%-29% in the general population, and 41% to 51% in genocide survivors (Rieder & Elbert, 2013).

**Uganda.** In Uganda, locally generated data and local authorship of NCDs-related research are markedly increasing. This will provide information useful for more effective planning and resource allocation for the Ugandan Health care system in the future. In Uganda, from 2000 to 2012, there has been an increase in NCDs-related premature deaths and age-standardized death rates for cancer, while age-standardized death rates for cardiovascular diseases have been decreasing (WHO, 2014c). The most prevalent cancers, with a steadily increasing trend in Uganda, are prostate and HIV-associated Kaposi Sarcoma in men, and cervical and breast cancer in women (Schwartz, Guwatudde, Nugent, & Kiiza, 2014).

The long history of civil war in Northern Uganda is responsible for mental illness. Among victims, in particular children abducted during the war, the most prevalent psychological
and mental illnesses are PTSD and high risk behavior problems such as smoking, heavy alcohol drinking, and sexual activities at an early age (Schwartz et al., 2014).

According to the GBD study 2013 data for Uganda, NCDs-related deaths increased from 39.4% (95% C. I [35.7% - 42.8%]) of total deaths in 1990 to 45.9% (95% C. I [42.9% - 49.9%]) in 2013 (IHME, 2015). Cardiovascular diseases are the most prevalent and accounted for an estimate of 28% of total deaths in 1990 and 2013 (IHME, 2015), and RHD remains the most common cause of heart failure, stroke, and atrial fibrillation (Schwartz et al., 2014). See Figures 6 and 7 for detailed proportional mortality for Uganda in 1990 and 2013, respectively.

**Figure 6.** 1990 Mortality proportions in Uganda, by the GBD study 2013, by specific NCDs.

Source: IHME, 2015
Communicable Diseases in East Africa

In LMICs, communicable diseases are still a major public health challenge. More than half of the burden of diseases in East Africa is caused by CDs. In EAC countries, Burundi and Uganda have the highest CDs-related disease burden with an estimate of 60% of total deaths, while Rwanda has the lowest CDs-related disease burden with an estimate of 52% of total deaths (WHO, 2014b). The major CDs across the region can be classified as the following: waterborne and foodborne diseases (e.g., cholera, dysentery, hepatitis A and E), vector-borne diseases (e.g., malaria, dengue, yellow fever), diseases associated with crowding (e.g., tuberculosis, meningococcal diseases), vaccine-preventable diseases (e.g., tetanus), and sexually transmitted infections including HIV/AIDS (WHO, 2008).

Figure 7. 2013 Mortality proportions in Uganda, by the GBD study 2013, by specific NCDs.
Source: IHME, 2015
In East Africa, the commitment and interventions from the Global Fund to Fight AIDS, Tuberculosis, and Malaria has had significant health outcomes such as an increase in life expectancy across the region (The Global Fund [GF], n.d.a). The Global Fund to Fight AIDS, Tuberculosis, and Malaria is an international funding organization founded in 2002, to accelerate the end of AIDS, tuberculosis, and malaria (GF, n.d.a). To date, in Rwanda alone the Global Fund funded antiretroviral therapy for 150,000 HIV/AIDS patients and distribution of 12,900,000 insecticide-treated bed nets for malaria prevention (GF, n.d.b).

In addition, there has been a decrease in incidence and mortality rates decreased from HIV/AIDS, tuberculosis, and malaria, the most prevalent communicable diseases in the region in addition to acute respiratory infection (Siddharthan et al., 2015).

**Burundi.** In Burundi, in 2012, maternal, neonatal and nutritional diseases caused the highest disease burden in the country, accounting for more than 2000 disability-adjusted life years (WHO, 2015a). According to the GBD study 2013 data for Burundi, deaths caused by communicable, maternal, neonatal, and nutritional diseases decreased from 50.3% (95% C. I [46.4% - 54.4%]) of total deaths in 1990 to 46.1% (95% C. I [42.4% - 49.6%]) in 2013 (IHME, 2015). The most prevalent subcategory of diseases is diarrhea, lower respiratory, and other common infectious diseases which accounted for 18% of total deaths in 2013 (IHME, 2015). Figures 8 and 9 illustrate proportional mortality for Burundi in 1990 and 2013, respectively.
**Figure 8.** 1990 Mortality proportions in Burundi, by the GBD study 2013, by specific CDs.

