A HEAVY BURDEN

The indirect cost of illness in AFRICA

Leaving no one behind in AFRICA

A heavy BURDEN

The indirect cost of illness in AFRICA

A heavy burden: the productivity cost of illness in Africa

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Foreword

It has been nearly four years since Member States of the United Nations adopted the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs). A key target within the SDGs is Universal Health Coverage (UHC), whose achievement underpins all health-related SDGs.

Evidence indicates that countries will need spend on average US$ 271 per capita to achieve UHC. Four years into the implementation of countries' efforts towards achieving UHC, current average expenditure on health in the Region falls short of this expectation.

We know that good health contributes to improvements in development outcomes. What has not yet been clearly synthesized is the impact of ill-health on development outcomes. This report is an attempt to address this gap in the evidence. It clearly shows that, if we fail to achieve UHC and the health-related SDG targets, the Region will likely suffer a loss of about 2.4 trillion international dollars annually. This is a huge cost to the Region and, indeed, for Africa as a whole. Implementing the recommended essential health services to address the main causes of morbidity and premature mortality in the Region would almost halve this cost.

The results in the report are presented by country, by regional economic group and by income group. This format has been adopted because we consider this report to be an important advocacy tool that can be used to engage critical stakeholders in Member States, economic communities and partners.

I urge you to use this evidence to support your advocacy work for domestic spending in Africa.

Dr Matshidiso Moeti
WHO Regional Director for Africa

Acknowledgments

Executive summary

The diseases afflicting the African population are responsible for a substantial loss in health, estimated at 704 765 879 DALYs in 2015 alone. In the WHO African Region, total losses amounted to 629 603 271 DALYs. Out of that total, 416 671 978 DALYs (59.1 %) were from **communicable, maternal, perinatal** and **nutritional conditions**; 216 073 399 DALYs (30.7 %) were from **noncommunicable** diseases (NCDs) and 71 551 401 DALYs (10.2 %) were from injuries. Five countries (the Democratic Republic of the Congo, Ethiopia, Nigeria, South Africa and the United Republic of Tanzania) accounted for almost 50% of the total DALYs accrued in the Region.

This study quantifies the GDP losses associated with these DALYs. Losses are estimated for all causes of DALYs by age group, by World Bank income group classification of countries and by regional economic community (REC). The estimated GDP losses due to ill-health, disability and premature death vary substantially by age and disease categories and by economic group and REC.

There are three reasons for the pattern of variation in GDP losses above. Firstly, the burden of disease, expressed in total DALYs, is driven by population size. Secondly, since DALYs do not respond proportionately to population changes, the unit values for the disease burden, expressed in DALYs per capita, are remarkably similar across regions and economic blocs, ranging mostly from 0.4 to 0.8, with a mean of 0.55. Thirdly, labour productivity, expressed as a ratio of GDP to population in international dollars (Int$), is large in high-income economies, and quite small in low-income countries. Thus, economies with similar per capita DALY losses can have very different per capita GDP losses.

With regard to the aetiology of productivity losses by cause in Africa, 37% of total losses are due to **NCDs** while 27% are due to infectious diseases (**AIDS, tuberculosis (TB), malaria)**. The other causes are **neglected tropical diseases (NTDs), road traffic injuries and maternal conditions**. In 2015, GDP losses due to maternal and neonatal health conditions were estimated at **Int$ 45 589 121 253** and **Int$ 347 336 223 573**, respectively. However, if the aspired to levels of morbidity and mortality due to these conditions are achieved in 2030, savings amounting to **Int$ 39 701 227 364** and **Int$ 198 477 842 042**, respectively, can be realized through strategic investments. Indeed, **47%** (**Int$ 796 144 038 564**) of the total cost of illness (**Int$ 2 983 187 560 197**) in Africa can be saved in 2030 if the health-related SDGs are achieved.

These estimates make a case for countries in the Region to invest sustainably in health. However, success will be possible only if countries **invest adequately in the development of resilient national and local health systems** to effectively deliver integrated packages of proven cost-effective health interventions for all ages already recommended in global health strategies and plans. This study illustrates how achievement of critical health SDG targets, including universal health coverage (UHC), would contribute to poverty eradication efforts on a large scale, reduce disparities in lifespan, tackle social exclusion, and promote political stability and economic development in the WHO African Region.

Acronyms, abbreviations and definitions

Definitions of terms used in the report

DALY — The disability-adjusted life year (DALY) is a measure of overall disease burden expressed as the number of years lost due to ill-health, disability or early death. It is calculated as the sum of the Years of Life Lost (YLL) due to premature mortality and the Years Lost due to Disability (YLD) for people living with a health condition or its consequences.

Productivity (indirect costs) — Productivity costs are indirect costs that occur when the productivity of individuals is affected by illness, treatment side effects, disability or premature death. They are usually estimated in terms of lost earnings due to sickness.

Non-health GDP — The component of the Gross Domestic Product of a country that excludes total health expenditure. It is used to determine value costs unrelated to direct health spending resulting from ill-health or death.

International dollar — The international dollar (Int$) is a hypothetical unit of currency that has the same purchasing power parity that the US dollar had in the United States at a given point in time.

DALY	disability-adjusted life year
EAC	East African Community
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community for the West African States
EVD	Ebola virus disease
GDP	gross domestic product
GHO	WHO Global Health Observatory
GNI	Gross national income
IHME	Institute for Health Metrics and Evaluation
MDGs	Millennium Development Goals
MMR	maternal mortality ratio
NCDs	noncommunicable diseases
OECD	Organisation for Economic Co-operation and Development
PEM	protein-energy malnutrition
PPP	purchasing power parity
RECs	regional economic communities
RMNCH	reproductive, maternal, newborn and child health
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
TB	tuberculosis
THE	total health expenditure
U5M	under five mortality
UHC	Universal Health Coverage
WHO	World Health Organization

Chapter 1. Background

1.1 Global and Regional Context

In September 2015, the United Nations General Assembly agreed on the 2030 Agenda for sustainable development, with a new generation of 17 Sustainable Development Goals (SDGs) and 169 targets to succeed the Millennium Development Goals (MDGs) and guide global development over the 15 years to 2030 (1). SDG 3, which is about ensuring healthy lives and promoting well-being for all at all ages, has 13 targets. Overall financing gap for implementation of the SDGs by 2030 is estimated at US$ 37.5 trillion or US$ 2.5 trillion per year (2).

More specifically, the latest estimates suggest that low income countries will need an additional USD 671 billion dollars (USD 76 per capita on average) until 2030 to attain the health-related SDGs (3). Seventy-nine per-cent of these costs are required to strengthen the health system. It is increasingly clear that for countries to achieve this, greater investment in health as well as increased efficiency in the use of mobilized resources is required. Considering the declining and unpredictable state of external financing for health, domestic resource mobilization, particularly public spending on health, is critical to achieve the goals of Universal Health Coverage (UHC) and the SDGs.

A recent WHO publication shows that despite commitments by African Heads of State to spend at least 15% of the government budget on health, only four countries were able to attain this target in 2015 (4). The data show that over the period 2000–2015, health spending as a proportion of the total budget was reduced in 19 countries. It is thus critical, given the broader scope and targets of the SDGs, to consider how a case for greater and more efficient investment in health can be made.

