

DEVELOPMENT
KNOWLEDGE AND
LEARNING

Combating Noncommunicable Diseases in Kenya

An Investment Case

Julia Mensah
Julius Korir
Rachel Nugent
Brian Hutchinson



WORLD BANK GROUP



DEVELOPMENT KNOWLEDGE AND LEARNING

Combating Noncommunicable Diseases in Kenya

An Investment Case

JULIA MENSAH, JULIUS KORIR, RACHEL NUGENT,
AND BRIAN HUTCHINSON

© 2020 International Bank for Reconstruction and Development / The World Bank
1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

Some rights reserved

1 2 3 4 23 22 21 20

Books in this series are published to communicate the results of Bank research, analysis, and operational experience with the least possible delay. The extent of language editing varies from book to book.

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Nothing herein shall constitute or be considered to be a limitation upon or waiver of the privileges and immunities of The World Bank, all of which are specifically reserved.

Rights and Permissions



This work is available under the Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO) <http://creativecommons.org/licenses/by/3.0/igo>. Under the Creative Commons Attribution license, you are free to copy, distribute, transmit, and adapt this work, including for commercial purposes, under the following conditions:

Attribution—Please cite the work as follows: Mensah, Julia, Julius Korir, Rachel Nugent, and Brian Hutchinson. 2020. “Combating Noncommunicable Diseases in Kenya: An Investment Case.” Development Knowledge and Learning. World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO

Translations—If you create a translation of this work, please add the following disclaimer along with the attribution: *This translation was not created by The World Bank and should not be considered an official World Bank translation. The World Bank shall not be liable for any content or error in this translation.*

Adaptations—If you create an adaptation of this work, please add the following disclaimer along with the attribution: *This is an adaptation of an original work by The World Bank. Views and opinions expressed in the adaptation are the sole responsibility of the author or authors of the adaptation and are not endorsed by The World Bank.*

Third-party content—The World Bank does not necessarily own each component of the content contained within the work. The World Bank therefore does not warrant that the use of any third-party-owned individual component or part contained in the work will not infringe on the rights of those third parties. The risk of claims resulting from such infringement rests solely with you. If you wish to re-use a component of the work, it is your responsibility to determine whether permission is needed for that re-use and to obtain permission from the copyright owner. Examples of components can include, but are not limited to, tables, figures, or images.

All queries on rights and licenses should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; e-mail: pubrights@worldbank.org.

Cover photo: © Georgina Goodwin / World Bank. Permission required for reuse.

Cover design: Debra Naylor / Naylor Design Inc.

Contents

Acknowledgments v

Executive Summary vii

Abbreviations xi

CHAPTER 1 Introduction 1

Background 1
Study objectives 2
Making the case 3
Note 3

CHAPTER 2 Situation Analysis 5

Disease and risk factor burden in the country 5
Policy response to NCD prevention and control in Kenya 7
Notes 7

CHAPTER 3 Investment Case Methods 9

Current economic burden of seven NCDs 9
Calculating the direct costs of NCDs 10
Calculating the indirect costs of NCDs 11
Return-on-investment analysis 13
Study limitations 15
Notes 16

CHAPTER 4 Results 17

Economic burden of NCDs in Kenya 17
Scale up of intervention coverages to target NCDs 18
Health benefits of the interventions 19
Costs and economic benefits from scaling up the intervention packages 19
Notes 21

CHAPTER 5 Discussion and Policy Recommendations 23

APPENDIX A Institutional Context 27

APPENDIX B Data Sources 29

APPENDIX C Treatment Gaps in the Different Conditions 31

APPENDIX D Details of Economic Burden by Condition 35**APPENDIX E Sensitivity Analysis 37****APPENDIX F Technical Appendix 39****BIBLIOGRAPHY 49****Boxes**

- 2.1 Selected findings of 2015 Kenya STEPwise survey for noncommunicable disease risk factors 6
- 3.1 Noncommunicable disease clinical interventions costed 11
- 3.2 Indirect productivity losses: Assumptions and sources 12

Figures

- 2.1 Deaths by cause, 1997 and 2017 6
- 4.1 The cumulative economic burden of seven noncommunicable diseases and conditions, 2017–30 18
- 4.2 Total economic burden from noncommunicable diseases 18
- F.1 Health states within the impact module's cardiovascular disease platform 40
- F.2 Health states within the impact module's chronic obstructive pulmonary disease platform 40
- F.3 Health states within the impact module's diabetes platform 41

Tables

- 1.1 Kenya health expenditures, by source and year 2
- 4.1 Health benefits from scaling up noncommunicable disease interventions 19
- 4.2 Estimated return on investment for scaling up interventions for four selected noncommunicable diseases 20
- B.1 Summary of data sources for inputs to the cost-of-illness analysis 29
- C.1 Treatment gaps in status quo and scale up scenarios 32
- D.1 Summary economic burden, by disease or injury 35
- D.2 Economic burden of noncommunicable diseases and injuries, by cost type 35
- E.1 Estimated return on investment for scaling up interventions 37
- E.2 Estimated return on investment for scaling up interventions 37
- E.3 Estimated return on investment for scaling up interventions 38
- F.1 Per person cost of screening, diagnosis, and treatment of noncommunicable diseases 42
- F.2 Per person cost of treatment for road traffic injuries, by severity 43
- F.3 Clinical interventions, by condition 44
- F.4 Baseline and target coverages 45
- F.5 Effect sizes of clinical interventions that target breast cancer and cervical cancer 47

Acknowledgments

The authors are grateful to and would like to sincerely thank all those who, in one way or another, contributed to the conceptualization and development of this book. First, the leadership of the Kenya Ministry of Health and staff of the Noncommunicable Disease Department for their unwavering support and cooperation. Specifically, we record our appreciation to Dr. Patrick Amoth, Dr. Pacificah Onyancha, Dr. Ejersa Waqo, Dr. Joseph Kibachio, Dr. Ephantus Maree, Dr. Gladwell Gathecha, Dr. Loise Nyanjau, and Dr. Elizabeth Nzioki for their valuable contributions from the design of the study to its completion. Many thanks for the unreserved management and technical support rendered throughout the process and review of the study by the World Bank Group's Magnus Lindelow and Ernest Massiah (Practice Managers); Patrick Osewe and Andreas Seiter (Lead Health Specialists); Paolo Belli (Program Leader); Pia Schneider (Lead Economist); Miriam Schneidman (Lead Health Specialist); Jane Chuma and Collins Chansa (Senior Health Economists); Samuel Lantei Mills and Wezi Msisha (Senior Health Specialists); and Laura Di Giorgio (Economist).

We appreciate the diligence of all technical partners who have been involved in the study, including the staff of the Center for Global Noncommunicable Diseases at RTI International, who worked tirelessly to support the timely delivery of this study. Special thanks to Sarah Masyuko (Public Health Intern) and Garrison Spencer (Public Health Researcher). We also thank contributors along the way, notably Dr. Mary Amuyunzu-Nyamongo, Executive Director and Founder of the African Institute for Health and Development in Kenya, and Dr. Soonman Kwon, Professor and former Dean of the School of Public Health at Seoul National University.

We are indebted to the Korea–World Bank Partnership Facility and Access Accelerated for financial support, and to the United Nations Interagency Taskforce on Noncommunicable Diseases.

Finally, our thanks to Richard Crabbe for his editorial work and communications advice, and to colleagues in the World Bank Publishing Program for bringing this study to life as a book.

Executive Summary

BACKGROUND

In Kenya, the growing prevalence of noncommunicable diseases (NCDs) is a major public health concern and a hindrance to long term economic growth. NCDs reduce human capital and increasingly divert societal resources to less productive uses. High costs to manage the growing caseload of NCDs afflict Kenyan families, businesses, and the government. In addition, NCDs lower economic productivity by shortening life spans and causing illness during an individual's prime working years. If more aggressive action is not taken, the NCD burden threatens Kenya's quest to advance Universal Health Coverage (UHC), a central pillar of the health reform agenda that includes prevention and care for NCDs. To fulfill its commitments to advance health through UHC and to build human capital—as demonstrated through the Government's stated commitment to the World Bank's Human Capital Project—Kenya must address the rising NCD burden.

OBJECTIVES

Scant published studies have quantified the health and economic burden of NCDs in Kenya. Moreover, within the Kenyan context, few studies have examined the costs and/or benefits of scaling up health interventions that target multiple NCDs and NCD risk factors. To make informed decisions about which interventions to implement to reduce the burden of NCDs, policy makers require credible measures of the expected benefits and costs from investing in NCD prevention and treatment interventions.

Given these needs, the purpose of this study was to do the following:

1. Assess the current economic burden of NCDs in Kenya;
2. Quantify the short- and medium-term economic benefits and costs of scaling up treatment interventions to address NCDs in Kenya; and
3. Provide evidence and strengthen advocacy and resource mobilization efforts that can accelerate investments in human capital development by demonstrating how NCDs impact productivity and the capacity of individuals to achieve their full potential.

METHODS

The investment case assesses the economic burden created by seven of the 15 diseases and conditions described by the Kenya Non-Communicable Diseases and Injuries Poverty Commission: diabetes, cardiovascular disease (CVD), cervical cancer, breast cancer, motor vehicle injuries, chronic obstructive pulmonary disease (COPD), and sickle cell disease. These conditions are responsible for the majority of NCD-related deaths in Kenya. The investment case measures economic burden using a cost-of-illness approach. The burden is comprised of *direct* and *indirect* costs. Direct costs reflect the cost to the government or private sector to provide treatment for a given disease or condition, while indirect costs reflect the value of lost economic productivity due to premature mortality, absenteeism (missed days of work), and presenteeism (working at reduced capacity while at work) caused by a disease or condition.

Second, the investment case examines the extent to which the economic burden can be reduced by scaling up interventions that are designed to treat four of seven diseases and conditions described above: CVD, COPD, breast cancer, and cervical cancer. The analysis uses the UN interagency OneHealth Tool (OHT) to assess the costs and health benefits of providing selected NCD care to the population—for example, number of lives saved, and healthy life years gained. In a return-on-investment (ROI) analysis, health benefits are monetized using the human capital approach, and the costs and benefits of the interventions are compared to assess the ROI of each intervention.

RESULTS AND RECOMMENDATIONS

Seven NCDs and conditions caused KSh 230 billion (a billion is 1,000 million) in economic losses in 2016, the equivalent of 3.4 percent of Kenya's gross domestic product (GDP). Ninety-three percent of the burden is comprised of indirect productivity losses while the remainder is attributable to direct medical costs. If the coverage levels of interventions to treat these conditions remain low, NCDs will continue to cause major economic losses, resulting in average annual losses of KSh 607 billion in 2030.

By acting now, the Government of Kenya can reduce future health and economic losses due to NCDs. From 2016 to 2030, scaling up screening and treatment for four major NCDs (CVD, COPD, and breast cancer and cervical cancer) would do the following:

- Avert nearly 110,000 incremental deaths, of which nearly 89,000 would have been caused by cardiovascular disease. In addition, 811,000 healthy life years would be restored to the Kenyan population, 67 percent of which are generated by interventions addressing chronic obstructive pulmonary disorder.
- Provide economic benefits (KSh 175 billion) that outweigh the costs (KSh 142 billion). The CVD interventions account for 86 percent of the total economic benefits while representing 43 percent of the costs. The CVD interventions (ROI 2.48) are the only package of interventions found to have an ROI greater than one over the analyzed period from 2016 to 2030. Cervical cancer interventions have the next highest ROI (0.73), followed by the breast cancer (0.57), and COPD (0.09) interventions.

The investment case shows that there is an evidence-based opportunity to reduce the health and economic burden of NCDs, and demonstrates that Kenya can facilitate its efforts to implement UHC and make a generational investment in human capital by addressing the NCD burden in the country. Given these findings, it is recommended that the Government of Kenya take the following steps:

1. *Invest in scaling up interventions for NCDs, drawing on economic and efficiency analyses to inform the prioritization of the allocation of scarce resources.* The investment case analysis shows that the package of CVD interventions is economically efficient and offers a return on investment (ROI) over the next 15 years, while investments in the cancer and COPD packages have ROIs lower than one. Given that CVD presents the highest burden of any condition analyzed in the investment case, and that the CVD interventions generate clear health and economic benefits, Kenya could prioritize scaling up the CVD interventions analyzed in this investment case. This could begin with expanding access to preventative services to address CVD risk factors, such as hypertension and hyperlipidemia. Despite offering lower economic returns, other conditions should not be neglected given the huge economic burden that all the NCDs impose on the country. Health is a human right; investing in scaling up interventions that address all NCDs creates an opportunity for all people to pursue their full potential.
2. *Increase NCD resource allocation by the Government of Kenya, and other national and international partners.* By investing KSh 142 million in NCD treatment now, Kenya would save KSh 175 billion in economic losses from poor health over 15 years. Kenya should analyze how to mobilize the resources required to fund this investment and may consider win-win strategies—such as increasing (or implementing) taxes on tobacco, alcohol, and sugar-sweetened beverages—that synergistically achieve health aims while also generating revenue.
3. *Prioritize and sustain efforts on prevention and health promotion.* Although the investment case primarily focused on clinical interventions, the results point to the importance of tackling NCD risk factors and investing in health promotion—basically interventions that prevent, halt, or delay the progression of disease. NCDs share modifiable risk factors (tobacco smoking, unhealthy diet, physical inactivity, and harmful consumption of alcohol), which, when tackled, can prevent, halt, or delay the progression of disease. Interventions to screen for and quickly manage metabolic risk factors, such as high blood pressure, high cholesterol, high fasting blood glucose, and obesity, will also delay the progression of disease, reducing the long-term costs of treatment. Investing in health promotion and primary prevention is thus a strategic approach to minimizing the costs of NCDs. Though further research on the benefits of such interventions in Kenya in relation to their costs is much needed, the World Health Organization (WHO) has identified a set of intervention “best buys” that could provide useful guidance. There is also considerable scope for the design and implementation of policies and programs aimed at behavior change, particularly among youth and adolescents.
4. *Continue investment in NCD control through Universal Health Coverage (UHC), delivering on the Big Four agenda.* By providing accessible, responsive, and inclusive health services that engage all population groups, and

especially those who are the most vulnerable, no one is left behind. Moreover, inclusion of NCD prevention services can reduce future catastrophic health expenditures, protecting individuals from poverty. Both the quantity and quality of health services should be considered. Investments in NCD control should be well coordinated with all health system stakeholders to create synergies in the delivery of care and ensure that health service delivery is not fragmented programmatically (noncommunicable versus communicable disease care). UHC services should also prioritize preventative interventions to maximize health service delivery benefits.

5. *Plan additional economic analysis of interventions addressing NCDs.* As indicated earlier, population level interventions have been proven to offer a high return for investment. Further prioritization and economic analysis of these interventions, therefore, is needed, especially given their high potential impact. In addition, the investment case did not analyze interventions addressing two diseases (diabetes and sickle cell disease) and one condition (road traffic injuries) that were included in the cost-of-illness analysis. Analysis of additional diseases and conditions would provide a more comprehensive picture of options for prioritizing and controlling NCDs and injuries. Finally, updating the current analysis of cancer and COPD interventions with additional information may produce different results. The ROI analysis did not place a monetary value on the decreases in disease morbidity that result from clinical interventions. Including this component in future analyses would provide more equal weighting to interventions such as those for COPD, which have a larger impact on disease morbidity than mortality.