Source: IHME, 2015

**Figure 9.** 2013 Mortality proportions in Burundi, by the GBD study 2013, by specific CDs.

Source: IHME, 2015
Rwanda. Lower respiratory infections (LRI), HIV/AIDS and malaria, and diarrheal diseases are among the top ten causes of death in Rwanda, according to 2012 WHO data (WHO, 2015b). Figures 10 and 11 illustrate mortality proportions for communicable, maternal, neonatal, and nutritional diseases in 1990 and 2013, respectively.

*Figure 10. 1990 Mortality proportions in Rwanda, by the GBD study 2013, by specific CDs.*

Source: IHME, 2015
According to the GBD study 2013 data, overall crude death rates for CDs in Rwanda, are decreasing. Deaths caused by communicable, maternal, neonatal, and nutritional diseases decreased from 45.5% (95% C. I [42.1% - 49.2%]) of total deaths in 1990 to 39.9% (95% C. I [34.2% - 45.2%]) in 2013 (IHME, 2015).

As in Burundi, the group comprised of maternal, neonatal, and nutritional diseases is responsible for the largest portion of disease burden in Rwanda. The group of tuberculosis, malaria and HIV/AIDS causes the third highest disease burden in Rwanda, with around 750,000 disability-adjusted life years lost (WHO, 2015b).

**Uganda.** According to 2012 WHO data, in Uganda, the group of HIV/AIDS, tuberculosis and malaria causes the highest burden of diseases with 6,000 disability-adjusted life years (WHO, 2015c). GBD 2013 data show that the crude death rate from HIV and tuberculosis increased from 13.9% (95% C. I [11% - 17.4%]) in 1990 to 20.4% (95% C. I [17.6% - 23.3%])
in 2013. Figures 12 and 13 illustrate mortality proportions in Uganda with communicable, maternal, neonatal, and nutritional diseases details for 1990 and 2013, respectively.

**1990 MORTALITY PROPORTIONS IN UGANDA**

- **Diarrhea, lower respiratory, and other common infectious diseases**: 25%
- **HIV & tuberculosis**: 14%
- **Neglected tropical diseases and malaria**: 9%
- **Other communicable diseases**: 8%
- **Injuries**: 5%
- **Non-communicable diseases**: 40%

*Figure 12. 1990 Mortality proportions in Uganda, by the GBD study 2013, by specific CDs.*

*Source: IHME, 2015*
Figure 13. 2013 Mortality proportions in Uganda, by the GBD study 2013, by specific CDs.

Source: IHME, 2015

Double Burden of Disease

In the 20th century, there was tremendous progress in the health sector globally. Some examples are improvement of sanitary conditions and provision of clean drinking water; improvement of maternal and neonatal health; the successful fight against infectious diseases in developed countries and eradication of some infectious diseases; and the rise of life expectancy at birth, a characteristic of an epidemiologic transition. The epidemiologic transition is defined as a process of change in diseases patterns and mortality dynamics, by which CDs and infant mortality decreases, and replaced by an increase in NCDs and elderly mortality (Population, n.d.). The current worldwide epidemiological profile is predominated by NCDs as the major causes of disease burden.

LMICs, such as EAC countries, are at the mid-point of their epidemiologic transition. They are still facing communicable diseases and poverty-related health conditions (e.g.,
malnutrition, maternal and neonatal deaths), while lifestyle-related chronic diseases are additionally emerging. This coexistence of both communicable diseases and NCDs as the disease burden of a given population is referred to as the double burden of diseases (Sarah, 2004).

Research estimates that by 2020 seven out of every ten deaths will be caused by NCDs in LMICs (Boutayeb, 2006). With the double burden of diseases, the capacities and resources of health systems are challenged by the emerging NCDs epidemics while still addressing persistent and re-emerging CDs, focusing on poverty-related conditions and targeting vulnerable groups (Accorsi et al., 2009).