1.2 Making a case for investment in health

In 2012, an investment case for health in the African Region was developed by WHO and other partners in the Harmonization for Health in Africa collaboration (5). It was estimated in this investment case that up to US$ 36 more per capita should be spent on health on average until 2015, which corresponds to a total additional investment of US$ 140 billion. It was further estimated that this investment would save the lives of around 3.1 million people and prevent between 3.8 and 5.1 million children from stunting in 2015 alone. This would lead to an increase in the number of health workers from 2.0 million to 2.8 million and an additional 58 000 to 77 000 health facilities. The economic benefits in the year 2015 were estimated to be US$ 100 billion.

Other attempts have been done to build a case for investment in health system inputs such as community health workers (6), reproductive maternal, neonatal and child health (7) and others. The broader scope of the health challenges that countries in the Region are simultaneously grappling with – the ever-increasing challenge of the noncommunicable diseases (NCDs) and road injuries, and the need for increased public investment in health – highlight the case for investing in health, all the more so given the broadened scope of other public spending priorities.

1.3 Health and economic growth

In the African Union's Agenda 2063, African Member States have committed to a prosperous Africa based on inclusive growth and sustainable development. As it is generally understood that health is a prerequisite for economic development (8), improving health is essential to fulfil this aspiration.

Several studies that investigated the relationship between health and GDP growth have found a positive relationship. Bloom et al. found that a one-year increment in life expectancy was associated with a 4% increment in GDP (9). Another study conducted in 13 OECD countries found a significant impact of health on total GDP and GDP per capita (10). The study also found that a one per cent increase in life expectancy resulted in a six per cent increase in total GDP and a five per cent increase in GDP per capita. Another study estimated an increase of 10–15% in economic growth related to reductions in adult mortality between 1960 and 1990 (13).

The Ebola virus disease (EVD) epidemic in Guinea, Liberia and Sierra Leone also provides some evidence of the impact of health on the GDP. Estimates of the impact of the epidemic show that in 2014 the GDP of the three countries was between two and five per cent lower than it would have been in the absence of the epidemic (11). The World Bank estimated that a year after the onset of the EVD outbreak, the GDP total losses for the three countries through 2015 would amount to a total of US$ 2.2 billion (US$ 240 million for Liberia, US$ 535 million for Guinea and US$ 1.4 billion for Sierra Leone) (12). Another study estimated an increase in 10–15% of economic growth related to reductions in adult mortality from 1960–1990 (13).

In a bid to address the gap in the evidence on the impact of health on the economic growth, as well as articulate the likely returns on investment once the health-related SDGs are achieved, the WHO Regional Office for Africa undertook the present study to estimate the indirect cost or the productivity losses (as measured by loss in GDP) of morbidity and premature mortality from a wide range of diseases and health conditions in the African Region. The study provides an additional lens for making the case for investment in health in the WHO African Region.

1.4 Objectives and scope of the study

Objectives

(a) To estimate the productivity costs associated with non-fatal disability[1] and premature mortality from a wide range of diseases and health conditions in the WHO African Region in 2015.

(b) To estimate the productivity costs and potential savings in the year 2030 if countries were to meet the SDG health targets, as opposed to status quo (2015).

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To address the objectives above, the following evaluation questions were developed:

Scenario 1: Status quo or 'business as usual'

▶ What was the productivity cost of morbidity and mortality associated with a wide range of diseases and health conditions on the non-health GDP in WHO African Region in 2015?

Scenario 2: Accelerated interventions in countries to reduce morbidity and mortality

▶ Assuming that in 2030, the accelerated interventions in countries were to result in the morbidity and mortality levels aspired to in the 2030 SDGs health targets, what would be the total productivity costs averted, compared to 2015[2].

Scope

Countries: Estimates for the productivity costs were obtained for all countries in WHO African Region.

Diseases: The productivity cost of morbidity and mortality was that due to HIV/AIDS, TB, Malaria, common maternal, neonatal, child and adolescent health conditions, as well as common noncommunicable diseases such as diabetes, heart disease, hypertension and cancer.

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1 Includes all forms of disability, temporary (due to illness) and permanent.

2 The assumption is that, due to implementation of the health-related interventions to address the conditions targeted in the SDGs, the levels of morbidity and mortality in 2030 are at the rate envisioned in the SDG targets. This scenario compares only two points in time (2015 and 2030) and not the intervening years.

Chapter 2. Methods – frameworks for analysis

To address the evaluation questions above, a costing framework previously used to estimate disease-specific productivity costs in WHO African Region was used (14–23). The sections below detail this framework. Further details are available in Annex 1.

2.1 Framework for evaluating question 1

The methodological details of the calculations of DALYs and data sources are contained in a WHO technical document [2].

To determine the productivity losses arising per person in a year, the amount of health lost (valued in DALYs) was multiplied by the monetary value or income of a full year of perfect health. In this study, the monetary value was imputed using the GDP per capita (as the level of the average income one person in perfect health would fully earn in each country in one year) minus the total health expenditure per person (THE per capita) as explained in chapter 1. In this costing framework, the GDP per capita less the THE per capita is called the non-health GDP per capita (NHGDPPC).

Step 1: Determining the productivity cost due to a particular condition for each age-group

The productivity cost due to a particular condition for each age-group is calculated by determining the product of the DALYs accrued for an age group due to disease j (for example) and the non-health GDP loss per capita for that country as shown in **Box 1**.

Step 2: Productivity costs for each condition of disease

The non-health GDP loss (*NHGDPLoss*) associated with DALYs accrued from jth disease (or health condition) in a country is the sum of the potential non-health GDP loss due to DALYs accrued from j[th] disease among all age groups as in **Box 2**.

Box 1. Productivity losses for condition j for 0-4 years age group in country Beta

$$NHGDPLoss_{0-4} = \left[NHGDPPC_{Int\$} \right] \times \left[DALY_{0-4} \right] \} \quad ....(2)$$

Where:

NHGDPPCint$ = the per capita non-health GDP in purchasing power parity (PPP) and;

DALY0-4 = the total jth disease (or health condition) DALYs accrued in a specific age group.

Box 2. Productivity losses for condition j in country Beta

$$NHGDPLoss_{ij} = \left(\begin{array}{c} NHGDPLoss_{0-4} + NHGDPLoss_{5-14} + NHGDPLoss_{15-29} + \\ NHGDPLoss_{30-49} + NHGDPLoss_{50-59} + NHGDPLoss_{60-69} + NHGDPLoss_{\geq 70} \end{array} \right) ....(1)$$

❝ The **629 603 271 704** DALYs accrued in 2015 could have led to a loss in productivity amounting to **Int$ 2 429 764 432 048** in the WHO African Region's GDP ❞

Step 3: productivity loss due to all conditions in the country

This was developed by summation of all the non-health GDP losses for all conditions in a country (**Box 3**).

The year 2015 was used as the base year for all calculations. 2015 is also significant in that it marked the end of the MDG era and served as the baseline for the SDGs. Since the DALY estimates published by WHO in the WHO Global Health Observatory (GHO) are already discounted at a 3% discount rate[3], no discounting was done to avoid double discounting.