Abbreviations

AMI	acute myocardial infarction
COI	cost of illness
COPD	chronic obstructive pulmonary disease
CVD	cardiovascular disease
GBD	Global Burden of Disease
GDP	gross domestic product
HC	human capital
HCP	Human Capital Project
ICC	interagency coordinating committee
IHD	ischemic heart disease
IHME	Institute for Health Metrics and Evaluation
KSh	Kenyan shilling
KEPH	Kenya Essential Package for Health
KNBS	Kenya National Bureau of Statistics
LMIC	low- and middle-income country
MI	myocardial infarction
NCD	noncommunicable disease
NCDI	noncommunicable diseases and injuries
NTSA	National Transport Safety Authority
OHT	OneHealth Tool
PV	present values
ROI	return on investment
RTI	road traffic injuries
SDG	Sustainable Development Goal
THE	total health expenditure
UHC	universal health coverage
VIA	visual inspection with acetic acid
WHO	World Health Organization

1 Introduction

BACKGROUND

The global burden of noncommunicable diseases (NCDs) or chronic diseases—primarily, cardiovascular diseases (or heart diseases), diabetes, cancers, and chronic lung diseases—has increased sharply over the past two decades, with low-and-middle-income countries (LMICs) most heavily impacted by this shift. In Kenya, NCDs caused 111,000 deaths in 2017, nearly 62 percent of which occurred in individuals under age 70 (GBD 2017 Causes of Death Collaborators 2018). The increasing prevalence of NCDs—resulting in a double burden of infectious and chronic diseases—constitutes a major public health concern. NCDs account for more than 50 percent of total hospital admissions and over 55 percent of hospital deaths in Kenya (Ministry of Health, Government of Kenya 2015a). By 2030, it is projected that deaths due to communicable diseases will decrease by 48 percent, while deaths due to NCDs will rise by 55 percent (Ministry of Health, Government of Kenya 2015b).

NCDs create high economic costs that are borne at the individual, household, community, and national levels. Large expenditures to treat ill health impose a direct burden, which can impoverish individuals and households (Chuma and Maina 2012). But the economic burden of NCDs also stems from indirect sources. Poor health reduces productivity by permanently or temporarily removing individuals from formal or informal labor markets. When individuals die prematurely, the labor output that they would have produced in their remaining years is lost. In addition, individuals with NCDs are less likely to participate in the workforce, and more likely to miss days of work (absenteeism) or to work at a reduced capacity while at work (presenteeism) (Wang et al. 2004). Between 2011 and 2030, it is estimated that NCDs will cause more than US\$21 trillion in lost economic output in LMICs (Bloom et al. 2011).

Despite the substantial health and economic burden of NCDs, both domestic and external financing to scale up interventions to address these conditions remain limited. In Kenya, although total expenditure for NCDs increased by 20 percent between 2012 and 2016, the proportion of NCD expenditure as a share of total health expenditure declined over the period from 6.2 percent in

TABLE 1.1 Kenya health expenditures, by source and year

FISCAL YEAR	TOTAL HEALTH EXPENDITURE (THE)	NCD EXPENDITURES AS % OF THE
2012/13	KSh 271.9 b	6.2% (KSh 16.9 b)
2015/16	KSh 346.7 b	5.7% (KSh 19.8 b)

Source: Kenya National Health Accounts FY2015/2016.

Note: b = billion; KSh = Kenyan shilling; NCD = noncommunicable disease.

2012/13 to 5.7 percent in 2015/16 (table 1.1) (Ministry of Health, Government of Kenya 2017b). Given that less than two percent of global donor funding on health is allocated to NCD prevention and control, and growth in donor funding is relatively stagnant, responsibility then falls to the Government of Kenya to finance interventions to address the NCD epidemic (Global Burden of Disease Health Financing Collaborator Network 2017).

Health has a central place in the Kenya government's national development goals and NCDs are central to Kenya's quest to achieve Universal Health Coverage (UHC) by 2022. The rising prevalence of NCDs requires increased resources to satisfy the fundamental principles of UHC, which are (1) equitable access to care; (2) the provision of high quality care; and (3) financial protection. Treatment for NCDs already accounts for a large share of screening and medicines provided through UHC in Kenya (Ministry of Health, Government of Kenya 2018). Prevention and early control of NCDs will ensure that people have access to effective treatment without experiencing financial hardship.

Kenya is a pioneer in the World Bank's global Human Capital Project (HCP). The HCP supports countries to improve health and education as a means of promoting equity and economic growth. Improvements in health can materially impact national prosperity. Good health has been linked to increases in the economic output of workers, increased rates of savings among individuals, and foreign investment in business and infrastructure (Jamison et al. 2015; Yamey et al. 2017). In 2017, Kenya ranked 94 out of 154 countries in terms of human capital (HC) and had a HC index higher than the average for its region and income group (World Bank 2018). Kenya must continue to invest in the health of the nation in order to realize the full potential of its HC, and to achieve the long term economic growth envisioned in the national *Vision 2030* agenda.

Tackling NCDs is vital to achieve the 2030 Sustainable Development Goals (SDG). SDG Target 3.4 seeks to reduce premature deaths from NCDs by one-third. Given the interrelation between NCDs, poverty, and its multisectoral dimensions, this SDG target is directly linked with eight other SDGs (1, 2, 4, 5, 8, 10, 11, 12), making it central to the broader development agenda.¹ According to the NCD Countdown, Kenya is losing ground in the goal to reduce NCD mortality by 2030 (NCD Countdown 2030 Collaborators 2018). Achieving SDG 3.4 will require concerted effort to tackle NCDs within the broader framework of health service delivery (Bertram et al. 2018).

STUDY OBJECTIVES

This study provides new evidence by assessing the short- and medium-term economic benefits and costs of scaling up treatment interventions to address NCDs in Kenya. Developing an "investment case" for NCDs brings visibility to a

growing epidemic and can guide policy makers toward actionable steps that can be taken to reduce the NCD burden. Importantly, the investment case can be used to advocate for greater allocation of resources from the National Treasury. In addition, the NCD investment case can be used to do the following:

1. Accelerate progress on UHC. Understanding the costs as well as the ROI of selected NCD interventions will inform the design of the package of affordable health services for chronic conditions as UHC is expanded to all Kenyans; support more effective integration of cost-effective interventions into routine health service delivery; and improve tracking and monitoring of achievements in health outcomes related to NCDs—all of which support pathways to UHC.
2. Accelerate investments in HC Development. In order to accelerate HC development, Kenya will need to invest national resources to tackle the key barriers to health and education. This requires a strong evidence base to demonstrate the interlinkages between health improvements and individual productivity. This investment case contributes to the evidence base by demonstrating how NCDs—a primary driver of premature mortality in adults—impact productivity and the capacity of individuals to achieve their full potential.
3. Strengthen advocacy and resource mobilization efforts. The investment case provides an opportunity to refocus and revitalize the fight against NCDs in Kenya. In LMICs, a lack of political commitment to and resource allocation for NCDs remain a challenge, in part because the diseases continue to be viewed as a “problem of affluent countries.” This investment case is an advocacy tool that can highlight the benefits of cost-effective interventions, and act to mobilize resources, both domestically and externally, to address critical gaps in NCD prevention and control.

MAKING THE CASE

The remainder of this report is divided into four sections. Chapter 2 provides a summary of NCD prevention and control efforts in Kenya, including recent surveys, and policy response. Chapter 3 describes the methodology for the NCD investment case. Chapter 4 presents the findings of the investment case. Chapter 5 discusses the implications of the findings and recommendations.

NOTE

1. SDG 1: End poverty; SDG 2: Zero hunger; SDG 4: Quality Education; SDG 5: Gender Equality; SDG 8: Decent Work and Economic Growth; SDG 10: Reduced Inequalities; SDG 11: Sustainable Cities and Communities; SDG 12: Responsible Consumption and Production.

2 Situation Analysis

DISEASE AND RISK FACTOR BURDEN IN THE COUNTRY

Epidemiological burden of noncommunicable diseases

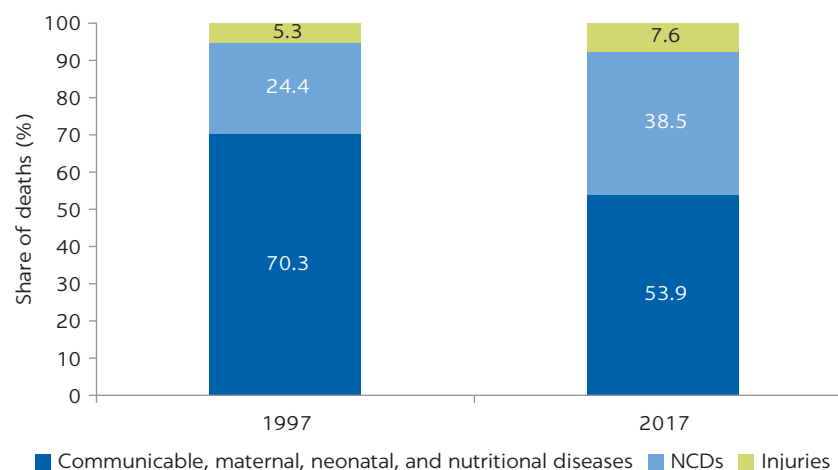
In Kenya, over one-third of all deaths are attributable to noncommunicable diseases (NCDs) (IHME 2017). Reliable cause of death data is limited in Kenya. However, the Institute for Health Metrics and Evaluation (IHME) estimates that in 2017 around 60,000 deaths were caused by the seven NCDs and injuries included in this investment case, with cardiovascular disease (CVD) accounting for the highest share of these NCD deaths (59 percent), followed by chronic respiratory diseases (14 percent), diabetes (12 percent), road traffic injuries (9 percent), breast cancer (3 percent), cervical cancer (3 percent), and sickle cell disease (<1 percent) (IHME 2017).

Kenya faces a double burden of communicable and noncommunicable diseases. Figure 2.1 shows that the percentage of deaths attributable to NCDs increased from 1997 to 2017, while communicable disease deaths declined (IHME 2017).

Burden of NCD risk factors

The prevalence of NCD risk factors is also high. In 2015, Kenya conducted its first nationally representative survey on NCD risk factors, using the World Health Organization (WHO) Stepwise Approach to NCD Risk Factor Surveillance (STEPS). The survey assessed the prevalence of tobacco smoking, physical inactivity, harmful consumption of alcohol, unhealthy diets, overweight and obesity, hyperglycemia (raised blood sugar), hyperlipidemia (raised cholesterol), and hypertension (raised blood pressure). These risk factors account for two-thirds of NCD incidence globally. Box 2.1 shows the prevalence of these risk factors in Kenya. Importantly, the vast majority of survey respondents had never been measured for blood pressure, blood glucose, or cholesterol, a concerning finding because of the linkage between these metabolic risk factors and CVD. There appears to be high awareness of some risk factors such as salt, but less awareness of screening for cancer or raised blood pressure. In addition, delays in diagnosis and treatment lead to disease complications and high rates of hospitalization.

FIGURE 2.1
Deaths by cause, 1997 and 2017



Source: Institute for Health Metrics and Evaluation.
Note: NCD = noncommunicable disease.

BOX 2.1

Selected findings of 2015 Kenya STEPwise survey for noncommunicable disease risk factors

Metabolic risk factors

- Blood pressure
 - 56 percent of Kenyans have never been screened for raised blood pressure.
 - 23.8 percent of Kenyans have high blood pressure.
 - Among those who had been previously diagnosed with hypertension, only 22.3 percent were currently on medication prescribed by a health worker.
- Blood glucose
 - 87.8 percent of Kenyans have never been measured for raised blood sugar.
 - Among those diagnosed with elevated blood sugar, less than half (40.1 percent) are currently taking medication.
- Cholesterol
 - Most Kenyans (97.7 percent) have never been measured for cholesterol levels.
 - Only 13.3 percent of Kenyans who reported that they have been diagnosed with elevated cholesterol levels are on medication.

Behavioral risk factors

- Tobacco use
 - 13 percent of Kenyans currently consume tobacco products, with a higher prevalence of use among men (23 percent) compared to among women (4.1 percent).
 - 24 percent and 20.9 percent of Kenyans are exposed to secondhand smoke at home and work, respectively.
- Alcohol consumption
 - 19.3 percent of Kenyans currently consume alcohol, and 13 percent of those who consume alcohol do so on a daily basis.
 - Consumption of unrecorded alcohol (alcoholic drinks that are homebrewed, excluding *changaa*, *busaa* or *muratina* or any alcohol not intended for drinking) was reported by 35.5 percent of adults.
- Fruit and vegetable consumption
 - Kenyans report an average daily consumption of two servings (2.1) of

continued

Box 2.1, continued

- fruit and vegetables, below the WHO recommendation of at least five servings of fruits and vegetables a day.
- Overweight/obesity
 - 27 percent of Kenyans are either overweight or obese, with the percentage significantly higher in women (38.5 percent) than men (17.5 percent).
- Cervical cancer screening
 - Among women age 30–49 years, the age recommended for screening, only 16.4 percent have ever been screened for cervical cancer.

Road traffic injuries

- 6 percent of respondents had been involved in a road traffic crash within 12 months prior to the survey.

POLICY RESPONSE TO NCD PREVENTION AND CONTROL IN KENYA

Kenya's Big Four Agenda—championed by President Uhuru Kenyatta in his 2017 inaugural speech—prioritizes the attainment of Universal Health Coverage (UHC) by 2022.^{1,2} The link between achieving UHC and addressing NCDs was summarized by the Cabinet Secretary for Health, Dr. Sicily Kariuki, during a March 2018 speech: “Unless we do more and make concerted efforts towards preventing and affordably treating NCDs, the attainment of UHC is unlikely to be feasible.” The UHC package includes NCD screening and treatment as part of increasing access to essential health care for all Kenyans, with care delivered through community health volunteers and primary health centers. These services include full coverage of essential medicines and supplies for NCD diagnosis.

The National NCD Strategy 2015–20 provides a framework upon which both the national and county governments can draw to develop action plans for the prevention and control of NCDs. Some disease-specific policies include the National Cancer Control Strategy 2017–22, the Kenya National Guidelines for Cardiovascular diseases management 2018, and the National and Clinical Guidelines for Management of Diabetes Mellitus among others (Ministry of Health, Government of Kenya 2017a). Appendix C details the situation of NCDs within the Kenyan health policy context.

The investment case is aligned with Kenya's National Strategy for the Prevention and Control of Non-Communicable Diseases 2015–20 by focusing on the conditions—CVD, diabetes, cancer, respiratory diseases, and injuries—causing high health burdens in the country. The provision of NCD services—especially clinical screening and treatment—analyzed in the investment case fall within the UHC package of care and Kenya has prepared multiple disease strategies to guide the provision of that care.

NOTES

1. Appendix A contains additional institutional context on NCDs in Kenya.
2. The other pillars of the Big Four Agenda are affordable housing, enhancing manufacturing, and food security and nutrition.

3 Investment Case Methods

The investment case analyzes seven of the 15 diseases and conditions described as presenting a “high” disease burden by the Kenya Non-Communicable Diseases and Injuries Poverty Commission (Kenya NCDI Poverty Commission 2018). These seven were selected based on some or all of the following criteria: (1) the disease or condition was designated by the Kenya Ministry of Health as a priority for intervention over the next five years; (2) proven cost-effective interventions are available to address the disease or condition; (3) scaling up interventions to address the disease or condition is highly feasible; (4) addressing the disease or condition was advised by policy makers in the ministry’s NCD department or key opinion leaders; and (5) data was available to facilitate analysis of the disease and condition.