In addition to an epidemiologic transition, LMICs such as EAC countries are undergoing a demographic transition, which is a five phase stepwise model describing how birth rates and death rates affect and determine a population size over time (British Broadcasting Corporation, n.d.). Following this paradigm, as the countries develop economically, death rates decreases first, followed by declines in birth rates leading to a net population increase (Bongaarts, 2009). Figure 14 describes phases of a demographic transition.
EAC countries and many LMICs are at the beginning of the third phase characterized by a gradual decrease in birth rates usually as a result of improved economic conditions, an increase in women’s status, access to contraception, and decrease in fertility rates (National Institute of Statistics of Rwanda [NISR], Ministry of Health, ICF International, 2012).

Health Care Systems

East Africa, and sub-Saharan Africa in general, was caught unprepared by the surprising and rapid rise of NCDs in the region. The region has been focusing on tackling persistent CDs, and NCDs were considered to be diseases of developed countries. Although much has been achieved, health systems are still fragile due to resource-limited settings, knowledge and policy gaps in NCDs, as well as shortage of trained workforce (Siddharthan et al., 2015).

Twenty-two years after the genocide and war in Rwanda, the health system started considerable improvements in 2005 after a joint investment in health care sector by the
government of Rwanda and the Clinton Foundation through Partners in Health (PIH) (Drobac et al., 2013). Although the country has a marked shortage of trained health care professionals (in 2010, Rwanda had an average of 0.056 physicians per 1,000 population [compared with 2.452 in the United States] and an average of 0.689 nursing and midwife personnel per 1,000 population [compared with 9.815 in the United States]) (WHO, 2014d), the Rwandan health insurance “Mutuelle de Santé” offered health care coverage for more than 90% of the Rwandan population by the year 2011 (Makaka, Breen, & Binagwaho, 2012).

The Burundian health care system is still facing several challenges, such as the sustainability and integration of health programs, but positive progress has been made over the past years. For example, in 2006, children under five years old and pregnant women were granted free healthcare (Peerenboom et al., 2014).

In Uganda, the district health system is undergoing strategic revisions in response to a rapid population growth, a growing private sector, and an increasing implementation of vertical health programs (Curtale, Musila, Opigo, Nantamu, & Ezati, 2016). In sub-Saharan Africa, poorly funded and often fractured public healthcare services are encouraging the growth of private sector medicine but, unfortunately, the latter is characterized by a high level of disorganized markets and lack of state regulations (Hutchinson et al., 2015).

Data Collection and Research Methodology

In this study, both longitudinal (change over time) and cross-sectional (current, as of the most recent data) analyses of mortality rates for three EAC countries including Burundi, Rwanda, and Uganda were conducted using mortality data from 1990 to 2013 obtained from the global burden of disease (GBD) study. In addition, mortality rates in these three EAC countries were compared with mortality rates for developed and developing countries in general using
Microsoft Office Excel and Tableau Software. Tableau Software is a publicly available software created to help ordinary people see, use, and understand data (Tableau software, 2016).

**Data Source: The Global Burden of Disease (GBD) Study**

The Global Burden of Disease (GBD) study was initially launched in the 1990s with an initiative from the World Bank and served as the most comprehensive effort to systematically measure the world’s health problems (IHME, 2016b). The GBD 1990 had a high impact on health-related political agendas worldwide as it uncovered neglected and hidden health challenges like mental health and road traffic injuries (IHME, 2016b). GBD findings were institutionalized and updated continually by the WHO.

The GBD 2013 is the first update of the comprehensive GBD, injuries, and Risk Factors Study 2010 (IHME, 2016b). The IHME is the current coordinator of GBD data collection.

**Data Compilation**

Using the GBD data tool located on the global health data exchange platform (IHME, 2016d) (see Figure 15), the following parameters were selected for free data download: (1) location: developed countries, developing countries, Burundi, Rwanda, and Uganda; (2) cause: total all causes; (3) risk, etiology or impairment: none; (4) age: age-standardized; (5) sex: both; (6) year: 1990 to 2013; (7) metric: deaths; and finally selected “Rate”. Data were downloaded as a comma delimited (CSV) file.
To obtain death rates for CDs, the following sub-categories of CDs were added together: A.1, A.2, A.3, and A.7 values (see Table 1). Despite the label of A.7 as “Other communicable, maternal, neonatal, and nutritional diseases”, this category contained no other diseases than communicable diseases. A.7 subcategories were: A.7.1 sexually transmitted diseases excluding HIV; A.7.2 hepatitis; A.7.3 leprosy; and A.7.4 other infectious diseases.