2.2 Framework for estimating productivity cost associated with DALYs accrued from all causes under scenario 2: SDGs

This subsection explains how the following question was answered:

Assuming that in 2030, the accelerated interventions in countries were to result in the morbidity and mortality levels aspired to in the 2030 SDGs health targets, what would be the total productivity costs averted compared to 2015.

Examples of the formulae used to determine the impact of achieving the health-related SDGs can be found below. For example, the condition addressed in target 3.1 is maternal mortality. The formula in **Box 4** was used to estimate the impact of reductions in maternal mortality based on attaining the SDGs. Annex 1 details the formulae for all the impact on NHGDP loss of attaining all the other health-related SDGs.

Target 3.1: By 2030, reduce the global maternal mortality ratio (MMR) to less than 70 per 100 000 live births (**Box 4**).

Africa's 2030 non-health GDP loss from maternal conditions was estimated by comparing two points in time, 2015 and 2030, to determine the savings that could be realized from achieving the SDGs, assuming that all other things remain constant. It is important to note that these are not cumulative estimates. They only demonstrate the savings that will be realized in 2030 compared to the losses in 2015 (**Box 5**).

Box 3.   Productivity losses for country beta

$$NHGDPLoss_{Beta} = \begin{pmatrix} NHGDPLoss_j + NHGDPLoss_i + NHGDPLoss_k + \\ NHGDPLoss_l + NHGDPLoss_m + NHGDPLoss_n + NHGDPLoss_x \end{pmatrix} ....(1)$$

Box 4.   Productivity losses due to maternal mortality in 2030 if SDG related targets are achieved

$$NHGDPLoss_{MMR2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{MMR2015} - \left[NHGDPLoss_{MMR2015} \times \left(\left(MMR2015 - SDG3.1 \right) / MMR2015 \right) \right] \right\}.$$

Where:

$NHGDPLoss$ are non-health GDP losses due to maternal conditions in 2030;

$NHGDPLoss_{MMR2030}$ are non-health GDP losses due to maternal conditions in 2015;

$MMR2015$ is the maternal mortality ratio in 2015;

$SDG3.1$ is the value of Target 3.1, which is 70 per 100,000 live births.

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3   Discounting is done to estimate the present value of health given the assumption that human beings usually prefer to consume in the present rather than defer consumption to the future.

Box 5. Example of estimate of GDP losses in 2030

$NHGDPLoss_{MMR2015}$ = Int\$ 45 589 121 253 in Scenario 1

$MMR2015$ = 542 per 100 000 live births in the WHO African Region in 2015

$SDG3.1$ = 70 per 100 000 live births

$NHGDPLoss_{MMR2030}$ = 45 589 121 253 - (45 589 121 253 × ((542 - 70)/542))) = Int\$ 5 887 893 889.

2.3 Data sources

The data on the indicators contained in **Table 1** were solely obtained from WHO and IMF databases. Due to time and budgetary constraints, no primary data were collected.

The indicators contained in **Table 1.** were used in the study to estimate the productivity losses under the two scenarios: (1) business as usual or status quo, and (2) accelerated interventions to attain health SDG targets.

The DALYs accrued in 2015 per country and per cause were obtained from the GHO (24). Methods and data sources for the global burden of disease 2000–2015 are reported in a WHO technical paper (25).

The 2015 per capita GDP in International Dollars (Int\$) or Purchasing Power Parity (PPP) for each country was obtained from the IMF World Economic Outlook database (26).

The per capita total expenditure on health for 2015 was not available. Therefore, projections for 2015 were calculated using 2013 and 2014 per capita total expenditure on health for each country from the GHO.

Table 1. Indicators and data sources

Variable	Indicator	Sources
Morbidity(disability) and mortality in 2015	Disability-Adjusted Life years (DALYs) by country by age bracket (2015)	WHO (24)
Maternal mortality; Under-five mortality; Neonatal mortality; and Road traffic mortality rate in 2015 per country and region.	Maternal mortality ratio (per 100 000 live births); Under-five mortality rate (per 1000 live births; Neonatal mortality rate (per 1000 live births); and Road traffic mortality rate (per 100 000 population) in 2015 per country & region	WHO (27)
Health SDG targets	Target 3.1: By 2030, reduce maternal mortality ratio; Target 3.2: By 2030, end preventable deaths of new-borns and children; Target 3.3: By 2030, end the epidemics of AIDS, TB, Malaria & NTDs; Target 3.4: By 2030, reduce by one third NCD mortality; Target 3.6: Halve deaths & injuries from road traffic accidents	United Nations (1)
Average economic output per person in each of the 47 countries in the WHO African Region with data in 2015	Gross domestic product (GDP) per capita in 2015.	IMF (26)
Expenditure on health in 2015	Projected 2015 THE per person per country in the WHO African Region (projected using 2013 and 2014 THE data). A constant growth is assumed.	WHO (28).

Chapter 3. Epidemiological burden of disease – DALYS accrued in 2015

3.1 Distribution of DALYs accrued by country and World Bank income group

In 2015, an estimated 629 603 271704 DALYs were accrued in the WHO African Region (**Table 2**). The countries with the largest number of DALYs accrued included the Democratic Republic of the Congo, Ethiopia, Nigeria, South Africa and the United Republic of Tanzania, accounting for 48.65% of the total DALYs accumulated in the Region. **Figure 1** shows the distribution of DALYs per capita accrued by all the countries in Africa. The figure shows that Central African Republic, Chad and Angola have the three highest DALYs accrued per capita.

The magnitude of DALYs accrued varies widely between countries, from a minimum of 29 689 DALYs in Seychelles to 154 351 956 DALYs in Nigeria. Ten countries accrued less than one million DALYs; 23 countries accrued between 1 and 9.9 million DALYs; 11 countries lost 10 to 19.9 million DALYs; and the remaining 10 countries accrued 20 million DALYs and more.

Table 2. shows the DALYs accrued per capita globally and for countries in different World Bank income groups in 2015. Countries in the lower-middle-income bracket accounted for the largest DALYs accrued. However, as can also be seen, the amount of DALYs accrued per capita does not differ significantly by income country group. This is especially true for the lower-middle-income countries and the low-income countries.