First, a cost-of-illness (COI) approach is used to measure the economic burden of all seven of those NCDs in Kenya over the period 2016–30.¹ Second, a return on investment (ROI) analysis is conducted for four of those diseases: cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), and breast cancer and cervical cancer. This more limited set of diseases and conditions comprised those available for analysis in the UN interagency OneHealth Tool (OHT), a software-based health modeling tool that assesses the costs and health benefits of interventions. This chapter describes the methodology underlying those two analyses. Costs and benefits are presented in real 2016² Kenyan shillings, and future costs and monetized benefits are discounted at a rate of 6.5 percent annually (Addicott, Fenichel, and Kotchen 2020).

CURRENT ECONOMIC BURDEN OF SEVEN NCDs

Projections of incidence, prevalence, and mortality from seven diseases and conditions are calculated to estimate the health burden of each from 2016 to 2030. For breast cancer, cervical cancer, COPD, CVD, and diabetes, estimates are obtained from the OHT under the assumption that current coverage rates of interventions to address each disease do not change over the period of the analysis. Projections of sickle cell disease are made assuming that the rate of

2.5 cases per 100,000 population holds steady as the population increases over the time horizon of the analysis. In each year for which deaths due to sickle cell are projected, 17 percent of deaths are assumed to be adults, based on a study from Tanzania (Makani et al. 2011). Future road traffic injuries are estimated using Institute for Health Metrics and Evaluation Global Burden of Disease (GBD) data to project mortality from road accidents, where the number of fatalities for 2016 was 3,978 and was projected to increase to 5,146 in 2020, 5,591 in 2025 and 6,036 in 2030. The number of individuals with minor and serious injuries was estimated using reports from National Transport and Safety Authority (NTSA). More information on the model and calculations used to make projections is provided in appendix F.

A COI approach is employed to determine the economic burden due to NCDs. COI assesses the direct and indirect costs related to a disease. Direct costs reflect the cost to the government or private sector to provide treatment; indirect costs reflect the value of lost productivity due to the disease, including costs due to premature mortality, absenteeism, and presenteeism. Direct and indirect costs are calculated independently of each other, and then summed to calculate the total cost of NCDs to an economy. The COI is also reported as a share of gross domestic product (GDP). More information on the sources underlying inputs to the COI analysis may be found in appendix B.

CALCULATING THE DIRECT COSTS OF NCDs

The investment case calculates the cost to provide screening, diagnosis, and treatment of ill health caused by seven diseases or injuries as shown in box 3.1.

The investment case uses the UN interagency OneHealth Tool (OHT)—which was developed by technical committees of the United Nations Interagency Taskforce on NCDs—academic literature, and expert opinion to estimate the resources required to provide screening, diagnosis, or treatment for patients. Five types of resources and their costs are assessed: (a) medicines and supplies; (b) compensation for health professionals; (c) overhead costs of outpatient visits and inpatient stays, such as utility costs, administrative and other nonhealth staff; (d) programmatic costs; and (e) patient transport costs. “Estimating mortality and morbidity of sickle cell disease and road traffic injuries” section of the appendix F provides information on the sources from which each type of cost data was derived, and also summarizes the per-person treatment costs of each clinical intervention.

Total direct costs are calculated by multiplying the number of persons to be treated in each year for a given disease by the per-person cost of treatment. The number of people treated for each condition was obtained by multiplying the population in need of the service by the coverage of each intervention, as calculated by OHT. The baseline coverages varied from intervention to intervention, although it was about 30 percent for most of the interventions. The baseline targets were obtained mainly from the Kenya NCDI Poverty Commission 2018 report and the Kenya Stepwise 2015 report. Endline target was 80 percent for all interventions; this target was obtained from the NCDI report. This endline coverage was considered plausible given the low coverages of interventions at the baseline.

BOX 3.1**Noncommunicable disease clinical interventions costed****Breast cancer**

- Screening: breast cancer screening and diagnosis by way of a clinical breast examination.
- Treatment: cancer treatment for stages I–IV.

Cervical cancer

- Screening: Visual inspection with acetic acid (VIA), pap smear, biopsy and histopathology.
- Treatment: cryotherapy, and cervical cancer treatment for stages I–IV.

COPD

- Treatment: Inhaled salbutamol, low-dose oral theophylline, Ipratropium inhaler, exacerbation treatment with antibiotics, exacerbation treatment with oral prednisolone, exacerbation treatment with oxygen.

CVD

- Secondary prevention: Screening for risk of CVD; treatment for those with very high cholesterol but low absolute risk of CVD (< 20 percent); treatment for those with high blood pressure but low absolute risk of CVD (< 20 percent); treatment for those with absolute risk of CVD 20–30 percent, treatment for those with high absolute risk of CVD (> 30 percent).
- CVD control: treatment of new cases of acute myocardial infarction (AMI) with aspirin;

treatment of cases with established ischemic heart disease (IHD), and; treatment for those with established cerebrovascular disease and post stroke.

Diabetes

- Screening: Screening for risk of diabetes.
- Diabetes control: Standard glycemic control (oral only), standard glycemic control (insulin).
- Treatment to prevent complications from diabetes: Neuropathy screening and preventative foot care; retinopathy screening and photocoagulation; treatment for those with very high cholesterol but low absolute risk of diabetes (< 20 percent); treatment for those with high blood pressure but low absolute risk of diabetes (< 20 percent); treatment for those with absolute risk of diabetes 20–30 percent, and; treatment for those with high absolute risk of diabetes (>30 percent).

Road traffic injuries

- Treatment: Treatment of minor, moderate and severe injuries.

Sickle cell disease

- Management: Management of sickle cell condition in adults, and management of sickle cell condition in children.

Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease.

CALCULATING THE INDIRECT COSTS OF NCDs

Within the investment case, indirect costs reflect the monetary value of lost productivity when people who, due to NCDs, exit the labor market early due to premature death, miss days of work due to ill health (absenteeism), or are less productive while at work due to ill health (presenteeism).

The indirect costs of premature mortality are estimated using the human capital (HC) approach, based on which each year of productive life saved is valued as the potential output a worker would have produced (proxied as GDP per worker) had (s)he continued working under complete health. The productivity loss is computed as follows:

Productivity loss from premature mortality = Number of NCD deaths_i x GDP per worker_i x labor force participation rate x employment rate x the expected number of years of working life lost

Where,

i represents the year in the analysis.

GDP per worker is KSh 489,641 in 2017 and grows at a projected rate of six percent annually.

Labor force participation rate is 67.3 percent and remains static throughout the analysis.

Employment rate is 89 percent and remains static throughout the analysis.

Expected number of years of working life lost due to each disease is reported in box 3.2.

BOX 3.2

Indirect productivity losses: Assumptions and sources

Breast and cervical cancers

- On average, each cancer death is assumed to result in the loss of 10 years working life, based on data from the Nairobi Cancer Registry, which shows that the average age of those who die from cancer is about 50 years. Assuming retirement at age 60, 10 years of working life are lost.
- Cancer causes individuals to lose 12.5 percent of working days due to absenteeism and 8.5 percent to presenteeism (Goetzel et al. 2004).

COPD

- The number of averted deaths was given by OHT, where the average age of death resulted in 11 years of working life lost.
- COPD causes individuals to lose 6.1 percent of working days to absenteeism and 17.2 percent to presenteeism (Goetzel et al. 2004).

CVD

- The number of averted deaths was given by OHT, where the average age of death resulted in 15 years of working life lost.
- CVD causes individuals to lose 2.8 percent of working days due to absenteeism and 6.8 percent to presenteeism (Goetzel et al. 2004)

Diabetes

- The number of averted deaths was given by OHT.
- Diabetes causes individuals to lose 5.7 percent (Namibia study) of working days due to absenteeism (Guariguata et al. 2012) and 11.2 percent to presenteeism (Goetzel et al. 2004).

Road traffic injuries

- World Bank estimates of mortality from road traffic injuries.
- On average, 150 days of work are lost due to serious accidents and 7 days for minor injuries (Mofadal and Kanitpong 2016).

Sickle cell disease

- Mortality of 0.65 per 100,000 is assumed using IHME GBD data. No data is available on the average age at death for the adults. The investment case assumes a loss of 10 years of working life.
- It is assumed 17 percent of those with sickle cell disease are adults (Makani et al. 2011) and that adults lost about 17 percent of working days annually due to the condition. No estimates of presenteeism are included in the analysis.

Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; IHME GBD = Institute for Health Metrics and Evaluation Global Burden of Disease; OHT = OneHealth Tool.

The value of lost future years of life is converted into a present value, using a cumulative discount factor applied over the expected number of years of life lost. The discount factor is derived from a 6.5 percent discount rate specific to Kenya that is calculated by (Addicott, Fenichel, and Kotchen 2020), who factored in Kenya's age-specific mortality rates and life expectancies to estimate the long-term social discount rate in Kenya.

The indirect cost of reductions in productivity because of absenteeism or presenteeism due to ill health are calculated as follows:

*Productivity loss from absenteeism or presenteeism = Percent productive time lost per year \times disease prevalence (# of people)_{*i*} \times GDP per worker_{*i*} \times labor force participation rate \times employment rate.*

Where,

i represents the year in the analysis.

GDP per worker is KSh 489,641 in 2017 and grows at a projected rate of six percent annually.

Labor force participation rate is 67.3 percent and remains static throughout the analysis.

Employment rate is 89 percent and remains static throughout the analysis.

Percent productive time lost per year due to a given disease is derived from academic literature, as reported in box 3.2.

Future losses are discounted at a rate of 6.5 percent. The total productivity loss is the sum of productivity losses from mortality, absenteeism, and presenteeism.

RETURN-ON-INVESTMENT ANALYSIS

The return-on-investment analysis examines the extent to which the health and economic burden of NCDs can be reduced through the scale up of interventions that target and treat four out of seven of the diseases and conditions: breast cancer, cervical cancer, COPD, and CVD. Policy measures designed to reduce NCD risk factor prevalence were not included in the analysis as they were deemed to be outside the mandate of the Kenya Ministry of Health. In particular, Kenya's National Cancer Control Strategy 2017–22 has spurred scaling up of cancer screening and down-staging of cancer treatment. National Cancer Screening Guidelines were implemented in 2018 that highlight mass screening of cervical, breast, and colorectal cancer and emphasizes individual training for prostate cancer. The ministry of health has added a component for early detection including endoscopy for patients at high risk. Oral cancer has also been included in these guidelines. None of these recent advances towards cancer prevention and early treatment is incorporated into the results of the current study. These changes suggest that a follow-up economic analysis of cancer prevention and care might be warranted.

Step 1: Select the interventions and specific NCDs for the investment case

The investment case focuses on clinical interventions designed to prevent or treat breast cancer, cervical cancer, COPD, and CVD. The interventions included

in the ROI analysis—those which target breast cancer, cervical cancer, COPD, and CVD—are described in “ROI analysis: Description of clinical interventions” section of appendix F.

Step 2: Assess the costs of scaling up coverage of clinical interventions

The analysis examines two scenarios using the OHT: a “business as usual” scenario in which current coverage rates of interventions stay the same from 2016 to 2030, and a “scale up” scenario in which coverages are scaled to reach more people in need of treatment.

“ROI analysis: Baseline and target coverages of interventions” section of appendix F lists the coverage rates of interventions in the analysis, from 2016 to 2030, and appendix C shows the extent to which the scale up in coverage reduces the treatment gap for each disease. The number of people reached in the baseline scenario is compared to the number of people reached in the scaled-up scenario to ascertain the additional number of people that the health system will treat. The additional number of people treated is multiplied by the unit cost of each treatment to obtain the total cost of providing treatment.

Step 3: Estimate the health gains

To assess the benefits of scaling up health interventions, the investment case uses the NCD impact module of the OHT to assess the impact of scaling up interventions on population health. The module applies effect sizes for each intervention to the people who receive treatment. The effect sizes are derived from academic literature (see appendix F, “ROI analysis: Intervention impact” section). OHT models the impact of the interventions, including on the number of lives saved and healthy years gained.

Step 4: Monetize the health gains

The number of lives saved as a result of scaling the interventions was monetized in order to assess labor productivity gains that result from avoidance of premature deaths.

For this purpose, the human capital (HC) approach used earlier was modified:

Productivity gains from avoided premature mortality = Number of NCD deaths avoided_i x GDP per worker_i x labor force participation rate x employment rate x the expected number of years of working life gained

Estimates of gains from avoided absenteeism and presenteeism were not included in the analysis.

Step 5: Return on investment

The ROI is a measure of the economic value of an investment. An investment is considered efficient if the financial gain from the investment exceeds its cost. The ROI is defined as the ratio between the monetarized benefits and the costs, both expressed in discounted present values (PV).

$$\text{Return on investment} = \frac{\text{PV (Total productivity benefits)}}{\text{PV (Total implementation costs)}}$$

A return on investment greater than one indicates that the PV of the project's benefits outweighs the PV of its costs. For the Kenyan investment case, the return on investment for NCD interventions was evaluated both in the short term (2016–22) and in the medium term (2016–30).

STUDY LIMITATIONS

Limitations of the study are as follows:

- This study does not include an evaluation of the costs and benefits of addressing behavioral risk factors (notably, tobacco smoking, unhealthy diets, physical inactivity, and harmful consumption of alcohol). Unlike other NCD investment cases, this study focused primarily on treatment—interventions within the purview of the health sector. Within this context, the inclusion of preventative interventions was limited to instances where those interventions formed part of the standard protocol, as defined in the One Health Tool, for facility-based primary prevention and treatment. Preventative measures can stop disease from emerging and have been shown to be highly cost-effective. Their inclusion would likely raise the ROI from NCD interventions.
- Uncertainty in model parameters. This investment case is based on assumptions regarding the model parameters which are subject to uncertainty and may affect the results. For example, the effectiveness and costs of the interventions considered may change as new technologies are continuously developed. Similarly, societal changes in lifestyle and in the environment can affect the prevalence and incidence of the selected NCD conditions. To test the sensitivity of the model parameters to these assumptions, a series of sensitivity analyses were performed where inputs were changed.
- Labor market assumptions. To value the economic output that is lost as a result of ill health, the investment case uses the HC approach. The HC approach assumes that when an individual drops out of the labor force their contributions are not replaced by another productive individual. High unemployment rates in Kenya (11 percent) may challenge this assumption, given that a slack labor force means that new workers are potentially available to substitute for, or replace individuals who cannot work because they are sick or have died. If coworkers can cover the tasks of a sick individual, or if firms can hire individuals to fill the roles of people who drop out of the workforce due to ill health, then in theory economic losses can be lessened (Lensberg et al. 2013). However, in the real world, it is not always possible to replace workers—it can be costly and worker absences can sometimes have an outsized effect by impacting the economic output of multiple other employees given that many worker projects occur in a team setting (Lensberg et al. 2013). Finally, the friction cost approach assumes that the individual who replaces a sick employee was completely unproductive in their previous role in the formal or informal labor market, or within their household (Neumann et al. 2017). Given these considerations, the investment case follows the Panel on Cost-Effectiveness in Health and Medicine's recommendation to use the HC approach (Neumann et al. 2017).