**Figure 15.** Screenshot of the GBD data tool located on the global health data exchange platform.

Source: IHME, 2016d
Table 1

*Summarized Causes of Death Added to Obtain “Communicable Diseases”*

<table>
<thead>
<tr>
<th>Cause</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1</td>
<td>HIV/AIDS and tuberculosis</td>
</tr>
<tr>
<td>A.2</td>
<td>Diarrhea, lower respiratory, and other common infectious diseases</td>
</tr>
<tr>
<td>A.3</td>
<td>Neglected tropical diseases and malaria</td>
</tr>
<tr>
<td>A.7</td>
<td>Other communicable, maternal, neonatal, and nutritional diseases</td>
</tr>
</tbody>
</table>

**Data Analysis and Visualization**

**Analysis.** Data computations were completed using Microsoft Office Excel 2016. The following comparisons were made in all analyses:

1. developing vs. developed countries;
2. Burundi vs. Rwanda vs. Uganda;
3. Burundi vs. developing countries; Rwanda vs. developing countries; and Uganda vs. developing countries.

Trends in the rates of mortality due to CDs and NCDs were computed as the annualized rate of decline in mean mortality rate between 1990 and 2013 (ignoring data from other years between these). The difference was calculated between 2013 mortality rate and 1990 mortality rate to obtain the decline in mortality rate. The later was divided by 23 years (the number of years from 1990 to 2013) to obtain the annualized rate of decline in mean mortality rates.

Cross-sectional analyses were conducted by comparing the 2013 mortality rates, and ratios of CDs to NCDs mortality rates, between developed countries, developing countries, Burundi, Rwanda, and Uganda. The 2013 CDs mortality rate was divided by the 2013 NCDs mortality rate to obtain ratios of 2013 CDs to NCDs mortality rate, that were compared
graphically (see visualization). Comparisons mentioned above (1 – 3) were repeated for longitudinal analysis.

All comparisons were descriptive, with no tests of statistical significance, as we did not have access to estimates of variation for the sum of rates across A.1, A.2, A.3, and A.7, or for variation in the differences in rates.

**Visualization.** Tableau Public 9.3 software was utilized to obtain graphical presentations of both longitudinal and cross-sectional analyses. Two graphs were produced: one of the annualized rate of decline in mean mortality rates from 1990 to 2013, and another of the ratio of 2013 CDs to NCDs mortality rates.

Two tables were produced to present data with numerical values. The first table showed mortality rates of 1990 and 2013 CDs and NCDs mortality rates, and the annualized rate of decline in mean mortality rates from 1990 to 2013 for developed countries, developing countries, Burundi, Rwanda, and Uganda. The second table showed longitudinal and cross-sectional comparisons of mortality rates mentioned above.

**Results**

**Overall Trends: Change in Mortality Rates from 1990 to 2013**

The data show that among developed and developing countries overall, and across the three EAC countries, mortality rates for both NCDs and CDs decreased from 1990 to 2013. For both developed and developing countries, NCDs have been the leading cause of death from 1990 to 2013. Since 2010, NCDs overtook CDs as the leading cause of death in Burundi, Rwanda, and Uganda (Figure 16).
Figure 16. Overall trends of NCDs and CDs mortality rates from 1990 to 2013 using Tableau Software.

Source: IHME, 2016d

**Developed Countries vs. Developing Countries**

**Mortality trend from 1990 to 2013.** In developed countries, mortality rates for both NCDs and CDs decreased from 1990 to 2013, and the magnitude of decline was higher for NCDs than CDs (Table 2, Figure 16). In developing countries, from 1990 to 2013 mortality rates for both NCDs and CDs decreased at almost similar rates of decline (Table 2, Figure 16).