Figure 1. DALYs per capita accrued by country in the WHO African Region, 2015
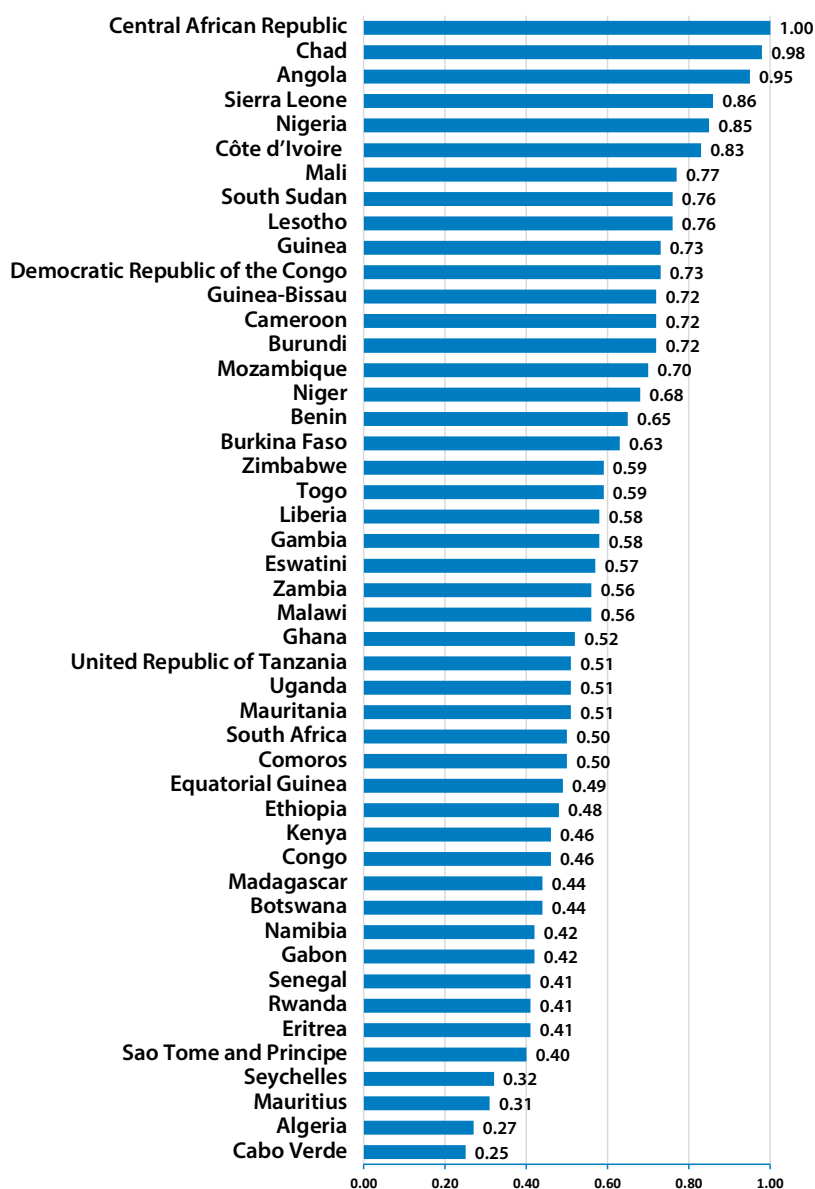
Table 2. DALYs accrued by World Bank income group

Income group	Population	DALYs in 2015	DALYs per capita
High-and upper-middle-income	131 839 170	68 544 065	0.520
Lower-middle-income	331 444 500	241 942 137	0.730
Low-income	529 983 521	319 117 069	0.602
Total	**993 267 191**	**629 603 271**	**0.634**

3.2 Distribution of DALYs by disease or condition and age group in 2015

Figure 2 shows the distribution of DALYs by condition and disease category. As the figure highlights, the communicable and noncommunicable diseases were the biggest contributor of morbidity and mortality, followed by the neonatal conditions. Furthermore, as **Figure 3**

shows, the brunt of ill health and mortality (about 37%) was borne by those aged 0–4 years; 10% by 5–14 years; 14.0% by 15–29 years; 17% by 30–49 years; the balance was borne by other age groups.

Figure 2. Productivity losses by disease or condition, 2015

Noncommunicable diseases
37%

Injuries
10%

Nutritional deficiencies
4%

Maternal conditions
1%

Neonatal conditions
12%

Communicable diseases
36%
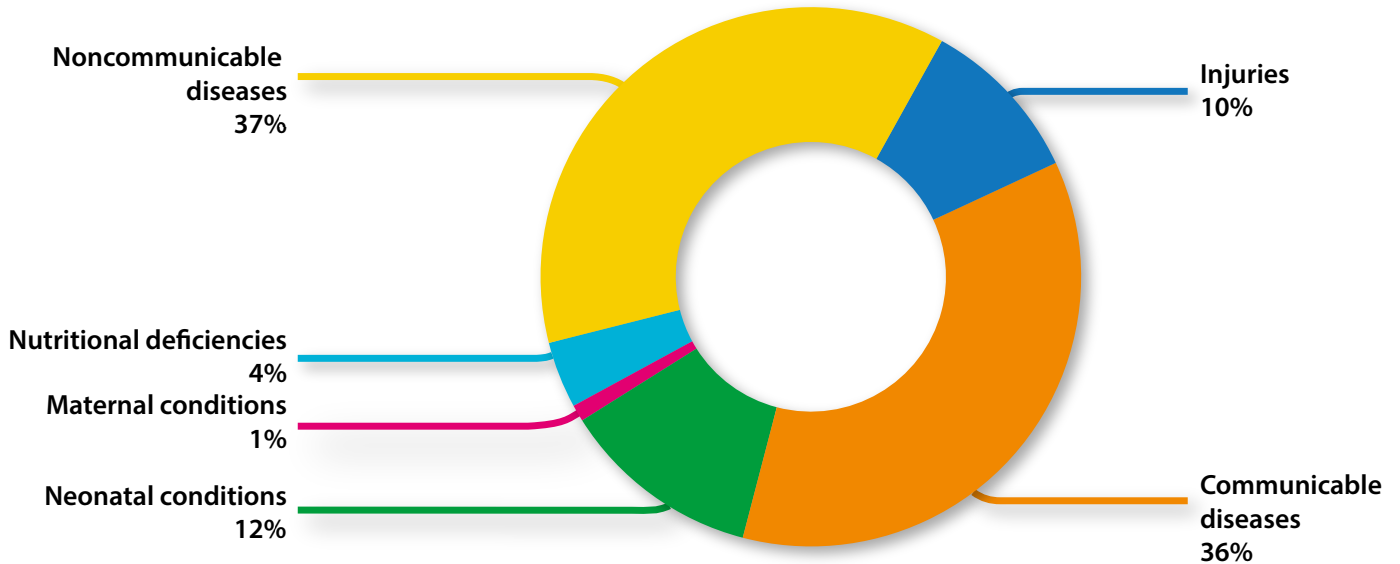
Figure 3. DALYS accrued by age group