- The ROI analysis includes only four out of seven high burden NCD conditions. Due to limited data availability on the impact of all the selected interventions on health outcomes, the ROI was estimated for four conditions only—breast cancer, cervical cancer, CVD, COPD. However, estimations of the economic burden are included for all seven conditions (including sickle cell disease, diabetes, and road traffic injuries).

NOTES

1. The choice of 2016, as base year, was based on the Kenya NCDI Poverty Commission report, which this NCD investment case relies on for the coverage rates for the selected interventions.
2. The base year used in the Kenya NCDI Poverty Commission's report is 2016. The base year is not included in the calculation of the ROI, and as such all investment case results are presented in 2017 currency units.

4 Results

This section presents a summary of the findings of the investment case. Results are shown for the current and projected economic burden of noncommunicable diseases (NCDs) and the returns from scaling up health interventions to target Chronic Obstructive Pulmonary Disease (COPD), cardiovascular disease (CVD), breast cancer, and cervical cancer.

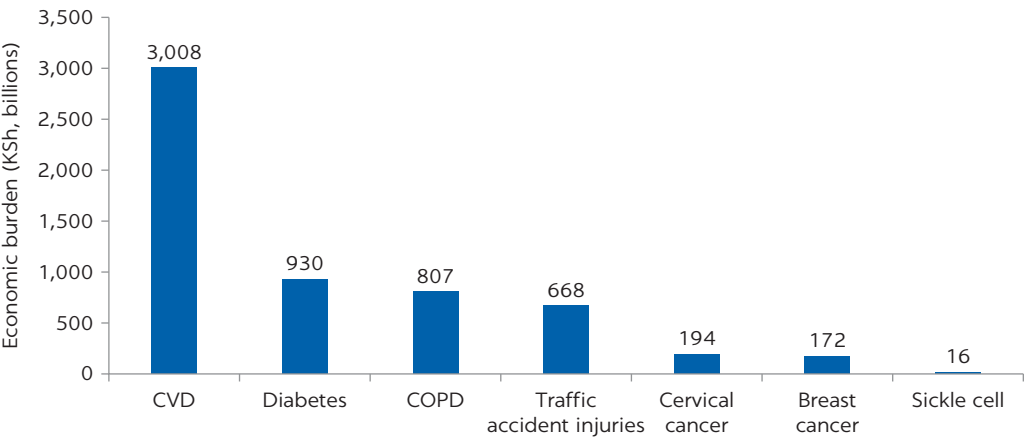
ECONOMIC BURDEN OF NCDs IN KENYA

The seven NCDs and conditions analyzed for this investment case—breast cancer, cervical cancer, COPD, CVD, diabetes, sickle cell disease, and road traffic injuries—impose a high burden on Kenya’s economic well-being. In 2016, NCDs led to KSh 230 billion (a billion is 1,000 million) in economic losses due to medical expenditures and indirect productivity losses, equivalent to 3.4 percent of GDP.

Given projected trends in the prevalence of NCDs, coupled with the increase in the national population, the NCD economic burden will increase annually through 2030. The results showed that with present coverage of the interventions, the economic burden of these NCDs will increase from KSh 230 billion in 2016 to KSh 607 billion in 2030. Figure 4.1 gives a breakdown of the cumulative economic losses caused by each disease or condition over the time horizon of the analysis. CVD causes the highest economic losses, KSh 3,008 billion, or around 52 percent of the losses generated by the seven NCDs and conditions that were analyzed. Diabetes presents the next highest economic burden (KSh 930 billion, 16 percent), followed by COPD (KSh 807 billion, 13.9 percent), and road traffic accident injuries (KSh 668 billion, 11.5 percent).

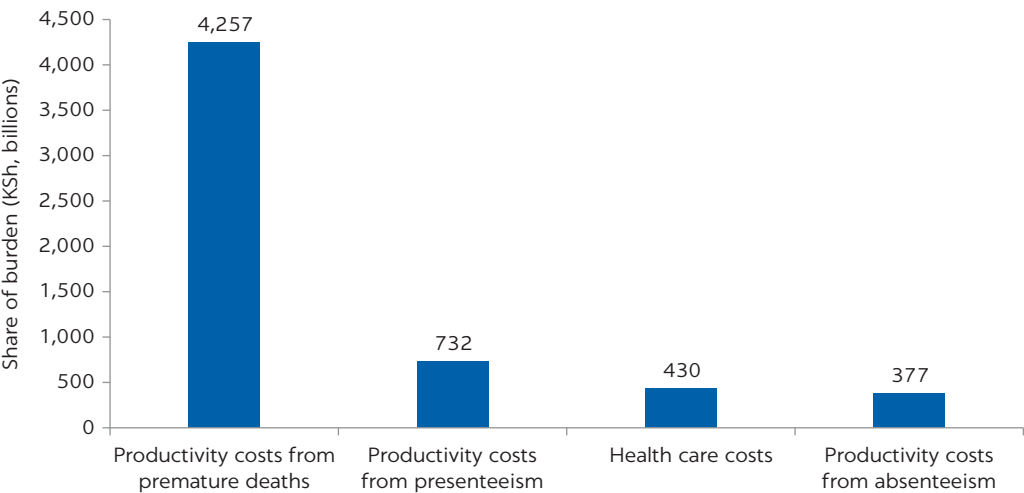
Direct economic losses due to health care expenditures account for KSh 430 billion, representing 74 percent of the total NCD burden. Government is estimated to have covered KSh 147.3 billion of those health care expenditures, KSh 132.7 billion was covered by households and individuals in out-of-pocket expenses, and the remainder by donors and other sources.¹ The indirect costs of NCDs—defined as the sum of the productivity loss due to premature deaths, absenteeism and presenteeism—constitute the largest share of total losses (93 percent). Figure 4.2 shows losses by source.

FIGURE 4.1
The cumulative economic burden of seven noncommunicable diseases and conditions, 2017–30



Source: World Bank.
Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; KSh = Kenyan shilling.

FIGURE 4.2
Total economic burden from noncommunicable diseases



Source: World Bank.
Note: KSh = Kenyan shilling.

SCALE UP OF INTERVENTION COVERAGES TO TARGET NCDs

This section presents the impact of scaling up clinical interventions that address breast cancer, cervical cancer, COPD, and CVD. Single interventions and policy measures that target a particular disease or risk factor are bundled together as “packages” within the analysis. For instance, each of the interventions addressing breast cancer—awareness, screening by clinical breast exam and mammography, and treatment of stage I–IV cancer—are analyzed together and named the “breast cancer package.”

The costs of implementing the policy measures and interventions, and the resulting health and economic benefits are discussed below. Appendix E presents results from a sensitivity analysis.

HEALTH BENEFITS OF THE INTERVENTIONS

In order to assess the health benefits from scaling up NCD interventions, this study examined the number of lives saved by a package of interventions, and the number of healthy life years gained.

Scaling up interventions to treat the four conditions would save nearly 110,000 lives over the period 2016–30, or about 7,860 deaths per year as shown in table 4.1. The CVD package provides the largest health impact, saving nearly 89,000 lives. These lives saved are mediated through avoided CVD events, controlled through better management of risk factors like high blood pressure and high cholesterol.

Together the packages of interventions restore nearly 811,000 healthy life years to the population, which results from the interventions' ability to improve quality of life. Implementing the COPD package would result in the highest number of healthy life years gained (540,588), followed by CVD (236,988), cervical cancer (20,560), and breast cancer (12,720).

COSTS AND ECONOMIC BENEFITS FROM SCALING UP THE INTERVENTION PACKAGES

By investing KSh 142 billion from 2016 to 2030 to scale up all of the clinical interventions targeting breast cancer, cervical cancer, COPD, and CVD, Kenya can generate KSh 175 billion in savings or about KSh 12.5 billion per year on average. Every Kenyan shilling invested is expected to generate 1.23 shillings in return.

As presented in table 4.2, the CVD package of interventions drives the return on investment—it is the only package with a return on investment (ROI) greater than one—generating 86 percent of the total productivity benefits, while representing only 43 percent of the costs of all of the packages. In the longer term, scaling up interventions for CVD is not only efficient, but the country gets back almost twice the cost of its interventions in productivity gains.

TABLE 4.1 Health benefits from scaling up noncommunicable disease interventions

Coverage at 80 percent (KSh, millions)

PACKAGE	NUMBER OF LIVES SAVED		HEALTHY LIFE YEARS GAINED	
	SHORT TERM (2016–22)	LONG TERM (2016–30)	SHORT TERM (2016–22)	LONG TERM (2016–30)
CVD	15,578	88,676	22,221	236,988
Breast cancer	893	5,245	1,300	12,720
Cervical cancer	1,229	7,840	2,018	20,560
COPD	1,378	8,140	88,031	540,588
Total	19,078	109,901	113,570	810,856

Source: World Bank.

Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; KSh = Kenyan shilling.

TABLE 4.2 Estimated return on investment for scaling up interventions for four selected noncommunicable diseases

	SHORT-TERM IMPACT (2016–22)			LONG-TERM IMPACT (2016–33)		
	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI
Breast	3,324	1,815	0.55	16,098	9,195	0.57
Cervical	2,903	1,776	0.61	12,422	9,099	0.73
COPD	12,010	886	0.07	52,061	4,832	0.09
CVD	14,081	28,708	2.04	61,242	151,904	2.48
Total	32,318	33,185	1.03	141,824	175,030	1.23

Source: World Bank.

Note: Breast = breast cancer; Cervical = cervical cancer; COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; KSh = Kenyan shilling; ROI = return on investment.

The ROIs for the cancer interventions are lower than 1. This means in the 15-year period used in this investment case analysis, the return to the government from implementing cancer screening and treatment does not pay itself back. This is unsurprising for two reasons. First, cancer manifests over a long time period and often is not detected until many years after a carcinogenic exposure or otherwise later in life. The investments in prevention and early diagnosis will provide long term returns and can be expected to break even over a longer time period. While the returns to the cancer packages take longer to manifest, they represent significant opportunities to advance Kenyans' right to health by working to prevent cancer altogether or to preclude advancement to late stages that can devastate individuals, especially women, and families.

Second, cancer interventions are more costly than those for other diseases and the prevalence is low enough in the population that fewer cases are prevented compared to CVD or COPD during this time period. It is worth noting that NCD prevention interventions often show much higher ROI than treatment interventions due to lower cost of prevention. By design, those prevention interventions are not a part of this investment case. However, as mentioned above, Kenya is implementing its new National Cancer Control Strategy, including scaling up HPV screening, testing and vaccination as well as breast cancer screening.² This implies that ROI for the stated cancer interventions will continue to improve.

Finally, the COPD interventions offer large morbidity benefits, restoring over 540,000 healthy life years to the population. However, the ROI analysis only valued the ability of interventions to prevent premature mortality. The COPD interventions did not save a sufficient number of lives to provide an economic argument for action in this analysis, but a different analysis that takes into account the ability of COPD interventions to improve individuals' functioning may conclude differently.

Appendix E presents results from a sensitivity analysis that varied coverage rates of interventions, and discount rates.

NOTES

1. To calculate the share of health care expenditure savings for public, nonprofit, and private entities, the investment case assumes that savings accrue to each entity in equal proportion to its contribution to total health expenditure, as obtained from the WHO health expenditures database—from which government is shown to cover 34.3 percent of total health expenditures, households cover 30.9 percent through out-of-pocket expenditures, donors cover 23.4 percent, with the remainder attributable to other sources.
2. Personal communication with Dr. Mary Nyangasi, head of the cancer control program in the Kenya Ministry of Health NCD department, October 2019.

5 Discussion and Policy Recommendations

This noncommunicable disease (NCD) Investment Case shows that NCDs cause significant health and economic harms. In 2017, over 111,000 Kenyans lost their lives due to NCD-related causes, 51 percent of which were attributable to the seven conditions considered in the investment case. Annually, these seven NCD conditions cost Kenya's economy approximately KSh 230 billion or 3 percent of gross domestic product (GDP). Economic losses due to these NCD conditions are projected to increase to KSh 607 billion annually by the year 2030 if Kenya does not take action.

However, the burden of NCDs can be reduced. Scaling up coverage of clinical interventions that target breast cancer, cervical cancer, COPD, and CVD would do the following:

- Save Kenyan lives and restore healthy life years. Kenya would avert nearly 110,000 deaths over the period 2016 to 2030 from scaling up interventions for breast cancer, cervical cancer, COPD and CVD. About 89,000 (81 percent) of the lives saved occur because individuals avoid deaths caused by CVD, emphasizing the need for Kenya to invest in measures to control the onset and management of CVD events, especially by managing risk factors like high blood pressure, high cholesterol, and obesity.
- Generate KSh 175 billion in economic benefits. These economic benefits derive from reducing premature mortality, which ensures that individuals remain alive and healthy enough to continue to contribute their skill and ability to the economy.

By reducing the NCD burden, Kenya can increase economic productivity and human capital development as envisioned in Vision 2030. This finding is important when viewed within the lens of missed opportunities for wealth creation and human capital formation. At the household level, the catastrophic expenditures associated with NCD treatment result in high out of pocket payments, which create opportunity costs in areas like education, further eroding efforts to accelerate investments in human capital formation.

While the investment case primarily focused on health facility-based interventions to treat already existing cases of disease or risk factors, primary prevention efforts should be considered to prevent disease from occurring in the

first place. Policy measures—increasing tobacco taxes, restricting the availability of alcohol by limiting the locations and hours of sale, legislating that food products display labels to warn about high salt, sugar, and fat content—have an essential role to play in NCD prevention. The World Health Organization has identified highly cost-effective interventions to reduce demand for tobacco and alcohol and improve diets and physical activity levels. There is considerable scope for the design and implementation of policies and programs aimed at behavior change, particularly among youth and adolescents.

This investment case provides evidence that can guide policy decisions related to NCDs. We therefore propose the following key actions that the government can take to tackle NCDs:

1. *Invest in scaling up interventions for NCDs, drawing on economic and efficiency analyses to inform the prioritization of the allocation of scarce resources.* The investment case analysis shows that the package of CVD interventions is economically efficient and offers a return on investment (ROI) over the next 15 years, while investments in the cancer and COPD packages have ROIs lower than one. Given that CVD presents the highest burden of any condition analyzed in the investment case, and that the CVD interventions generate clear health and economic benefits, Kenya could prioritize scaling up the CVD interventions analyzed in this investment case. This could begin with expanding access to preventative services to address CVD risk factors, such as hypertension and hyperlipidemia. Despite offering lower economic returns, other conditions should not be neglected given the huge economic burden that all the NCDs impose on the country. Health is a human right; investing in scaling up interventions that address all NCDs creates an opportunity for all people to pursue their full potential.
2. *Increase NCD resource allocation by the Government of Kenya, and other national and international partners.* By investing KSh 142 million in NCD treatment now, Kenya would save KSh 175 billion in economic losses from poor health over 15 years. Kenya should analyze how to mobilize the resources required to fund this investment and may consider win-win strategies—such as increasing (or implementing) taxes on tobacco, alcohol, and sugar-sweetened beverages—that synergistically achieve health aims while also generating revenue.
3. *Prioritize and sustain efforts on prevention and health promotion.* Although the investment case primarily focused on clinical interventions, the results point to the importance of tackling NCD risk factors and investing in health promotion—basically interventions that prevent, halt, or delay the progression of disease. NCDs share modifiable risk factors (tobacco smoking, unhealthy diet, physical inactivity, and harmful consumption of alcohol), which, when tackled, can prevent, halt, or delay the progression of disease. Interventions to screen for and quickly manage metabolic risk factors, such as high blood pressure, high cholesterol, high fasting blood glucose, and obesity, will also delay the progression of disease, reducing the long-term costs of treatment. Investing in health promotion and primary prevention is thus a strategic approach to minimizing the costs of NCDs. Though further research on the benefits of such interventions in Kenya in relation to their costs is much needed, the World Health Organization (WHO) has identified a set of intervention “best buys” that could provide useful guidance. There is also

considerable scope for the design and implementation of policies and programs aimed at behavior change, particularly among youth and adolescents.