After comparison, developing countries had a slower annualized rate of decline in NCDs mortality rates, and a higher annualized rate of decline in CDs mortality rates compared to developed countries (Table 2).
Table 2

1990 and 2013 CDs and NCDs Mortality Rates, and the Annualized Rates of Decline in Mean Mortality Rates from 1990 to 2013 for Developed Countries, Developing Countries, Burundi, Rwanda, and Uganda

<table>
<thead>
<tr>
<th>Location</th>
<th>Cause of Death</th>
<th>1990 Mortality Rate</th>
<th>2013 Mortality Rate</th>
<th>Annualized Rate of Decline from 1990 to 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed</td>
<td>NCDs</td>
<td>690.0</td>
<td>513.2</td>
<td>7.69</td>
</tr>
<tr>
<td>Developing</td>
<td>NCDs</td>
<td>833.8</td>
<td>702.7</td>
<td>5.70</td>
</tr>
<tr>
<td>Burundi</td>
<td>NCDs</td>
<td>1055.0</td>
<td>789.4</td>
<td>11.55</td>
</tr>
<tr>
<td>Rwanda</td>
<td>NCDs</td>
<td>1100.6</td>
<td>655.1</td>
<td>19.37</td>
</tr>
<tr>
<td>Uganda</td>
<td>NCDs</td>
<td>751.2</td>
<td>695.3</td>
<td>2.43</td>
</tr>
<tr>
<td>Developed</td>
<td>CDs</td>
<td>38.3</td>
<td>29.0</td>
<td>0.40</td>
</tr>
<tr>
<td>Developing</td>
<td>CDs</td>
<td>291.0</td>
<td>160.8</td>
<td>5.66</td>
</tr>
<tr>
<td>Burundi</td>
<td>CDs</td>
<td>975.0</td>
<td>615.5</td>
<td>15.63</td>
</tr>
<tr>
<td>Rwanda</td>
<td>CDs</td>
<td>860.9</td>
<td>411.0</td>
<td>19.56</td>
</tr>
<tr>
<td>Uganda</td>
<td>CDs</td>
<td>922.2</td>
<td>611.3</td>
<td>13.52</td>
</tr>
</tbody>
</table>

Note: Mortality rate is defined as the number of deaths due to a particular cause (NCDs or CDs) per 100,000 persons within the specified year.
**Current mortality rates.** Developing countries had higher 2013 mortality rates for both NCDs and CDs than developed countries (see Table 2). In 2013, NCDs claimed more lives than CDs in developing countries (more than three fourths of combined CDs and NCDs-related deaths) (See Figure 17), and developed countries had the lowest CDs to NCDs mortality rate ratio.

![Figure 17. Ratios of 2013 CDs mortality rate to NCDs mortality rate.](image)

Source: IHME, 2016d

**Mortality Rates Comparison across the Three EAC Countries**

**Mortality trend from 1990 to 2013.** Rwanda had the highest annualized rates of decline in mean mortality rate from 1990 to 2013 for both NCDs and CDs, followed by Burundi and Uganda, respectively (Table 2, Figure 16).

**Current mortality rate.** In 2013, Rwanda had the lowest mortality rates and Burundi had the highest mortality rates for both CDs and NCDs (Table 2).
For the three EAC countries, NCDs mortality rates were higher than CDs mortality rates (Table 2). We compared ratios of CDs to NCDs mortality rates, and we found that Uganda had the highest; for each NCDs-related death there were 0.88, 0.78, and a 0.63 CDs-related death in Uganda, Burundi, and Rwanda, respectively. Figure 17 displays ratios of 2013 CDs to NCDs mortality rates of developed countries, developing countries, Burundi, Rwanda, and Uganda.

**Comparing Mortality Rate of the Three EAC Countries to Developing Countries**

**Burundi vs. developing countries.**

*Mortality trend from 1990 to 2013.* Burundi had higher annualized rates of decline in mean mortality rates from 1990 to 2013 than developing countries for both NCDs and CDs (see Table 3).