50–59 years – 8%

60–69 years – 7%

70+ years – 7%

30–49 years – 17%

15–29 years – 14%

0–4 years – 37%

5–14 years – 10%
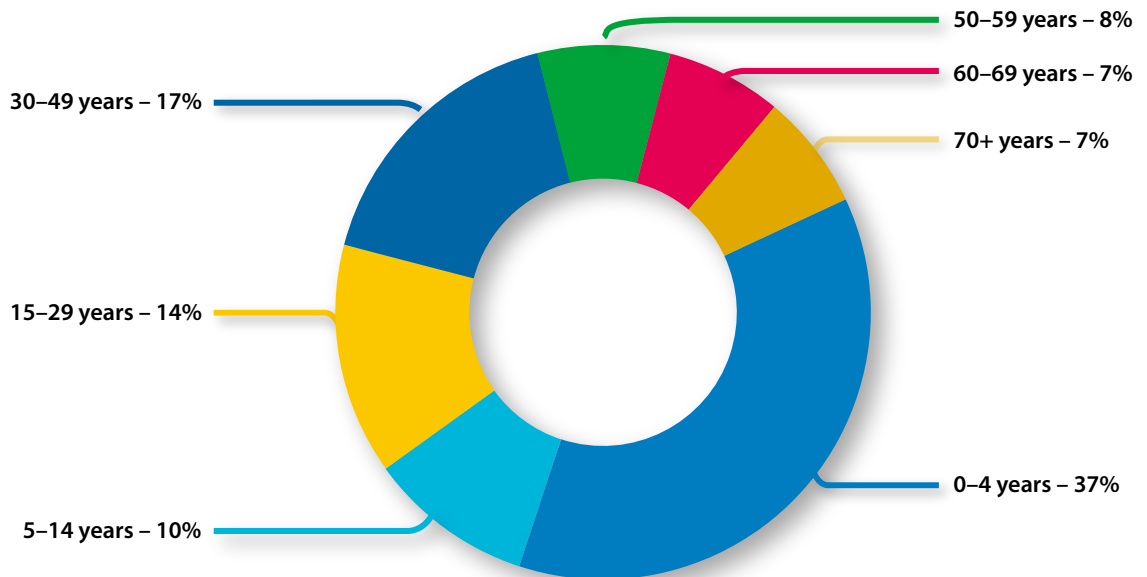
"Noncommunicable diseases are the largest cause of productivity losses in the African Region"

3.3 Productivity cost of disease in Africa

Scenario 1: Status Quo/Baseline – Productivity Cost (in 2015 Int$ or PPP)

The section below describes the productivity losses that accrued due to ill health and premature mortality in the WHO African Region in 2015.

Productivity cost of DALYs accrued from all causes and by age group

The 629 603 271 704 DALYs accrued in 2015 could have led to a loss in productivity amounting to Int$ 2 429 764 432 048 in the WHO African Region's GDP (**Table 3**). The productivity cost varies widely, from a minimum of Int$ 242 375 111 in Sao Tome and Principe to a maximum of Int$ 879 059 495 828 in Nigeria. Twelve countries in the Region account for the bulk of the productivity costs due to ill health, with over Int$ 80 billion in each country.

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Table 3.   Productivity costs by country in 2015

Countries	Int$ (PPP)
Algeria	148 931 121 416
Angola	176 684 921 891
Benin	14 421 137 444
Botswana	15 624 721 361
Burkina Faso	19 604 309 370
Burundi	5 631 659 221
Cabo Verde	836 270 059
Cameroon	51 321 465 764
Central African Republic	2 838 481 756
Chad	34 225 426 775
Comoros	554 802 983
Congo	14 655 518 776
Cote d'Ivoire	64 315 440 523
Democratic Republic of the Congo	41 248 253 265
Equatorial Guinea	21 784 894 414
Eritrea	2 726 506 407
Eswatini	6 977 621 506
Ethiopia	88 425 883 890
Gabon	15 280 770 622
Gambia	1 741 884 835
Ghana	61 154 808 548
Guinea	10 567 816 838
Guinea-Bissau	1 898 631 831
Kenya	69 219 515 912
Lesotho	4 683 162 478
Liberia	1 961 846 970
Madagascar	15 781 016 977
Malawi	10 079 244 442
Mali	28 886 572 406
Mauritania	9 081 592 955
Mauritius	7 676 401 039
Mozambique	21 658 686 724
Namibia	11 018 617 833
Niger	14 217 818 881
Nigeria	879 059 495 828
Rwanda	8 502 103 047
Sao Tome and Principe	242 375 111
Senegal	15 128 792 495
Seychelles	811 854 561
Sierra Leone	8 887 889 122
South Africa	330 505 005 681
South Sudan	13 869 627 313
Togo	6 351 384 957
Uganda	39 881 834 432
United Republic of Tanzania	80 608 363554
Zambia	33 132 541 472
Zimbabwe	17 066 338 363
Total productivity cost (Int$)	**2 429 764 432 048**

Figure 4 shows that out of the total productivity costs, 36.9% would be borne by those aged 0–4 years; 10.5% by 5–14 years; 13.7% by 15–29 years; 16.9% by 30–49 years; 7.6% by 50–59 years; 6.8% by 60–69 years; and 7.5% by those aged 70 years and above. Thus, those in the most productive age bracket of 15 to 59 years would bear 38.2% of the losses. The high percentage (36.9%) of losses in the 0–4 years age group is due to the fact that this age group incurs the highest DALYS, due to a great extent to the higher number of years of life lost.

> The **629 603 271704 DALYs** accrued in 2015 could have led to a loss in productivity amounting to **Int$ 2 429 764 432 048** in the WHO African Region's GDP

Figure 4. Productivity losses in the WHO African Region by age group in 2015

50–59 years 7.60%
30–49 years 16.90%
15–29 years 13.70%
5–14 years 10.50%
60–69 years 6.80%
70+ years 7.60%
0–4 years 36.90%

Disease or condition-specific productivity losses

Table 4 provides a summary breakdown of productivity losses by condition in 2015. The losses are mainly due to noncommunicable diseases, followed closely by communicable diseases (infectious and respiratory conditions combined). Unlike other disaggregated data, these losses are presented for the entire African continent, and not limited to the countries in the WHO African Region. A detailed breakdown of the productivity losses by disease or condition is presented in **Annex 1**.

Table 4. Productivity losses by disease or condition [4]

Disease or condition	Cost in 2015 int$	%
Infectious and parasitic diseases	808 670 913 758	27.11%
Maternal conditions	45 589 121 253	1.53%
Neonatal conditions	347 336 223 573	11.64%
Nutrition related conditions	110 312 390 440	3.70%
Noncommunicable diseases	1 107 489 132 375	37.12%
Injuries	290 040 286 090	9.72%
Respiratory conditions	273 749 492 707	9.18%
Total	**2 983 187 560 196**	**100.00%**

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4   The estimates in this table are for the entire continent of Africa.

The infectious and parasitic diseases combined led to a productivity cost of Int$ 808 670 913 758 (27.11%), while respiratory infections (including lower respiratory infections, upper respiratory infections and otitis media) led to a DALY loss worth Int$ 273 749 492 707, that is 9%.

The main drivers of productivity losses in this category include HIV/AIDS (28.5%), diarrheal diseases (20.9%), and parasitic and vector borne diseases (18.2%). Malaria accounted for 79.5% of the loss due to parasitic and vector bone diseases (**Annex 1, Table 1**).

The maternal and neonatal conditions resulted in productivity losses valued at Int$ 45 589 121 253 (2%) and Int$ 347 336 223 573 (12%) respectively. Preterm birth complications and birth asphyxia led to most of the losses due to neonatal conditions (**Annex 1, Table 2**). On the other hand, nutritional deficiencies caused productivity losses valued at Int$ 110 312 390 440, that is 7.0%. About 98% of these losses are attributed to protein-energy malnutrition (PEM) and iron-deficiency anaemia.

For a while now, we have been seeing a gradual increase in noncommunicable diseases (NCDs). Results show that DALYs accrued from NCDs were valued at Int$ 1 107 489 132 375, which is 37% of the total loss (**Annex 1, Table 3**). This was the highest cause of loss in productivity by disease group or condition. This productivity loss originated from 16 categories of NCDs, with cardiovascular disease (22.9%) and malignant neoplasms (cancers, 11.4%) accounting for the bulk of productivity losses. These are huge losses resulting from what could be preventable causes of morbidity and premature mortality.