4. *Continue investment in NCD control through Universal Health Coverage (UHC), delivering on the Big Four agenda.* By providing accessible, responsive, and inclusive health services that engage all population groups, and especially those who are the most vulnerable, no one is left behind. Moreover, inclusion of NCD prevention services can reduce future catastrophic health expenditures, protecting individuals from poverty. Both the quantity and quality of health services should be considered. Investments in NCD control should be well coordinated with all health system stakeholders to create synergies in the delivery of care and ensure that health service delivery is not fragmented programmatically (noncommunicable versus communicable disease care). UHC services should also prioritize preventative interventions to maximize health service delivery benefits.
5. *Plan additional economic analysis of interventions addressing NCDs.* As indicated earlier, population level interventions have been proven to offer a high return for investment. Further prioritization and economic analysis of these interventions is needed, especially given their high potential impact. In addition, the investment case did not analyze interventions addressing two diseases (diabetes and sickle cell disease) and one condition (road traffic injuries) that were included in the cost-of-illness analysis. Analysis of additional diseases and conditions would provide a more comprehensive picture of options for prioritizing and controlling NCDs and injuries. Finally, updating the current analysis of cancer and COPD interventions with additional information may produce different results. The ROI analysis did not place a monetary value on the decreases in disease morbidity that result from clinical interventions. Including this component in future analyses would provide more equal weighting to interventions such as those for COPD, which have a larger impact on disease morbidity than mortality.

APPENDIX A

Institutional Context

Enabling factors for successes in noncommunicable disease (NCD) control in Kenya include the formation of a dedicated NCD department in the ministry of health, increased number of stakeholders and increasing research on NCDs. An NCD interagency coordinating committee (ICC) was formed to address the multisectoral response to NCDs. Strong support from Parliament and the President for the Universal Health Care agenda has provided additional impetus for prevention and control of NCDs.

Kenya faces an important challenge in effectively translating national ambitions into practice. The Kenya Constitution 2010 devolved health services to the 47 counties giving them a greater role in planning, allocating resources and implementing programs tailored to their needs. This had increased the demand of health services with resultant challenges in the dissemination and enforcement of policies to the lower level facilities, coordination of health services and ensuring constant supply of NCD medicines and diagnostics. The delivery of preventative services, such as screening and chronic care models and data capture, remain limited as the health system continues to emphasize treatment for communicable diseases. Late detection of cases and limited options combined with high costs for treatment of NCDs is common. For example, 70 percent of cancer patients presenting at health facilities are in advanced stages of illness, stages III and IV with high probability of death. The high cost of treatment for advanced cases also limits health seeking behavior in the population. As a result, there remains a persistent gap between need and actual delivery of NCD care. The treatment gaps—the percentage not receiving treatment—for selected NCDs are chronic obstructive pulmonary disease (87 percent); diabetes (69 percent); cervical cancer (64 percent); cardiovascular disease (60 percent); and breast cancer (57 percent).

The Kenya Service Availability and Readiness Assessment Mapping report 2013 showed that NCD tracer commodities were among the least available products (Ministry of Health, Government of Kenya 2014). Only 25 percent of primary health care facilities and 32 percent of hospitals had NCD tracer commodities available. Availability of key medications and readiness of NCD services was limited despite their inclusion in the Kenya Essential Package for Health (KEPH). In 2013, only 4.9 percent of facilities were providing all KEPH services required to halt and reverse the rising burden of NCDs, with dispensaries and public facilities having the highest proportion of facilities providing all of their expected services. NCD screening and rehabilitation were the least available service.

The Kenya Non-Communicable Diseases and Injuries Poverty Commission's 2018 report found that services for basic NCDs and injuries are lacking, particularly in poorer regions and in the public sector. Coverage of basic NCD

and injuries, such as diagnosis and treatment of hypertension and diabetes or cancer screening is low and is inversely related to wealth. This report showed that access to screening for both hypertension and diabetes was associated with wealth quintile, with progressively higher proportions never previously screened with increasing poverty level. This was also seen when comparing urban and rural areas with a higher proportion of individuals never previously screened in rural areas for both hypertension (60.7 percent vs. 48.1 percent) and diabetes (89.6 percent vs. 84.8 percent). Of those patients found to have hypertension, access to treatment was associated with wealth quintile, with poorer populations less likely to be on treatment.

Other challenges associated with NCD prevention and control in Kenya include (1) limited funding to NCDs in the health sector with poor prioritization of NCD prevention and control in government agenda setting—planning and budgeting at both national and county level; (2) low levels of awareness of NCDs and their risk factors in the population; (3) lack of an NCD prevention and control infrastructure at the county level to coordinate planning, programming, monitoring and evaluation; (4) limited resources for public health initiatives to raise awareness of and promote healthy lifestyles in the prevention and control of priority NCDs; (5) unavailability of quality data due to poor capture and reporting of NCD-related indicators in the District Health Information System and limited population level data on NCD-related morbidity and mortality trends; (6) low levels of awareness of NCD prevention and control strategies among health policy makers, planners, and health care providers; and (7) poor coordination mechanisms to handle NCDs efforts by the various sectors outside health.

APPENDIX B

Data Sources

TABLE B.1 Summary of data sources for inputs to the cost-of-illness analysis

VARIABLE	MEASUREMENT	SOURCES
Total in need population	Total number of people with a given NCD condition in a given year.	OneHealth Tool and IHME Global Burden of Disease (GBD)
Coverage target	The percentage of population that is provided with a given service in each year per NCD disease or condition.	Kenya NCDI Poverty Commission
Cases treated	Actual numbers based on population in need and coverage targets.	OneHealth Tool and IHME GBD
Salaries and allowances	Total average annual salary and allowances per cadre in the public health sector in 2016.	Kenya Ministry of Health
Prices of drugs, reagents and supplies	Prices in KSh for these inputs in 2016.	OneHealth Tool and Kenya Medical Supplies Authority
Patient transport cost	Average transport cost in KSh incurred by patients when seeking NCD service.	Literature
Overhead cost	Cost of utilities, administration and other staff (excluding doctors, nurses, pharmaceutical technologists, laboratory technologist and technicians, radiographers/X-ray technicians).	Dynamic Costing Model (Kenya)
Contact time	Time it takes, in minutes, a doctor or a nurse or any other staff involved in screening, diagnoses and treatment to serve one patient during an outpatient visit or an inpatient day.	Expert opinion, literature and OneHealth tool
GDP at market prices	Annual value in KSh for each year from 2016 to 2030.	Kenya National Bureau of Statistics (KNBS) and the National Treasury for projections
Labor force participation rate	Rate for men = 72.4 percent, 62.4 percent for women, and an average of 67.3 percent. Rates were maintained constant from 2016 to 2030.	International Labour Organization
Employment rate	Rate for men = 91 percent, rate for women = 87 percent, average rate for both = 89 percent	World Bank
Mortality	Number of deaths per disease or condition for each year.	World Bank estimation for sickle cell and road injuries using literature and OneHealth Tool for other conditions. IHME Global Burden of Disease also used.
Absenteeism	Measured as fraction of working time lost as a result of being sick and the resulting disability associated with the disease/condition.	Literature
Presenteeism	Measured as percentage of output per worker lost to relatively lower productivity attributed to the disease or condition.	Literature
Output per worker	Average gross domestic product per worker.	KNBS, Economic Survey 2017, National Treasury.
Coverage target	The percentage of population that is provided with services in each year per disease or condition.	Kenya NCDI Poverty Commission
Cases treated	Actual numbers based on population in need and coverage targets.	OneHealth Tool and GBD

Source: World Bank.

Note: IHME = Institute for Health Metrics and Evaluation; KSh = Kenyan shilling; NCD = noncommunicable disease; NCDI = Non-Communicable Diseases and Injuries.

APPENDIX C

Treatment Gaps in the Different Conditions

TABLE C.1 Treatment gaps in status quo and scale up scenarios

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Diabetes management	Population in need	751,861	772,415	793,668	815,493	837,868	860,786	884,247	908,259	932,834	957,984	983,725	1,010,076	1,037,050	1,064,653
	Status quo coverage	235,536	241,975	248,633	255,470	262,480	269,659	277,009	284,531	292,230	300,109	308,173	316,428	324,878	333,525
	Scale up coverage	235,536	270,084	306,399	344,501	384,445	426,285	470,083	515,901	563,807	613,870	666,164	720,766	777,754	837,200
	Gap with status quo	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%
	Gap with scale up	69%	65%	61%	58%	54%	50%	47%	43%	40%	36%	32%	29%	25%	21%
COPD: Inhaled salbutamol	Population in need	525,836	544,700	559,338	579,518	595,127	616,573	633,196	655,981	673,686	697,895	716,747	742,451	762,490	789,738
	Status quo coverage	84,134	100,380	116,662	134,945	153,033	173,521	193,577	216,474	238,677	264,203	288,747	317,132	344,210	375,690
	Scale up coverage	84,134	87,152	89,494	92,723	95,220	98,652	101,311	104,957	107,790	111,663	114,679	118,792	121,998	126,358
	Gap with status quo	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%
	Gap with scale up	84%	82%	79%	77%	74%	72%	69%	67%	65%	62%	60%	57%	55%	52%
CVD (all interventions in the investment case)	Population in need	2,473,154	2,570,818	2,676,065	2,788,093	2,906,250	3,029,872	3,158,979	3,292,934	3,431,270	3,573,448	3,718,964	3,867,730	4,018,780	4,170,801
	Status quo coverage	997,816	1,037,000	1,079,238	1,124,224	1,171,689	1,221,356	1,273,242	1,327,091	1,382,713	1,439,894	1,498,431	1,558,295	1,619,097	1,680,310
	Scale up coverage	997,816	1,109,366	1,229,951	1,359,831	1,499,236	1,648,317	1,807,546	1,977,006	2,156,810	2,346,973	2,547,471	2,758,519	2,979,669	3,210,100
	Gap with status quo	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
	Gap with scale up	60%	57%	54%	51%	48%	46%	43%	40%	37%	34%	32%	29%	26%	23%
Sickle cell	Population in need	60,429	62,047	63,718	65,435	67,199	69,011	70,872	72,784	74,748	76,766	78,839	80,966	83,150	85,388
	Status quo coverage	6,043	6,205	6,372	6,543	6,720	6,901	7,087	7,278	7,475	7,677	7,884	8,097	8,315	8,539
	Gap with status quo	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%

continued

TABLE C.1, continued

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Breast cancer— status quo	Stage I and II	2,042	2,123	2,208	2,298	2,391	2,493	2,596	2,703	2,816	2,932	3,054	3,181	3,311	3,446
	Stage III and IV	2,740	2,848	2,979	3,117	3,252	3,394	3,535	3,681	3,832	3,991	4,157	4,330	4,511	4,697
	Total cases	4,782	4,971	5,187	5,415	5,643	5,887	6,131	6,384	6,648	6,924	7,212	7,511	7,822	8,143
Breast cancer— scale up	Stage I and II	2,042	2,267	2,506	2,760	3,027	3,315	3,616	3,935	4,272	4,628	5,006	5,405	5,826	6,270
	Stage III and IV	2,740	2,762	2,785	2,793	2,776	2,744	2,690	2,620	2,535	2,437	2,325	2,198	2,058	1,903
	Total cases	4,782	5,029	5,291	5,553	5,804	6,059	6,306	6,555	6,807	7,065	7,331	7,603	7,884	8,174
Breast cancer	Gap with status quo	57%	57%	57%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%
	Gap with scale up	57%	55%	53%	50%	48%	45%	43%	40%	37%	34%	32%	29%	26%	23%
Cervical cancer— status quo	Stage I and II	1,788	1,889	1,994	2,104	2,217	2,335	2,458	2,585	2,717	2,854	2,996	3,144	3,295	3,450
	Stage III and IV	3,148	3,325	3,511	3,703	3,902	4,109	4,325	4,548	4,780	5,021	5,271	5,529	5,795	6,068
	Total cases	4,936	5,214	5,505	5,807	6,120	6,445	6,783	7,133	7,498	7,876	8,267	8,673	9,090	9,518
Cervical cancer— scale up	Stage I and II	1,788	2,055	2,344	2,656	2,991	3,351	3,738	4,153	4,597	5,071	5,577	6,117	6,689	7,294
	Stage III and IV	3,148	3,121	3,087	3,047	2,998	2,943	2,879	2,807	2,726	2,636	2,536	2,427	2,305	2,171
	Total cases	4,936	5,175	5,431	5,702	5,989	6,294	6,617	6,960	7,323	7,707	8,114	8,544	8,994	9,465
Breast cancer	Gap with status quo	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%
	Gap with scale up	64%	60%	57%	53%	50%	47%	44%	40%	37%	34%	31%	28%	26%	23%

Source: World Bank.

Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease.

APPENDIX D

Details of Economic Burden by Condition

TABLE D.1 Summary economic burden, by disease or injury

Kenyan shillings, billions

	BREAST CANCER	CERVICAL CANCER	SICKLE CELL	DIABETES	COPD	CVD	TRAFFIC ACCIDENT INJURIES	TOTAL
2016	6.7	6.8	0.7	38.2	33.2	116.3	28.5	230.4
2017	7.0	7.3	0.7	40.3	34.9	123.8	30.7	244.9
2018	7.4	7.9	0.8	42.9	36.8	132.4	32.4	260.6
2019	8.0	8.7	0.8	45.7	39.1	142.1	34.2	278.6
2020	8.6	9.5	0.9	48.9	41.7	153.1	36.3	298.9
2021	9.3	10.4	0.9	52.2	44.5	164.8	38.5	320.7
2022	10.0	11.3	1.0	55.8	47.6	177.3	40.8	343.9
2023	10.7	12.3	1.1	59.6	50.9	190.6	43.2	368.4
2024	11.5	13.4	1.1	63.6	54.5	204.8	45.8	394.7
2025	12.3	14.5	1.2	67.9	58.5	220.4	48.5	423.3
2026	13.1	15.7	1.3	72.5	62.8	237.3	51.4	454.1
2027	14.0	17.0	1.4	77.4	67.5	255.4	54.4	487.1
2028	14.9	18.4	1.4	82.6	72.6	275.0	57.6	522.5
2029	15.9	19.8	1.5	88.2	78.1	296.1	61.0	560.6
2030	22.1	21.4	1.6	94.2	84.0	318.8	64.6	606.7
Total	171.5	194.5	16.5	929.9	806.7	3,008.3	668.0	5,795.3

Source: World Bank calculations.

Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease.