*Current mortality rate.* In 2013, Burundi had higher mortality rates for both NCDs and CDs than developing countries. Burundi is the only country among the three EAC countries to have a higher current (2013) NCDs mortality rate than developing countries as a group.

**Rwanda vs. developing countries.**

*Mortality trend from 1990 to 2013.* From 1990 to 2013, Rwanda had higher annualized rates of decline in mean mortality rates compared to developing countries for both CDs and NCDs.

*Current mortality rate.* In 2013, Rwanda had a lower NCDs-related mortality rate, but a higher CDs-related mortality rate, compared to developing countries.

**Uganda vs. developing countries.**

*Mortality trend from 1990 to 2013.* From 1990 to 2013, Uganda was the only country of the three EAC countries to have a slower rate of decline in NCDs death rate compared to developing countries.
**Current mortality rate.** In 2013, Uganda had a lower NCDs-related mortality rate compared to developing countries.

Table 3

**Comparisons of Mortality Trends and Current (2013) Mortality Rates**

<table>
<thead>
<tr>
<th>Locations</th>
<th>Cause of Death</th>
<th>Difference in Annualized Rate of Decline in Mean Mortality Rates from 1990 to 2013</th>
<th>Difference in 2013 Mortality Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing vs. Developed</td>
<td>NCDs</td>
<td>-1.99</td>
<td>189.5</td>
</tr>
<tr>
<td>Burundi vs. Developing</td>
<td>NCDs</td>
<td>5.85</td>
<td>86.7</td>
</tr>
<tr>
<td>Rwanda vs. Developing</td>
<td>NCDs</td>
<td>13.67</td>
<td>-47.7</td>
</tr>
<tr>
<td>Uganda vs. Developing</td>
<td>NCDs</td>
<td>-3.27</td>
<td>-7.4</td>
</tr>
<tr>
<td>Developing vs. Developed</td>
<td>CDs</td>
<td>5.26</td>
<td>131.8</td>
</tr>
<tr>
<td>Burundi vs. Developing</td>
<td>CDs</td>
<td>9.97</td>
<td>454.7</td>
</tr>
<tr>
<td>Rwanda vs. Developing</td>
<td>CDs</td>
<td>13.9</td>
<td>250.2</td>
</tr>
<tr>
<td>Uganda vs. Developing</td>
<td>CDs</td>
<td>7.86</td>
<td>450.5</td>
</tr>
</tbody>
</table>

*Note:* Mortality rate is defined as the number of deaths due to a particular cause (NCDs or CDs) per 100,000 persons.

**Discussion**

Findings of this study suggest a remarkable improvement in the health sector in Burundi, Rwanda, Uganda, and in developing countries in general. These findings are similar to those found by the National Institute of Statistics of Rwanda (NISR), namely that Rwanda has seen an
increase in population health insurance coverage; a reduction in neonatal, under-five, and maternal mortality; improved antenatal care coverage, modern contraceptive utilization, and immunization coverage; and an increase in the number of women delivering at a health care facility, among other improvements since the year 2000 (NISR et al., 2012).

In Uganda, findings are similar to those of the Uganda Bureau of Statistics (UBOS) and ICF International (2012) that the Ugandan health sector has seen improvement in family planning and postnatal vaccination, increased life expectancy at birth, and reduction in infant mortality since 2000.

This study found that Rwanda had a high rate of decline in death rates. In the rebuilding process after the 1994 genocide, Rwanda, via the Rwandan Ministry of Health (MoH), partnered with different non-governmental organizations (NGOs) such as Partners in Health (PIH). That partnership helped Rwanda to rebuild and improve its public health infrastructure, recruit and train health professionals, and implement different programs including community-based HIV care (Drobac et al., 2013).

It was noted in this study that from 2010 onwards NCDs overtook CDs as the number one killer in Burundi, Rwanda, and Uganda. These countries have similar disease patterns (or trends) as their GBD Region (Eastern sub-Saharan Africa), but are not similar to developing countries in general. From 1990 to 2013, in developing countries as a group, NCDs were consistently the number one killer, not just since 2010 as in Burundi, Rwanda, Uganda and, according to the GBD 2013 study, in the entire Eastern sub-Saharan Africa region (IHME, 2016d).