Injuries are also causing a significant loss in productivity in the Region. The productivity losses attributable to injuries were valued at Int$ 290 040 286 090, or 10% of the total losses. Unintentional injuries constitute 77.8% and intentional injuries 22.2% of the productivity losses. Road accidents and drowning account for 44.3% of the unintentional injuries economic losses, while self-harm and interpersonal violence are responsible for 87.2% of intentional injuries productivity losses (**Annex 1, Table 4**).

Productivity losses in 2015 by the World Bank Income Group

As shown in **Table 5,** the 47 countries of the WHO African Region are distributed across four categories in the World Bank economic classification. One of the countries is a high-income economy, nine are upper-middle-income economies, 17 are lower-middle-income economies and 27 are low-income economies. In this study, analysis was done for three groups: high and upper-middle-income economies, lower-middle-income economies and low-income economies.

Table 5. Countries by World Bank income group

Income group	Gross national income (GNI)* per capita in US$	Countries
High-income economies (HIC)	> 12 475	Seychelles (1)
Upper-middle-income economies (UMIC)	4 036 – 12 475	Algeria, Angola, Botswana, Equatorial Guinea, Gabon, Mauritius, Namibia, South Africa (8)
Lower-middle-income economies (LMIC)	1 026 – 4 035	Cabo Verde, Cameroon, Congo, Côte d'Ivoire, Eswatini, Ghana, Kenya, Lesotho, Mauritania, Nigeria, Sao Tome and Principe, Zambia (12)
Low-income economies (LIC)	<= 1 025	Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Senegal, Sierra Leone, South Sudan, Togo, Uganda, United Republic of Tanzania, Zimbabwe (26)

Source: World Bank [1]. * The World Bank's fiscal year used in this study is FY17, which corresponds to the period of 1 July 2015 to 30 June 2016. In the following fiscal year (FY18), Angola was reclassified as LMIC.

In 2015, countries in the African Region lost a total of 629 603 271 DALYs (**Table 2**), which is equivalent to a productivity cost of **Int$ 2 429 764 432 048** (**Table 3**). **Table 6** shows the productivity costs of the countries by World Bank Income Group. The average cost per DALY of high and upper-middle-income countries (Group 1) was two times and seven times higher than that of lower-middle-income countries (Group 2) and low-income countries (Group 3), respectively.

Table 6. Productivity costs by World Bank income group

Summary of Productivity cost	HICs and UMICs Sub-Total Cost (Int$)	LMICs Sub-Total Cost (Int$)	LICs Sub-Total Cost (Int$)	Grand total cost (Int$)
(1) Total cost of DALYs	728 318 308 818	1 194 679 808 932	506 766 314 299	2 429 764 432 048
(2) Average cost per DALY	10 625.55	4 937.87	1 588.03	3 859.20
(3) Average cost per person in population	5 524.29	3 604.46	956.19	2 446.23

Productivity costs borne by Group 1 countries

The DALYs accrued in HICs and UMICs resulted in an economic loss of **Int$ 728 318 308 818** in 2015 (**Table 6**), which was equal to 42.31% of the group's total GDP in 2015. The estimated total value of DALYS accrued varied greatly, from **Int$ 811 854 561** in Seychelles to **Int$ 330 505 005 681** in South Africa. Of the total productivity loss accrued across the high and upper-middle-income countries about 67.5% was borne by Angola and South Africa.

The DALYs accrued by LMICs resulted in a total loss of **Int$ 1 194 679 808 932**, or 51.38% of the group's total GDP in 2015. The loss varied from **Int$ 242 375 111** in Sao Tome and Principe to **Int$ 879 059 495 828** in Nigeria. Approximately 50.9% of loss in LMICs was borne by Nigeria and about 80% of Group 2's loss was borne by Egypt, Morocco, Nigeria and Sudan.

The estimated DALYs accrued in LICs led to a total loss of Int$ 506 766 314 299 in 2015, or 56.1% of the group's total GDP. The loss ranged from a minimum of Int$ 554 802 983 in Comoros to a maximum of Int$ 88 425 883 890 in Ethiopia, which bore 17.4% of the group's loss. The distribution of total productivity cost of DALY lost in LICs across the 26 LICs was highest in the Democratic Republic of the Congo, Ethiopia, Uganda and United Republic of Tanzania, which together accounted for 49.4% of the loss in this group.

Productivity losses by sub-region in the WHO African Region, 2015

Table 7 provides a breakdown of the burden of disease by sub-region in the WHO African Region. Although the Central African region had the lowest population in 2015, the largest DALYs and productivity losses per capita were incurred in this sub-region. This is in part explained by the fact that the sub-region has a higher number of upper middle-income countries than any other sub-region in the WHO African Region. Thus, the loss in productivity due to ill health is likely to be higher than in others with lower GDP per capita.

Table 7. Loss in productivity due to ill health in the African Region

WHO African Region sub-region	DALYs accumulated in 2015	DALYS per capita	Productivity losses 2015 int $	Productivity losses per capita
Central Africa	97 948 043	0.77	329 445 965 709	2 340.32
East and Southern Africa	232 686 496	0.61	779 046 225 086	2 086.09
West Africa	322 799 064	0.70	1 321 272 241 253	2 876.01
Total	**653 433 603**	**0.69**	**2 429 764 432 048**	**2 488.64**

Productivity costs by the Regional Economic Communities

The main regional economic communities (RECs) in the African Region include the East African Community (EAC), the Economic Community of Central African States (ECCAS), the Economic Community for the West African States (ECOWAS) and the Southern African Development Community (SADC) (**Table 8**). Some countries are members of more than one REC.

Table 8. Membership of regional economic communities

EAC	ECCAS	ECOWAS	SADC
5 countries	10 countries	15 countries	15 countries
Burundi, Kenya, Rwanda, Uganda, United Republic of Tanzania	Angola, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Sao Tome and Principe	Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo	Angola, Botswana, Democratic Republic of the Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, United Republic of Tanzania, Zambia, Zimbabwe

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" Of all the regional economic communities, ECOWAS bore the brunt of the burden of disease in 2015, together with the high productivity costs accrued… "

Table 9 summarizes the non-health GDP lost due to DALY losses in the key RECs in the African Region. Of all the RECs, ECOWAS bore the brunt of the burden of disease in 2015, together with the high productivity costs accrued. The EAC had the least DALYs and productivity costs accrued.