TABLE D.2 Economic burden of noncommunicable diseases and injuries, by cost type

Kenyan shillings, billions

	HEALTH CARE COSTS	PRODUCTIVITY COST OF PREMATURE DEATHS	PRODUCTIVITY COST OF ABSENTEEISM	PRODUCTIVITY COST OF PRESENTEEISM	TOTAL
COPD	37.9	314.0	142.1	312.7	806.7
CVD	123.6	2,502.1	111.6	271.1	3,008.3
Breast	44.1	123.8	2.1	1.5	171.5
Cervical	64.9	126.2	2.0	1.3	194.5
Diabetes	111.8	600.0	72.4	145.7	929.9
Sickle	1.5	3.1	11.9	—	16.5
Injuries	46.1	587.5	34.4	—	668.0
Total	429.9	4,256.7	376.5	732.2	5,795.3

Source: World Bank calculations.

Note: Breast = breast cancer; Cervical = cervical cancer; COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; Sickle = sickle cell disease; — = not available.

APPENDIX E

Sensitivity Analysis

A sensitivity analysis is performed to assess if the results of the economic burden and the return on investment (ROI) would change significantly when underlying assumptions are varied. The sensitivity analysis is carried at two levels: first, by varying the end line target coverage rates from 80 percent to 70 percent and to 90 percent, and second, by changing the discount rate from 6.5 percent to 5 percent and to 8 percent. In all the scenarios constant or real values of the costs and productivity were used, with 2016 as the base year. Tables E.1 and E.2 show the sensitivity of the ROI with respect to the change in the end line coverage at 70 percent and 90 percent, respectively, while maintaining the discount rate at 6.5 percent.

The results in table E.1 show that the ROI is not sensitive to change in intervention coverage. Reducing coverage from 80 percent to 70 percent in 2030

TABLE E.1 Estimated return on investment for scaling up interventions

70 percent coverage in 2030

	SHORT-TERM IMPACT (2016–22)			LONG-TERM IMPACT (2016–30)		
	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI
CVD	11,265	22,707	2.02	48,994	123,984	2.53
Breast	2,739	1,454	0.53	13,382	7,239	0.54
Cervical	2,241	1,521	0.68	9,554	8,314	0.87
COPD	9,533	668	0.070	41,314	3,653	0.088
Total	25,777	26,350	1.02	113,244	143,191	1.26

Source: World Bank.

Note: Breast = breast cancer; Cervical = cervical cancer; COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; KSh = Kenyan shilling; ROI = return on investment.

TABLE E.2 Estimated return on investment for scaling up interventions

90 percent coverage in 2030

	SHORT-TERM IMPACT (2016–22)			LONG-TERM IMPACT (2016–30)		
	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI
CVD	16,897	30,652	1.81	73,490	160,696	2.19
Breast	3,579	2,186	0.61	17,191	11,250	0.65
Cervical	6,073	2,558	0.42	29,830	14,317	0.48
COPD	13,858	889	0.064	60,077	4,841	0.081
Total	40,408	36,285	0.90	180,589	191,104	1.06

Source: World Bank.

Note: Breast = breast cancer; Cervical = cervical cancer; COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; KSh = Kenyan shilling; ROI = return on investment.

TABLE E.3 Estimated return on investment for scaling up interventions*80 percent coverage in 2030 and 5 percent discount rate*

	SHORT-TERM IMPACT (2016–2022)			LONG-TERM IMPACT (2016–2030)		
	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI	TOTAL COST (KSh, MILLIONS)	TOTAL PRODUCTIVITY BENEFITS (KSh, MILLIONS)	ROI
CVD	14,965	33,567	2.24	70,006	191,916	2.74
Breast	3,533	2,091	0.59	18,471	11,444	0.62
Cervical	3,084	2,348	0.76	14,193	14,050	0.99
COPD	12,763	1,009	0.079	59,509	5,956	0.100
Total	34,346	39,015	1.14	162,180	223,366	1.38

Source: World Bank.

Note: Breast = breast cancer; Cervical = cervical cancer; COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease; KSh = Kenyan shilling; ROI = return on investment.

leads to modest reduction in ROI for cardiovascular disease (CVD), cervical cancer, chronic obstructive pulmonary disease (COPD). On the other hand, as shown in table E.2, the ROI remained stable even with increased coverage from 80 percent to 90 percent by 2030. For instance, the ROI on CVD reduces from 2.48 to 2.19 in the longer term. The ROI on breast cancer, cervical cancer and COPD follows the same pattern.

The sensitivity results for ROI with a discount rate of five percent as opposed to the 6.5 percent that was used in the scale up scenario are presented in table E.3.

Table E.3 shows that by decreasing the rate of discounting future costs and benefits, the effect is to increase the ROI for all interventions. This notwithstanding, the results show that the benefits continued to exceed cost for CVD, but for breast cancer, cervical cancer and COPD are below one, where costs outweighed productivity benefits. Overall, these results show that change of the discount rate did not significantly affect the ROI.

APPENDIX F

Technical Appendix

COI ANALYSIS: PROJECTING THE HEALTH BURDEN

Projections of prevalence of—and mortality from—seven diseases and conditions are calculated to estimate the health burden of each from 2016 to 2030.

For breast cancer and cervical cancer, cardiovascular disease (CVD), chronic obstructive pulmonary disorder (COPD), and diabetes estimates are obtained from the OneHealth Tool (OHT), under the assumption that current coverage rates of interventions to address each disease do not change over the period of the analysis. For road traffic injuries (RTI) and sickle cell disease, estimates are calculated manually in Excel using information obtained from published literature.

OneHealth Tool: Projecting mortality and morbidity of five diseases

The OHT contains PopMod, a collection of multistate dynamic population lifetables that project the extent to which the population experiences health events and the likelihood of death, considering competing risk among diseases, and existing prevention, treatment, and control efforts. PopMod is described elsewhere (Lauer et al. 2003).

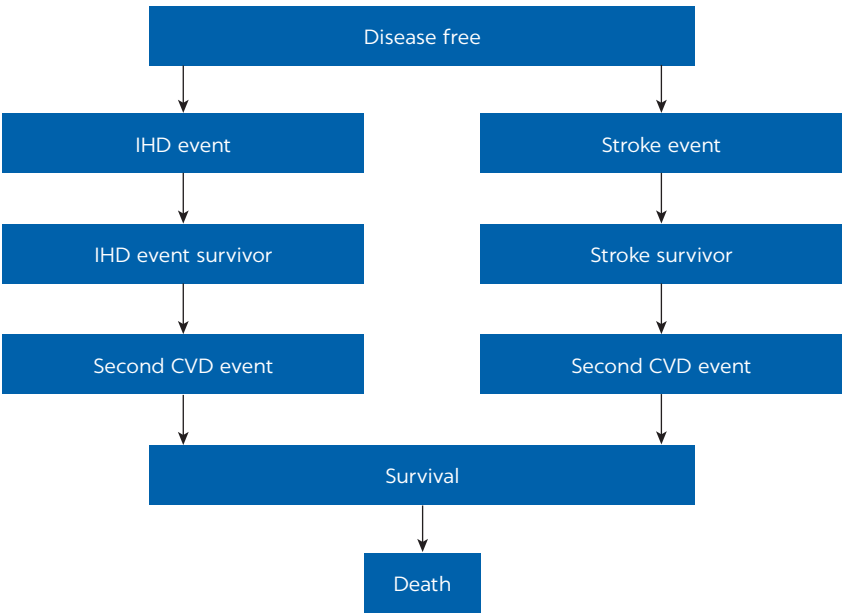
Within the OHT, PopMod is linked to platforms built for breast cancer, cervical cancer, CVD, COPD, and diabetes. Each contains health states specific to the disease. For example, figure F.1 shows health states for CVD; figure F.2 shows health states for COPD; and figure F.3 shows health states for diabetes. Using prevalence data from the 2010 Global Burden of Disease (GBD) study (Lozano et al. 2012), PopMod divides the population among disease health states, and places the remaining population in the “disease free” state. Over time, individuals may experience events that transition them from one health state to another (for example, a previously disease-free healthy person may have a stroke). Baseline rates of transition between health states, and the likelihood of survival or death are sourced from the 2010 GBD study. The OHT reports prevalence rates of each disease, and the number of deaths that occur in a given year.

Estimating mortality and morbidity of sickle cell disease and road traffic injuries

Sickle cell disease

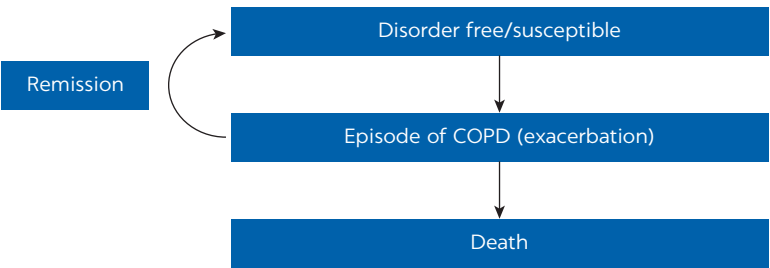
Projections of sickle cell disease are made assuming that the rate of 2.5 cases per 100,000 population holds steady as the population increases over the time horizon

FIGURE F.1
Health states within the impact module’s cardiovascular disease platform



Source: World Bank.
Note: Individuals may transition to death from any health state. CVD = cardiovascular disease; IHD = ischemic heart disease.

FIGURE F.2
Health states within the impact module’s chronic obstructive pulmonary disease platform

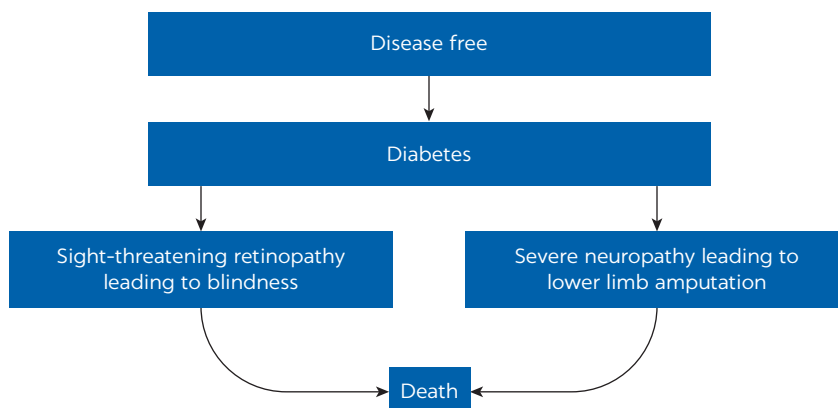


Source: World Bank.
Note: Individuals may transition to death from any health state. COPD = chronic obstructive pulmonary disease.

of the analysis. In each year for which deaths due to sickle cell are projected, 17 percent of deaths are assumed to be adults, based on a study from Tanzania (Makani et al. 2011). Population projections are obtained using the OHT.

Road traffic injuries

Data from Kenya National Safety Authority (NTSA)—on both serious and minor injuries in 2016 and 2017—was used to compute a ratio of about 38 RTI per 100,000 people. This ratio was applied to growing population rates over the time horizon of the analysis. The resulting number was then divided into serious and minor injuries using data from NTSA.

FIGURE F.3**Health states within the impact module's diabetes platform**

Source: World Bank.

Note: Individuals may transition to death from any health state.

Mortality from RTI was originally estimated using data from the Institute for Health Metrics and Evaluation's GBD study, where a regression analysis was employed to analyze data from 1995 to 2016. The resulting coefficients of intercept and time trend variable was applied to project mortality from 2016 to 2030. These projections were compared to estimates from a systematic review conducted by Adeloye et al. (2016), which found that RTIs cause about 9.3 deaths per 100,000 people in Africa. This rate was similar to that found in the regression analysis. Hence, the rate of 9.3 deaths per 100,000 population was used, applying the rate to OHT population projections through 2030.

COST-OF-ILLNESS ANALYSIS: CALCULATING DIRECT AND INDIRECT COSTS

Direct costs of screening, diagnosis, and treatment

The investment case uses the UN interagency OHT, academic literature, and expert opinion to estimate the resources required to screen, diagnose, or treat patients.

Data on individual cost components is drawn from various sources. Salaries of health personnel are given by the Kenya Ministry of Health. Prices of medications, reagents, and supplies are given by the Kenya Medical Supplies Authority and default data embedded in the OHT. Overhead costs—inclusive of utilities, administration and other nonhealth staff—are given by a dynamic costing model developed for Kenya. The amount of time each doctor, nurse, or other type of staff member spends with a patient to perform a given task or treatment is estimated from expert opinion, academic literature, and resource estimates embedded in the OHT.

Drawing from these estimates of resources and costs, tables F.1 and F.2 show the calculated per person treatment cost of each intervention.

TABLE F.1 Per person cost of screening, diagnosis, and treatment of noncommunicable diseases*Kenyan shillings*

BREAST CANCER	DRUGS, SUPPLIES, REAGENTS	LABOR	OVERHEAD	PATIENT TRANSPORT	TOTAL UNIT COST
Diagnosis: screened with clinical breast exam	53,231	21,432	1,786	1,000	77,449
Diagnosis: screened with mammogram	50,962	14,288	1,786	1,000	68,036
Breast cancer treatment: stage I	115,900	11,182	82,168	32,000	241,250
Breast cancer treatment: stage II	149,788	20,351	82,168	32,000	284,307
Breast cancer treatment: stage III	162,950	20,351	119,680	39,000	341,981
Breast cancer treatment: stage IV	108,875	12,487	92,886	24,000	238,248
CERVICAL CANCER	DRUGS, SUPPLIES, REAGENTS	LABOR	OVERHEAD	PATIENT TRANSPORT	TOTAL UNIT COST
Visual inspection with acetic acid (VIA)	259	185	272	200	916
Papanicolaou test (pap smear)	245	637	378	200	1,460
Biopsy and histopathology	1,859	649	2,589	1,000	6,097
Cryotherapy	6,248	611	262	300	7,421
Cervical cancer treatment: stage I	155,574	18,851	82,168	32,000	288,593
Cervical cancer treatment: stage II	174,476	19,610	82,168	32,000	308,254
Cervical cancer treatment: stage III	178,635	19,610	119,680	39,000	356,925
Cervical cancer treatment: stage IV	113,335	12,487	92,886	24,000	242,707
CVD AND DIABETES	DRUGS, SUPPLIES, REAGENTS	LABOR	OVERHEAD	PATIENT TRANSPORT	TOTAL UNIT COST
Screening for risk of CVD/diabetes	209	222	272	200	903
Treatment for those with very high cholesterol but low absolute risk of CVD/diabetes (< 20 percent)	1,472	1,004	1,088	800	4,364
Treatment for those with high blood pressure but low absolute risk of CVD/diabetes (< 20 percent)	899	1,004	1,088	800	3,791
Treatment for those with absolute risk of CVD/diabetes 20–30 percent	2,357	1,056	1,221	1,347	5,981
Treatment for those with high absolute risk of CVD/diabetes (>30 percent)	2,376	1,079	1,164	1,284	5,903
Treatment of new cases of acute myocardial infarction (AMI) with aspirin	3,731	6,268	5,448	8,000	23,447
Treatment of cases with established ischemic heart disease (IHD)	3,828	1,550	5,045	4,000	14,423
Treatment for those with established cerebrovascular disease and post stroke	3,828	3,067	5,993	7,000	19,888
Standard glycemic control (oral only)	5,262	1,805	1,090	800	8,957
Standard glycemic control (insulin)	39,075	1,805	1,090	800	42,770
Intensive glycemic control (weighted cost)	21,931	1,805	1,090	800	25,626
Retinopathy screening and photocoagulation	90				90
Neuropathy screening and preventive foot care	1,519				1,519

continued

TABLE F.1, *continued*

COPD	DRUGS, SUPPLIES, REAGENTS	LABOR	OVERHEAD	PATIENT TRANSPORT	TOTAL UNIT COST
Inhaled salbutamol	1,563	209	272	800	2,844
Low-dose oral theophylline	1,831	209	272	800	3,112
Ipratropium inhaler	2,778	209	272	800	4,059
Exacerbation treatment with antibiotics	38	209	272	800	1,319
Exacerbation treatment with oral prednisolone	318	209	272	800	1,599
Exacerbation treatment with oxygen	3,749	3,634	4,903	1,000	13,286
SICKLE CELL DISEASE	DRUGS AND SUPPLIES	LABOR	OVERHEAD	PATIENT TRANSPORT	TOTAL UNIT COST
Outpatient	6,220	835	1,088	800	8,943
Inpatient	8,315	10,658	14,298	2,500	35,770

Source: World Bank.