Even though we found a higher magnitude of decline in CDs-related death rates in the three EAC countries compared to developing countries, in 2013 these rates were still higher in the three EAC countries than in developing countries. First, this finding confirms the statement
that health sector in these three EAC countries experienced remarkable improvement and second, it is a clear indication that there is still a long way to go and a lot to improve to get to the level of health sector in developing countries in general.

In our study, 2013 CDs to NCDs mortality rate ratios were also compared. This calculation allowed us to compare the similarity of burdens of CDs and NCDs in the same country (or group of countries). Our interpretation is that for a particular country (or group), the higher the ratio (closer to one, as all had higher NCDs mortality rates in 2013), the closer the CDs-related mortality rate is to the NCDs-related mortality rate, therefore both CDs and NCDs contribute almost equally to that country’s burden of disease.

It was found that the three EAC countries had higher NCDs mortality burden than developed countries, where the current mortality burden was predominately caused by NCDs. It was also found that the three EAC countries had higher CDs mortality burden than developing countries as a group. These findings clearly indicate that both NCDs and CDs mortality burdens are high in the three EAC countries, a phenomenon known as ‘double burden of diseases’.

It was found that Uganda has the highest 2013 CDs to NCDs mortality rate ratio, followed by Burundi and Rwanda. These three countries are in the middle of an epidemiologic transition, where the burden of disease is caused by both NCDs and CDs.

Findings from this study, in particular the decline in mortality rates in Burundi, Rwanda, and Uganda, suggest that these countries are undergoing a demographic transition. Schwartz et al. (2014) confirmed that the population growth and observed urbanization trends in Uganda are characteristics of a country undergoing a demographic transition.
**Strength and Limitations**

To our knowledge, this is the first analysis for comparison of mortality rates in the EAC African region. The best available IHME data estimates were used for comparative mortality analyses and data visualization tools were used to present mortality trends. However, there are certain limitations in the analysis.

In Burundi, Rwanda, and Uganda, and in other LMICs in general, the practice of data collection is not uniform, flawless, or always up-to-date. Thus, mortality rates must be estimated in these countries, especially data before the year 2000. For example, in Rwanda, before 1994 there was no systematic document storage in a digital format. During the genocide, public institutions were destroyed and most of the records were destroyed or burned. The first post 1994 national demographic and health survey was conducted in 2000. Therefore, to obtain health data for Rwanda before 2000, one must estimate, and estimated data may not reflect the exact situation in Rwanda. Another example is Burundi. In Burundi, the first national demographic and health survey was not done until after 2000, so data before 2000 are estimated that may not reflect the precise situation in Burundi.

In this study, the analysis was limited to CDs and NCDs only, and excluded the burden of death due to injuries. The burden of death due to injuries should be studied especially in countries like Rwanda, Burundi, and Uganda with a history of genocide (1994 Rwandan genocide), and long-lasting civil wars (Lord’s Resistance Army civil war in Northern Uganda since 1980s).

Even though EAC countries have many similarities, it cannot be guaranteed that our findings can be generalized to the other two EAC countries (Kenya, and Tanzania), or other LMICs.
South Sudan was the newest member state to join the EAC, after signing the EAC treaty in April 2016. South Sudan was not included in our study because it joined the organization after our study had already started.

**Conclusion**

Burundi, Rwanda, and Uganda experienced a decline from 1990 to 2013 in rates of mortality due to each of communicable and non-communicable diseases. The three EAC countries had higher magnitudes of decline in mortality rate due to CDs than developing countries in general. Only Rwanda and Burundi had a higher magnitude of decline in mortality rate due to NCDs than developing countries. In Uganda, NCDs declined at a slower rate than in developing countries. Even though NCDs are the major contributor to the mortality burden of disease, CDs are still responsible for a relatively large portion of the mortality disease burden. Burundi, Rwanda and Uganda via their respective ministries of health, made remarkable improvements, but the road is still long because recent death rates in these three EAC countries are still higher than developing countries, in particular for CDs.
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## Appendix A – List of Public Health Competencies Met in CE