Table 9. Productivity costs due to DALY losses in the key RECs in Int$ in the WHO African Region, 2015

Summary of productivity cost (subtotal cost Int$)	EAC	ECCAS	ECOWAS	SADC
1. Total cost of DALYs accrued	203 843 476 166	363 913 767 595	1129 034 100 108	773 556751 149
2. Average cost per DALY	2 485	2 842	4 283	3 862
3. Average cost per person in population	1 263	2 231	3 234	2 410

The 82 017 651 DALYs accrued in the EAC region in 2015 have led to a productivity cost of **Int$ 203 843 476 166**, which is equivalent to **48.75%** of the Region's 2015 GDP. Kenya and the United Republic of Tanzania bore 73.5 % of the EAC countries economic loss. The average costs per person and per DALY for the EAC were Int$ 1263 and Int$ 2485, respectively. However, productivity cost per capita varied from a minimum of Int$ 504 in Burundi to a maximum of Int$ 1508 in the United Republic of Tanzania, and cost per DALY ranged from Int$ 764 in Burundi to Int$ 3167 in Kenya. NCDs accounted for about 47% of the productivity cost accrued in the EAC, whereas neonatal and HIV/AIDS accounted for 18% and 13%, respectively.

The 128 037 282 DALYs accrued in the ECCAS region in 2015 were valued at productivity costs amounting to Int$ 363 913 767 595, which is equivalent to 77 % of the Region's GDP in 2015. About 62.7% of ECCAS GDP loss was borne by Angola and Cameroon. The average costs per person and per DALY for ECCAS are Int$ 2231 and Int$ 2842, respectively. However, the cost per person varies from Int$ 504 in Burundi to Int$ 25 781 in Equatorial Guinea, and the cost per DALY ranges from Int$ 626 in Central African Republic to Int$ 37 598 in Equatorial Guinea. In ECCAS, the NCDs accounted for about 43% of the productivity cost, while neonatal conditions account for 26%.

The 263 631 088 DALYs accrued in the ECOWAS region in 2015 are valued at Int$ 1 129 034 100 108 lost productivity; which is equivalent to 75% of the region's GDP in 2015. Approximately 78% of ECOWAS' GDP loss was borne by Nigeria. The average costs per person and per DALY for ECOWAS were Int$ 3234 and Int$ 4283, respectively. The cost per person varied from Int$ 436 in Liberia to Int$ 4,82 in Nigeria; while cost per DALY varied from Int$ 747 in Liberia to Int$ 6340 in Cabo Verde. The NCDs accounted for 40% of the losses, while neonatal conditions and HIV/AIDS were responsible for 22% and 12%, respectively.

Nearly 65.6% of SADC GDP loss was borne by Angola and South Africa. The average costs per person and per DALY for SADC were Int$ 3234 and Int$ 4283, respectively. The cost per person varied from a minimum of Int$ 534 in the Democratic Republic of the Congo to a maximum of Int$ 8457 in Seychelles; and cost per DALY varied from Int$ 739 in the Democratic Republic of the Congo to Int$ 27 345 in Seychelles. The NCDs, neonatal conditions and HIV/AIDS accounted for 57%, 17% and 7% of the productivity cost, respectively.

Productivity costs (in 2015 Int$ or PPP) assuming the SDG targets were to be achieved

SDG 3 is about ensuring healthy lives and promoting well-being for all at all ages. It has 13 targets. The analysis in this section relates to five of those targets:

SDG 3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100 000 live births [3].

SDG 3.2: By 2030, end preventable deaths of new-borns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births [3].

SDG 3.3: By 2030, end the epidemics of AIDS, TB, malaria and neglected tropical diseases (NTDs), and combat hepatitis, water-borne diseases and other communicable diseases [3].

SDG 3.4: By 2030, reduce by one third premature mortality from noncommunicable diseases through prevention and treatment and promote mental health and well-being [3].

SDG 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents [3].

Since SDG 3.3 is not specific, the targets for AIDS, TB, malaria and NTDs contained in WHO global and regional strategies were used. For example, WHO strategies envisage:

- By 2020, HIV-related deaths reduced to below 287 000 from a 2014 baseline of 790 000, that is 63.67% [23].
- By 2030, reduce malaria mortality rates globally by at least 90% compared with 2015 [25].
- By 2030, reduce number of TB deaths by 90% compared with 2015 [24].
- By 2030, reduce mortality due to vector-borne diseases globally by at least 75% relative to 2016 [26].

Table 10 indicates the decrease in productivity cost (productivity losses) if health SDG targets are achieved by 2030. It compares the Scenario 1 (Status Quo) potential economic losses with those of Scenario 2 (health SDG targets). In the Status Quo scenario, the SDG health conditions accounted for Int$ 1 688 770 859 224 (43%) of the total economic losses from all causes of illness. The analysis here is not limited to the WHO African Region but includes all countries on the continent for which there were data.

Table 10. Decrease in productivity cost (productivity losses) if health SDG targets are achieved by 2030

SDG targets	Scenario 1: Status Quo economic losses (A)	Scenario 2: Economic losses if health SDG targets are fully achieved (B)	(C) Decrease (Int$) (C=A-B)	(D) % Decrease = [(C/A) x 100]
3.1 Maternal mortality	45 589 121 253	5 887 893 889	39 701 227 364	87
3.2 Neonatal Mortality	347 336 223 573	148 858 381 531	198 477 842 042	57
3.2 Under 5 mortality	1 100 363 226 951	338 365 075 938	761 998 151 013	69
3.3 AIDs mortality	230 410 682 552	83 706 159 357	146 704 523 194	64
3.3 TB mortality	83 427 759 883	8 342 775 988	75 084 983 894	90
3.3 Malaria mortality	116 896 902 182	11 689 690 218	105 207 211 964	90
3.3 NTD mortality	31 217 670 130	7 804 417 533	23 413 252 598	75
SDG 3.4: NCDs	1 107 489 132 375	738 326 088 250	369 163 044 125	33
SDG 3.6: Road injuries	73 739 590 850	36 869 795 425	36 869 795 425	50
Total	**1 688 770 859 224**	**892 626 820 660**	**796 144 038 564**	**47**

Note: *To avoid double counting the totals in this table exclude the economic losses related to neonatal and under five mortalities. The losses and savings (decreases) mentioned in this table are for one year.*

If the continent accelerates implementation of the relevant interventions and succeeds in fully achieving the health SDG targets mentioned above, the related economic losses in 2030 would be Int$ 892 626 820 660. Thus, full achievement of health SDG targets mentioned in this section would reduce the continental economic losses by Int$ 796 144 038 564, which is 47% of Scenario 1 losses.

Chapter 4. Discussion

The results of this study demonstrate that diseases and health conditions in the WHO African Region are responsible for substantial losses in both health (as measured by DALYs acting as a proxy), and current and future economic productivities (as measured in Int$). The average cost per DALY of HICs and UMICs is twofold and sevenfold higher than that of LMICS and LICs, respectively.

4.1 SDG Targets 3.1 and 3.2

Should the maternal and neonatal health conditions of scenario 1 be sustained, the WHO African Region would incur a productivity cost of Int$ 45 589 21 253 and Int$ 347 336 223 573 every year, respectively. However, full achievement of Targets 3.1 and 3.2 would enable the WHO Africa Region to reduce the loss to Int$ 887 893 889 (87%) and Int$ 148 858 381 531 (57%)in 2030 alone, following reductions in the DALYs of the maternal and neonatal conditions burdens. Such savings can be realized if the Global Strategy for Women's, Children's and Adolescents' Health (2016-2030) (29), recommendations of the Commission on Women's Health in the African Region (30), and the regional strategic plan for immunization (31) among others are fully implemented in countries of the

Region. In addition to economic gains, the WHO African Region would be able to ensure that "… every woman, child and adolescent in every setting realizes her or his right to physical and mental health and well-being, enjoys social and economic opportunities, and is able to participate fully in shaping prosperous and sustainable societies" (27). Such endeavours ought to be buttressed with creation of sustained enabling health systems and socioeconomic determinants environments, and high-level commitment and adequate financing.