Note: COPD = chronic obstructive pulmonary disease; CVD = cardiovascular disease.

TABLE F.2 Per person cost of treatment for road traffic injuries, by severity

Kenyan shillings

COST CATEGORY	COST ITEM	AVERAGE COST
MINOR		
Direct/medical	Admission fees (average admission period = 3 days)	1,000 per day, hence 3,000
	Consultation fee	1,000
	Surgical care	5,000
	Analgesics	300
	Antibiotics	500
	Wound care	1,000
	Radiological investigations	2,000
	Total	12,800
MODERATE		
Direct/medical	Admission fees (average admission period = 10 days)	1,000
	Initial consultation fee	1,000
	Surgical care	
	Analgesics	1,000
	Antibiotics	1,000
	Radiological investigations/imaging	5,000
	Wound care	5,000
	Implants	45,000
	Rehabilitation	10,000
	Total	69,000
SEVERE		
Direct/medical	Admission fees (average admission period = 14 days)	1,000
	Initial consultation fee	1,000

continued

TABLE F.2, *continued*

COST CATEGORY	COST ITEM	AVERAGE COST
	Surgical care	20,000
	Analgesics	2,000
	Antibiotics	3,000
	Radiological investigations/imaging	20,000
	Advanced care (ICU, HDU etc.). On average patients may need intensive care for 3–5 days	5,000 daily, 25,000
	Implants	45,000
	Rehabilitation	20,000
	Wound care	10,000
	Total	147,000

Source: World Bank.

Note: HDU = high dependency unit; ICU = intensive care unit.

ROI ANALYSIS: DESCRIPTION OF CLINICAL INTERVENTIONS

TABLE F.3 Clinical interventions, by condition

CARDIOVASCULAR DISEASE	
CVD SECONDARY PREVENTION	
Treatment for individuals with high CVD risk (≥ 20 percent)	To lower the risk of stroke or acute myocardial infarction (MI), individuals with elevated metabolic risk factors for CVD receive pharmacological treatment—consisting of diuretics, ACE inhibitors, calcium channel blockers, statins, and lifestyle advice, alone or in combination.
Treatment for individuals with high blood pressure (≥ 140 mmHg), but low absolute CVD risk <20 percent	
Treatment for individuals with high cholesterol (≥ 6 mmol/L), but low absolute CVD risk <20 percent	
CVD CONTROL	
Treat new cases of acute myocardial infarction	Treatment for acute MI consists of immediate provision of aspirin.
Provide multidrug therapy to treat those with established ischemic heart disease and stroke	Treatments for cases of established stroke and IHD consist of multidrug therapy, including treatment with aspirin, beta blockers, thiazide, calcium channel blockers and ACE inhibitors.
CANCERS	
BREAST	
Screening: Clinical breast exam or mammography, with timely diagnosis	Breast cancer interventions focus on early diagnosis through scale up of annual clinical breast examinations or biannual mammography screenings (in women age 40–70), which shifts the stage in which women are identified to have cancer, improving survival rates. Once diagnosed, women receive stage-specific treatment (inclusive of surgery and/or systemic therapy, and hormone therapy).
Treatment of breast cancer stages I–IV	
CERVICAL	
Screening: Visual inspection with acetic acid (VIA), Pap test, or HPV DNA test, with timely diagnosis	Cervical cancer interventions focus on early diagnosis and treatment. Preventative efforts include screening of women age 30–49 (triennial for VIA and PAP tests, quinquennial for HPV tests) to identify cases of pre cancer. Treatment of pre cancer is conducted using cryotherapy or loop electrosurgical excision procedures. Women with cancer receive stage-specific treatment (inclusive of surgery and/or systemic therapy, and hormone therapy).
Treatment of cervical intraepithelial neoplasia using cryotherapy or loop electrosurgical excision procedure	
Treatment of cervical cancer stages I–IV	

continued

TABLE F.3, *continued*

CHRONIC OBSTRUCTIVE PULMONARY DISEASE	
FUNCTIONAL IMPROVEMENT	
Symptom relief using bronchodilators	To provide symptom relief and improve functioning, individuals with COPD receive pharmacological treatment consisting of short- or long-acting bronchodilators, including ipratropium, salbutamol, or theophylline.
ACUTE EXACERBATIONS	
Treatment of COPD exacerbations with antibiotics, prednisolone, or oxygen therapy	Acute exacerbations are treated according to cause and severity. Antibiotics treat lung inflammations triggered by viral infections. Prednisolone is prescribed to reduce inflammation. Oxygen therapy is administered in cases of hypoxia or to provide symptom relief.

Source: World Bank.

Note: ACE = angiotensin-converting enzyme; HPV = human papillomavirus.

ROI ANALYSIS: BASELINE AND TARGET COVERAGES OF INTERVENTIONS

TABLE F.4 Baseline and target coverages

Percent

	CURRENT COVERAGE IN KENYA (2016)	TARGET COVERAGE ^a (SCALE UP)	
		2022 (SHORT TERM)	2030 (MEDIUM TERM)
CERVICAL CANCER			
HPV DNA test	1	3	5
VIA	1	4	7
Pap smear	5	10	17
Biopsy and histopathology	13.5	15	18
Cervical cancer treatment: stage I	50	63	80
Cervical cancer treatment: stage II	55	66	80
Cervical cancer treatment: stage III	75	81	90
Cervical cancer treatment: stage IV	100	100	100
BREAST CANCER			
Screening: clinical breast examination	23	47	80
Screening: mammography	2	2.9	4
Breast cancer treatment: stage I	50	63	80
Breast cancer treatment: stage II	55	66	80
Breast cancer treatment: stage III	80	81	90
Breast cancer treatment: stage IV	100	100	100
CARDIOVASCULAR DISEASE			
Screening for risk of CVD/diabetes	30	51	80
Treatment for high cholesterol but low absolute risk of CVD/ diabetes (<20 percent)	30	51	80
Treatment for high blood pressure but low absolute risk of CVD/ diabetes (< 20 percent)	30	51	80

continued

TABLE F.4, *continued*

	CURRENT COVERAGE IN KENYA (2016)	TARGET COVERAGE ^a (SCALE UP)	
		2022 (SHORT TERM)	2030 (MEDIUM TERM)
Treatment for high absolute risk of CVD/diabetes (>30 percent)	30	51	80
Treatment of new cases of acute MI with aspirin	30	51	80
Treatment of cases with established ischaemic heart disease	30	51	100
Treatment for those with established cerebrovascular disease and post stroke	30	51	100
CHRONIC OBSTRUCTIVE PULMONARY DISORDER			
Inhaled salbutamol	15	43	80
Low-dose oral theophylline	15	43	80
lpratropium inhaler	15	43	80
Treatment of acute exacerbation with antibiotics	15	43	80
Treatment of acute exacerbation with oral prednisolone	15	43	80
Treatment of acute exacerbation with oxygen	15	43	80

Source: World Bank.

Note: Coverages represent the percent of the population in need that receives the intervention. The population in need varies by intervention. For instance, the population in need of a pap smear is women age 30–49, while the population in need of a biopsy is the women who test positive for precancer or cancer. CVD = cardiovascular disease; HPV = human papillomavirus; MI = myocardial infarction; VIA = visual inspection with acetic acid.

a. Target coverages are reflective of goals states by the Kenya Non-Communicable Diseases and Injuries Poverty Commission.

ROI ANALYSIS: INTERVENTION IMPACT

Effect sizes of interventions

Table F.4 lists the effect sizes of the interventions that are included in the analysis. The effect sizes are embedded in the OHT and are derived from academic literature.

The majority of the effect sizes represent changes in the rates that individuals move from one health state to another. The OHT applies these effect sizes to the populations that are reached by interventions, impacting transition rates of individuals between health states (see “COI analysis: Projecting the health burden” section). However, the remaining effect sizes—for interventions that target high CVD risk, high cholesterol, high blood pressure, and treatment for stroke or IHD survivors—act to reduce metabolic risk factors. For these interventions, the impact is mediated by a risk equation first published in a study by Ortégón et al. (2012) and detailed within the OHT NCD Module User guide. In this method, the change in the rates of transition from one CVD health state to another are:

modelled by stochastically simulating populations specific for age and sex with the observed baseline values of ischemic heart disease (IHD) and stroke incidence and the observed distribution of risk factors (systolic blood pressure, serum cholesterol, body mass index, and prevalence of long-term smokers). Incidence risk is apportioned between individuals using estimates of the relative risk of modelled risk factors on cardiovascular events. Population level incidence of IHD and stroke is recalculated after applying the impact of the interventions on the individual risk factor values for those receiving the intervention. (Ortégón et al. 2012, 3–4)

TABLE F.5 Effect sizes of clinical interventions that target breast cancer and cervical cancer

INTERVENTION	EFFECT SIZE	SOURCE
BREAST CANCER		
Biannual mammography screening (women age 50–69)	Sensitivity 0.76, Specificity 0.93	IARC 2016
Treatment of breast cancer stages I–IV	Percent reduction in mortality, by stage (I—95.7 percent, II—78.3 percent, III—59.6 percent, IV 46 percent)	Davies et al. 2013; Groot et al. 2006; Perez et al. 2014; Zelle et al. 2012
CARDIOVASCULAR DISEASE		
Treatment for individuals with high CVD risk (≥ 20 percent)	1.05 mmol/L reduction in cholesterol 5.9 mmHg reduction in systolic blood pressure	Law, Morris, and Wald 2009; Taylor et al. 2013
Treatment for individuals with high blood pressure (≥ 140 mmHg), but low absolute CVD risk (< 20 percent)	5.9 mmHg reduction in systolic blood pressure	Law, Morris, and Wald 2009
Treatment for individuals with high cholesterol (≥ 6.0 mmol/L), but low absolute CVD risk (< 20 percent)	1.05 mmol/L reduction in cholesterol	Taylor et al. 2013
Treat new cases of acute myocardial infarction with aspirin	15 percent reduction in CVD mortality	ATT 2002
Provide multidrug therapy to treat those with established ischemic heart disease and stroke	1.05 mmol/L reduction in cholesterol 5.9 mmHg reduction in systolic blood pressure	Law, Morris, and Wald 2009; Taylor et al. 2013
CERVICAL CANCER		
Triannual screening through visual inspection with acetic acid (VIA) test (women age 30–49), with timely diagnosis	Sensitivity 0.62, Specificity 0.95	Goldie et al. 2001; IARC 2005
Screening through the Pap test (women age 30–49), with timely diagnosis	Sensitivity 0.62, Specificity 0.95	Goldie et al. 2001; IARC 2005
Screening through the HPV DNA test (women age 30–49), with timely diagnosis	Sensitivity 0.88, Specificity 0.75	Goldie et al. 2001; IARC 2005; WHO 2014
Treatment of cervical cancer stages I–IV	Percent reduction in mortality, by stage (I—77.5 percent, II—68.4 percent, III—65 percent, IV 75 percent)	Chuang et al. 2016; Goldie et al. 2003; NCCN 2017
CHRONIC OBSTRUCTIVE PULMONARY DISORDER		
Symptom relief with inhaled salbutamol	15 percent improvement in functioning (quality of life improvement)	Sestini et al. 2002
Low-dose oral theophylline	11 percent improvement in functioning (quality of life improvement)	OHT
Ipratropium inhaler	17 percent improvement in functioning (quality of life improvement)	OHT
Exacerbation treatment with antibiotics	76 percent reduction in case fatality rate	Rico-Mendez et al. 2005; Sin and Man 2006; Vollenweider et al. 2012
Exacerbation treatment with oral prednisolone	34 percent reduction in case fatality rate	Rico-Mendez et al. 2005; Sin and Man 2006; Vollenweider et al. 2012
Exacerbation treatment with oxygen	50 percent reduction in case fatality rate	Rico-Mendez et al. 2005; Sin and Man 2006; Vollenweider et al. 2012

Source: World Bank.

Note: CVD = cardiovascular disease; HPV = human papillomavirus; OHT = OneHealth Tool.

Additional information on impact modelling

- The modelling and assumptions behind the clinical interventions that address breast cancer and cervical cancer are detailed in Gopalappa et al. (2018).
- The modelling and assumptions behind the clinical interventions that address COPD are detailed in Stanciole et al. (2012).
- The modelling and assumptions behind clinical interventions that address CVD are detailed in Ortégón et al. (2012).
- See the OHT NCD Module User guide: <https://avenirhealth.org/Download/Spectrum/Manuals/SpectrumManualE.pdf>

Bibliography

- Addicott, E. T., E. P. Fenichel, and M. J. Kotchen. 2020. "Even the Representative Agent Must Die: Using Demographics to Inform Long-Term Social Discount Rates." <https://www.journals.uchicago.edu/doi/abs/10.1086/706885>
- Adeloye, D., J. Thompson, M. A. Akanbi, D. Azuh, V. Samuel, N. Omeregbe, and C. K. Ayo. 2016. "The Burden of Road Traffic Crashes, Injuries and Deaths in Africa: A Systematic Review and Meta-Analysis." *Bulletin of the World Health Organization* 94 (7): 510–21a.
- Anesetti-Rothermel, A. and U. Sambamoorthi. 2011. "Physical and Mental Illness Burden: Disability Days among Working Adults." *Population Health Management* 14 (5): 223–30.
- ATT (Antithrombotic Treatment Trialists') Collaboration. 2002. "Collaborative Meta-Analysis of Randomized Trials of Antiplatelet Therapy for Prevention of Death, Myocardial Infarction, and Stroke in High Risk Patients." *BMJ* 324: 71–86. doi: <https://doi.org/10.1136/bmj.324.7329.71>.
- Bertram, M. Y., K. Sweeny, J. Lauer, D. Chisholm, P. Sheehan, B. Rasmussen, S. R. Upreti, L. P. Dixit, K. George, and S. Deane. 2018. "Investing in Non-Communicable Diseases: An Estimation of the Return on Investment for Prevention and Treatment Services." *Lancet* 391 (10134): 2071–78. doi: 10.1016/S0140-6736(18)30665-2
- Bloom, D. C., E. Cafiero, E. Jané-Llopis, S. Abrahams-Gessel, L. Bloom, S. Fathima, A. Feigl, T. Gaziano, M. Mowafi, A. Pandya, K. Prettnier, L. Rosenberg, B. Seligman, A. Stein, and C. Weinstein. 2011. *The Global Economic Burden of Non-communicable Diseases*. Geneva, Switzerland: World Economic Forum.
- Chaker, L., A. Falla, S. J. van der Lee, T. Muka, D. Imo, L. Jaspers, V. Colpani, S. Mendis, R. Chowdhury, W. M. Bramer, R. Pazoki, and O. H. Franco. 2015. "The Global Impact of Non-Communicable Diseases on Macro-Economic Productivity: A Systematic Review." *European Journal of Epidemiology* 30 (5): 357–95.
- Chuang, L. T., S. Temin, R. Camacho, A. Dueñas-Gonzalez, S. Feldman, M. Gultekin, V. Gupta, S. Horton, G. Jacob, E. A. Kidd, K. Lishimpi, C. Nakisige, J.-H. Nam, H. Y. S. Ngan, W. Small, G. Thomas, and J. S. Berek. 2016. "Management and Care of Women with Invasive Cervical Cancer: American Society of Clinical Oncology Resource-Stratified Clinical Practice Guideline." *Journal of Global Oncology* 5: 311–40.
- Chuma, J. and T. Maina. 2012. "Catastrophic Health Care Spending and Impoverishment in Kenya." *BMC Health Services Research* 12: 413.
- Davies, C., et al. 2013. "Long-Term Effects of Continuing Adjuvant Tamoxifen to 10 Years versus Stopping at 5 Years after Diagnosis of Oestrogen Receptor-Positive Breast Cancer: ATLAS, a Randomised Trial." *Lancet* 381 (9869): 805–16.
- GBD 2017 Causes of Death Collaborators. 2018. "Global, Regional, and National Age-Sex-Specific Mortality for 282 Causes of Death in 195 Countries and Territories, 1980–2017: A Systematic Analysis for the Global Burden of Disease Study 2017." *Lancet* 392 (10159): 1736–88.