### Tier 1 Core Public Health Competencies

#### Domain #1: Analytic/Assessment Skills
- Describes factors affecting the health of a community (e.g., equity, income, education, environment)
- Identifies quantitative and qualitative data and information (e.g., vital statistics, electronic health records, transportation patterns, unemployment rates, community input, health equity impact assessments) that can be used for assessing the health of a community
- Applies ethical principles in accessing, collecting, analyzing, using, maintaining, and disseminating data and information
- Uses information technology in accessing, collecting, analyzing, using, maintaining, and disseminating data and information
- Selects valid and reliable data
- Selects comparable data (e.g., data being age-adjusted to the same year, data variables across datasets having similar definitions)
- Collects valid and reliable quantitative and qualitative data
- Describes public health applications of quantitative and qualitative data
- Uses quantitative and qualitative data
- Contributes to assessments of community health status and factors influencing health in a community (e.g., quality, availability, accessibility, and use of health services; access to affordable housing)

#### Domain #2: Policy Development/Program Planning Skills
- Contributes to state/Tribal/community health improvement planning (e.g., providing data to supplement community health assessments, communicating observations from work in the field)
- Contributes to development of program goals and objectives
- Identifies current trends (e.g., health, fiscal, social, political, environmental) affecting the health of a community

#### Domain #3: Communication Skills
- Communicates in writing and orally with linguistic and cultural proficiency (e.g., using age-appropriate materials, incorporating images)
- Solicits input from individuals and organizations (e.g., chambers of commerce, religious organizations, schools, social service organizations, hospitals, government, community-based organizations, various populations served) for improving the health of a community
- Conveys data and information to professionals and the public using a variety of approaches (e.g., reports, presentations, email, letters)
- Facilitates communication among individuals, groups, and organizations
- Describes the roles of governmental public health, health care, and other partners in improving the health of a community

#### Domain #4: Cultural Competency Skills
- Describes the concept of diversity as it applies to individuals and populations (e.g., language, culture, values, socioeconomic status, geography, education, race, gender, age, ethnicity, sexual orientation, profession, religious affiliation, mental and physical abilities, historical experiences)

#### Domain #5: Community Dimensions of Practice Skills
- Describes the programs and services provided by governmental and non-governmental organizations to improve the health of a community

#### Domain #6: Public Health Sciences Skills
- Identifies prominent events in the history of public health (e.g., smallpox eradication, development of vaccinations, infectious disease control, safe drinking water, emphasis on hygiene and hand washing, access to health care for people with disabilities)
- Retrieves evidence (e.g., research findings, case reports, community surveys) from print and electronic sources (e.g., PubMed, Journal of Public Health Management and Practice, Morbidity and Mortality Weekly Report, The World Health Report) to support decision making
- Recognizes limitations of evidence (e.g., validity, reliability, sample size, bias, generalizability)

#### Domain #7: Financial Planning and Management Skills
- Describes public health funding mechanisms (e.g., categorical grants, fees, third-party reimbursement, tobacco taxes)

#### Domain #8: Leadership and Systems Thinking Skills
- Incorporates ethical standards of practice (e.g., Public Health Code of Ethics) into all interactions with individuals, organizations, and communities
- Describes the ways public health, health care, and other organizations can work together or individually to impact the health of a community
### Concentration Specific Competencies

**Global Health:**

<table>
<thead>
<tr>
<th>Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify strategies that strengthen community capabilities for overcoming barriers to health and well-being</td>
</tr>
<tr>
<td>Exhibit interpersonal skills that demonstrate willingness to collaborate, trust building abilities, and respect for other perspectives</td>
</tr>
<tr>
<td>Identify and respond with integrity and professionalism to ethical issues in diverse economic, political, and cultural contexts</td>
</tr>
<tr>
<td>Apply the health equity and social justice framework for the analysis of strategies to address health disparities across different populations</td>
</tr>
<tr>
<td>Conduct evaluation and research related to global health</td>
</tr>
<tr>
<td>Enhance socio-cultural and political awareness</td>
</tr>
<tr>
<td>Apply systems thinking to analyze a diverse range of complex and interrelated factors shaping health at local, national, and international levels</td>
</tr>
</tbody>
</table>