- Global Burden of Disease Health Financing Collaborator Network. 2017. "Evolution and Patterns of Global Health Financing 1995–2014: Development Assistance for Health, and Government, Prepaid Private, and Out-of-Pocket Health Spending in 184 Countries." *Lancet* 389 (10083): 1981–2004.
- Goetzel, R. Z., S. Long, R. Ozminkowski, K. Hawkins, S. Wang, and W. Lynch. 2004. "Health, Absence, Disability, and Presenteeism Cost Estimates of Certain Physical and Mental Health Conditions Affecting U.S. Employers." *Journal of Occupational and Environmental Medicine* 46 (4): 398–412.
- Goldie, S. J., D. Grima, M. Kohli, T. C. Wright, M. Weinstein, and E. Franco. 2003. "A Comprehensive Natural History Model of HPV Infection and Cervical Cancer to Estimate the Clinical Impact of a Prophylactic HPV-16/18 Vaccine." *International Journal of Cancer* 106 (6): 896–904.
- Goldie, S. J., L. Kuhn, L. Denny, A. Pollack, and T. Wright. 2001. "Policy Analysis of Cervical Cancer Screening Strategies in Low-Resource Settings: Clinical Benefits and Cost-Effectiveness." *JAMA* 285 (24): 3107–15.
- Gopalappa, C., P. Meckoni, B. Munkhbat, C. Pretorius, J. Lauer, A. Ilbawi, M. Bertram. 2018. "A Two-Step Markov Processes Approach for Parameterization of Cancer State-Transition Models for Low- and Middle-Income Countries." *Journal of Medical Decision Making* 38 (4): 520–30.
- Groot, M. T., R. Baltussen, C. Uyl-de Groot, B. Anderson, and G. N. Hortobágyi. 2006. "Costs and Health Effects of Breast Cancer Interventions in Epidemiologically Different Regions of Africa, North America, and Asia." *Breast Journal* 12 (Suppl 1): S81–90.
- Guariguata, L., I. de Beer, R. Hough, E. Bindels, D. Weimers-Maasdorp, F. Feeley III, and T. Rinke de Wit. 2012. "Diabetes, HIV and Other Health Determinants Associated with Absenteeism among Formal Sector Workers in Namibia." *BMC Public Health* 12: 44.
- IARC (International Agency for Cancer Research). 2016. *Breast Cancer Screening. IARC Handbooks of Cancer Prevention*. Vol. 15. Lyon, France: IARC.
- IARC (International Agency for Research on Cancer). 2005. *Cervix Cancer Screening. IARC Handbooks of Cancer Prevention*. Vol. 10. 2005. Lyon, France: IARC.
- IHME (Institute for Health Metrics and Evaluation). 2017. GBD Compare (database). <http://www.healthdata.org/data-visualization/gbd-compare>.
- . n.d. Global Burden of Disease Results Tool. <http://ghdx.healthdata.org/gbd-results-tool>.
- Jamison, Dean T., Lawrence Summers, George Alleyne, Kenneth Arrow, Seth Berkley, Agnes Binagwaho, Flavia Bustreo, David Evans, Richard Feachem, Julio Frenk, Gargee Ghosh, Sue J Goldie, Yan Guo, Sanjeev Gupta, Richard Horton, Margaret Kruk, Adel Mahmoud, Linah Mohohlo, Mthuli Ncube, Ariel Pablos-Mendez, K Srinath Reddy, Helen Saxenian, Agnes Soucat, Karene Ulltveit-Moe, and Gavin Yamey. 2015. "Appendix 3: Global Health 2035: A World Converging within a Generation." *Salud Pública de México* 57 (5): 444–67.
- Jaspers, Loes, Veronica Colpani, Layal Chaker, Sven J. van der Lee, Taulant Muka, David Imo, Shanthi Mendis, Rajiv Chowdhury, Wichor M. Bramer, Abby Falla, Raha Pazoki, and Oscar H. Franco. 2015. "The Global Impact of Non-Communicable Diseases on Households and Impoverishment: A Systematic Review." *European Journal of Epidemiology* 30 (3): 163–88.
- Kenya NCDI Poverty Commission. 2018. "The Kenya Non-Communicable Diseases and Injuries Poverty Commission Report." Ministry of Health, Nairobi.
- Lauer, J. A., K. Röhrich, H. Wirth, C. Charette, S. Gribble, and C. Murray. 2003. "PopMod: A Longitudinal Population Model with Two Interacting Disease States." *Journal of Cost Effectiveness and Resource Allocation* 1 (1): 6.
- Law, M. R., J. Morris, and N. Wald. 2009. "Use of Blood Pressure Lowering Drugs in the Prevention of Cardiovascular Disease: Meta-Analysis of 147 Randomised Trials in the Context of Expectations from Prospective Epidemiological Studies." *BMJ* 338: b1665.
- Lensberg, B. R., M. F. Drummond, N. Danchenko, N. Despiégl, and C. François. 2013. "Challenges in Measuring and Valuing Productivity Costs, and Their Relevance in Mood Disorders." *ClinicoEconomics and Outcomes Research* 5: 565–73.
- Lozano, R., et al. 2012. "Global and Regional Mortality from 235 Causes of Death for 20 Age Groups in 1990 and 2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *Lancet* 380 (9859): 2095–128.

- Makani, Julie, Sharon Cox, Deogratius Soka, Albert N. Komba, Julie Oruo, Hadija Mwamtemi, Pius Magesa, Stella Rwezaula, Elineema Meda, Josephine Mgaya, Brett Lowe, David Muturi, David Roberts, Thomas Williams, Kisali Pallangyo, Jesse Kitundu, Gregory Fegan, Fenella J. Kirkham, Kevin Marsh, and Charles R. Newton. 2011. "Mortality in Sickle Cell Anemia in Africa: A Prospective Cohort Study in Tanzania." *PLoS One* 6 (2): e14699.
- Ministry of Health, Government of Kenya. 2014. *Kenya Service Availability and Readiness Assessment Mapping (SARAM)*. Nairobi: Ministry of Health.
- . 2015a. *Kenya STEPwise Survey for Noncommunicable Disease Risk Factors 2015 Report*. Nairobi: Ministry of Health.
- . 2015b. "Kenya National Strategy for the Prevention and Control of Non-Communicable Diseases 2015–2020." Ministry of Health, Nairobi.
- . 2017a. "National Cancer Control Strategy 2017–2022." Ministry of Health, Nairobi.
- . 2017b. "Kenya National Health Accounts FY 2015/16." Ministry of Health, Nairobi.
- . 2018. "Roadmap towards Universal Health Coverage in Kenya 2018–2022." Ministry of Health, Nairobi.
- Mofadal, A., and Kunawee Kanitpong. 2016. "Analysis of Road Traffic Accident Costs in Sudan Using the Human Capital Method." *Open Journal of Civil Engineering* 6: 203–16. doi:10.4236/ojce.2016.62019.
- Mwai, D., and Ministry of Health. 2016. *Kenya National Health Accounts FY 2015/16*. doi:10.13140/RG.2.2.20647.65448
- NCD Countdown 2030 Collaborators. 2018. "NCD Countdown 2030: Worldwide Trends in Non-Communicable Disease Mortality and Progress towards Sustainable Development Goal Target 3.4." *Lancet* 392 (10152): 1072–88.
- Neumann, P. J., T. G. Ganiats, L. B. Russell, G. D. Sanders, and J. E. Siegel, eds. 2017. *Cost-Effectiveness in Health and Medicine*. 2nd ed. New York, NY: Oxford University Press.
- Ortegón, M., S. Lim, D. Chisholm, and S. Mendis. 2012. "Cost Effectiveness of Strategies to Combat Cardiovascular Disease, Diabetes, and Tobacco Use in Sub-Saharan Africa and South East Asia: Mathematical Modelling Study." *BMJ* 344: e607.
- Perez, E. A., et al. 2014. "Trastuzumab Plus Adjuvant Chemotherapy for Human Epidermal Growth Factor Receptor 2-Positive Breast Cancer: Planned Joint Analysis of Overall Survival from NSABP B-31 and NCCTG N9831." *Journal of Clinical Oncology* 32 (33): 3744–52.
- Rico-Mendez, F. G., S. Barquera, J. J. Múgica-Hernández, J. L. Espinosa Pérez, S. Ortega, and L. G. Ochoa. 2005. "Survival in a Cohort of Patients with Chronic Obstructive Pulmonary Disease: Comparison between Primary and Tertiary Levels of Care." *Archivos de Bronconeumología* 41 (5): 260–66.
- Sestini, P., E. Renzoni, Stewart Robinson, Phillippa Poole, Felix Ram. 2002. "Short-Acting Beta 2 Agonists for Stable Chronic Obstructive Pulmonary Disease." *Cochrane Database of Systematic Reviews* 2002 (4): Cd001495. doi:10.1002/14651858.CD001495.
- Sin, D. D. and S. F. Paul Man. 2006. "Pharmacotherapy for Mortality Reduction in Chronic Obstructive Pulmonary Disease." *Proceedings of the American Thoracic Society* 3 (7): 624–29.
- Stanciole, A. E., Mónica Ortegón, Dan Chisholm, and Jeremy A. Lauer. 2012. "Cost Effectiveness of Strategies to Combat Chronic Obstructive Pulmonary Disease and Asthma in Sub-Saharan Africa and South East Asia: Mathematical Modelling Study." *BMJ* 344: 608.
- Taylor, Fiona, Mark Huffman, Ana Filipa Macedo, Theresa Moore, Margaret Burke, George Davey Smith, Kirsten Ward, and Shah Ebrahim. 2013. "Statins for the Primary Prevention of Cardiovascular Disease." *Cochrane Database of Systematic Reviews* 2013 (1): Cd004816. doi:10.1002/14651858.CD004816.pub5.
- Vollenweider, Daniela J., Harish Jarrett, Claudia Steurer-Stey, Judith Garcia-Aymerich, and Milo Puhan. 2012. "Antibiotics for Exacerbations of Chronic Obstructive Pulmonary Disease." *Cochrane Database of Systematic Reviews* 2012 (12): Cd010257. doi:10.1002/14651858.CD010257.
- Wagstaff, A. 2002. "Poverty and Health Sector Inequalities." *Bull World Health Organ* 80 (2): 97–105.

- Wang, Philip S., Arne Beck, Patricia Berglund, Joseph Leutzinger, Nico Pronk, Dennis Richling, Thomas Schenk, Gregory Simon, Paul Stang, T. Bedirhan Ustün, and Ronald Kessler. 2004. "Chronic Medical Conditions and Work Performance in the Health and Work Performance Questionnaire Calibration Surveys." *Journal of Occupational and Environmental Medicine* 45 (12): 1303–11.
- WHO (World Health Organization). 2014. *Comprehensive Cervical Cancer Control: A Guide to Essential Practice*. 2nd ed. Geneva: WHO.
- World Bank. 2018. "Human Capital Index: Kenya Country Brief." Human Capital Project. World Bank, Washington, DC.
- Xu, Ke, David Evans, Kei Kawabata, Riadh Zeramdini, Jan Klavus, and Christopher Murray. 2013. "Household Catastrophic Health Expenditure: A Multicountry Analysis." *Lancet* 362 (9378): 111–17.
- Yamey, G., N. Beyeler, H. Wadge, and D. Jamison. 2016. "Investing in Health: The Economic Case." *Report of the WISH Investing in Health Forum*, "World Innovation Summit for Health," Doha, Qatar, November 29–30.
- Zelle, Sten G., Kofi Nyarko, William Bosu, Moses Aikins, Laurens Niëns, Jeremy A. Lauer, Cecilia R. Sepulveda, Jan Hontelez, and Rob Baltussen. 2012. "Costs, Effects and Cost-Effectiveness of Breast Cancer Control in Ghana." *Tropical Medicine & International Health* 17 (8): 1031–43.

ECO-AUDIT

Environmental Benefits Statement

The World Bank Group is committed to reducing its environmental footprint. In support of this commitment, we leverage electronic publishing options and print-on-demand technology, which is located in regional hubs worldwide. Together, these initiatives enable print runs to be lowered and shipping distances decreased, resulting in reduced paper consumption, chemical use, greenhouse gas emissions, and waste.

We follow the recommended standards for paper use set by the Green Press Initiative. The majority of our books are printed on Forest Stewardship Council (FSC)–certified paper, with nearly all containing 50–100 percent recycled content. The recycled fiber in our book paper is either unbleached or bleached using totally chlorine-free (TCF), processed chlorine-free (PCF), or enhanced elemental chlorine-free (EECF) processes.

More information about the Bank’s environmental philosophy can be found at <http://www.worldbank.org/corporateresponsibility>.



Noncommunicable diseases such as cancer, diabetes, chronic lung diseases, and heart diseases are the leading cause of death and disability. In Kenya, the growing prevalence of these diseases is a major public health concern and a hindrance to long-term economic growth. This is because these conditions reduce human capital and divert societal resources. The high cost of managing the growing caseload of noncommunicable diseases (NCDs) also afflicts Kenyan families, businesses, and the government, and increasingly leads to impoverishment.

Developing an appropriate policy response to the threat of NCDs requires a clear understanding of the economic impacts as well as the benefits of potential interventions, both from a health and an economic perspective. Such information allows policy makers to evaluate the trade-offs between different investment decisions, with the goal of ensuring that any interventions maximize the rewards to individuals and to society at large.

Combating Noncommunicable Diseases in Kenya is one of a few published studies on the economic burden of NCDs in Kenya. It focuses on a limited set of conditions, aligned with the burden of NCDs in Kenya, and demonstrates both the long-term costs of these diseases and the strong health and economic benefits of scaling up interventions. It contributes to a growing body of analysis on NCDs in Kenya—and in Africa—and provides much-needed evidence to facilitate advocacy and foster dialogue to confront this serious challenge.