Innovative financing approaches such as the Global Financing Facility in support of Every Woman Every Child provide opportunities for smart, scalable and sustainable financing. As a recent report shows, the external financing for maternal and newborn health increased by 5.5% between 2010 and 2016 (32). These opportunities bode well for improving maternal health but nevertheless place a great need for increasing domestic financing for health.

SDG Target 3.3: AIDS, TB, malaria and NTDs

Table 11 presents productivity costs and savings in the 2015 SDG priority communicable diseases DALY cohort in Africa.

Table 11. 2015 DALY cohort productivity costs in Africa and savings for SDG priority communicable diseases

Communicable diseases SDG targets	Scenario 1: NHGDP losses	Scenario 2: NHGDP losses	Decrease or savings in Int$
3.3 AIDs mortality	230 410 682 552	83 706 159 357	146 704 523 194
3.3 TB mortality	83 427 759 883	8 342 775 988	75 084 983 894
3.3 Malaria mortality	116 896 902 182	11 689 690 218	105 207 211 964
3.3 NTDs mortality	31 217 670 130	7 804 417 533	23 413 252 598
TOTAL (2015 Int$)	**461 953 014 747**	**111 543 043 096**	**350 409 971 650**

Note: The economic losses and potential savings reported in this table are only for the DALYs accrued in 2015.

If the current epidemiological trends do not change, a continuing status quo (Scenario 1) until 2030 will cost WHO African Region GDP losses equivalent to at least Int$ 461 953 014 747. However, full achievement of the SDG 3.3 targets related to HIV/AIDS, TB, malaria and NTDs would reduce the losses to approximately Int$ 111 543 043 096 in 2030 alone. Thus, intuitively, the benefits of achieving the SDG 3.3 targets would greatly surpass the cost of health interventions into those diseases.

The savings implied in **Table 11** could be realized if all countries fully achieved SDG Target 3.3 by 2030. This is feasible if countries accelerate and intensify the implementation of the cost-effective interventions recommended in various relevant global and regional strategies and plans adopted by the World Health Assembly and the regional committees. Such strategies include:

► The global health sector strategies for HIV/AIDS, viral hepatitis, sexually transmitted infections, which were endorsed in May 2016 by the Sixty-ninth World Health Assembly resolutions WHA69.22 (33–35).

► The End TB Strategy, which was adopted in 2014 by the Sixty-seventh World Health Assembly resolution WHA67.1 (36).

► The Global technical strategy for malaria 2016-2030, which was endorsed in May 2015 by the Sixty-eighth World Health Assembly resolution WHA68.2 (37).

► The Global plan to combat neglected tropical diseases 2008–2015 (34) and its roadmap for accelerated implementation (38); and more

A recent report shows that while the initial rate of growth of external financing for HIV/AIDS, TB and malaria saw great gains (6.6% to 13.2% from 1990 to 1999 and more than 20% for the period 2000–2009) this has begun to slow down, with less than 5% gains from 2010 to 2016. In the case of HIV/AIDS, there has even been a decrease in funding from 2010 to 2016 (32).

In light of this, the spotlight is placed on greater domestic resource mobilization of financing for health and greater efficiency for mobilized resources (domestic and external) with a focus on integration for maximum effectiveness.

4.2 SDG Target 3.4: Noncommunicable diseases

This study estimates that in 2015 the WHO African Region lost DALYs worth Int$ 1 107 489 132 375. The envisioned SDG target 3.4 reduction by one third of the burden of NCDs translates into annual savings of Int$ 369 163 044 125. Such savings are achievable through expanded effective coverage of the cost-effective interventions contained in various NCD-related global strategies and plans adopted in the past.

Examples of such strategies and plans include the Global strategy for the prevention and control of noncommunicable diseases, which was endorsed in 2000 by the Fifty-third World Health Assembly resolution WHA 53.14 (39); the Global action plan for the prevention and control of noncommunicable diseases, endorsed in May 2013 by the Sixty-sixth World Health Assembly resolution; WHA 66.10 (40); the Global strategy on diet, physical activity and health (41); the Global 2004 oral health action plan (42); tobacco control (43); mental health action plan (44); health promotion strategy (45); regional determinants of health strategy (46).

These interventions will require substantial increases in NCDs financing than has been the case before. NCDs accounted for 1.2% of all development assistance for health (DAH) in 2011 (47), or US$ 377 million. DAH for NCDs is increasing slowly, as shown by a recent report that estimates that of the 37 billion USD spent on health in 2016, 1.73% was spent on NCDs, despite the growing burden of those diseases (32).

4.3 SDG Target 3.6: Road traffic injuries

The road traffic injuries sustained in the WHO African Region in 2015 led to productivity losses worth Int$ 73 739 590 850. We estimate that economic loss can be reduced by Int$ 36 869 795 425 in 2030 if SDG Target 3.4 is fully achieved.

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Such savings are achievable through cost-effective policy interventions contained in the Global Plan for the Decade of Action for Road Safety 2011–2020 (48), which were backed up by a resolution of United Nations General Assembly.

The findings of this study show that there are great economic gains to be made from a comprehensive rather than a selective approach to investing in health. Member States in the WHO African Region endorsed a framework of actions geared towards strengthening health systems for UHC and the SDGs (49). This framework recognizes the indivisibility of the SDGs, and therefore the need to tackle social determinants of health in addition to the biomedical determinants of health. An integrated approach to building health systems and integrated person-centred service delivery are also emphasized. Furthermore, the framework emphasizes the development of a package of essential services across the life cohort tailored to address the burden of disease within each country.

4.4 Limitations of the study

There are several limitations inherent in the type of analysis presented in this study. Firstly, the study focuses only on productivity losses associated with morbidity and premature mortality and does not include direct costs, such as the health systems and household resources spent on prevention, diagnosis and treatment of various diseases. Thus, the estimates are likely to be underestimates of the total cost of illness from the various diseases that afflict people in Africa.

Secondly, the GDP per capita gives no indication of how available national output or income is distributed across individuals and households. This is a general limitation of using averages, as they mask gross inequalities that exist within countries in the Region.

Thirdly, the GDP only captures economic activities associated with market transactions. It omits the value of full-time home makers (domestic labour), the majority of whom are women. In order to reduce the impact of this omission on the estimated productivity losses, mortality and morbidity for men and women are both valued at the prevailing GDP per capita. In addition, disability and death of those aged below 14 years represents intra – and inter-generational depletion or attrition of future labour force. Thus, these losses are also valued at the 2015 GDP per capita.

Fourthly, morbidity and mortality cause psychological pain, stress and anxiety among family members which is not captured in GDP calculations. There is evidence that disability and mortality of a parent or a breadwinner often negatively impacts on nutrition and education of children. Psychic losses can only be captured using willingness-to-pay (contingent valuation) approach, which was beyond the scope of the current project.

Fifthly, the cost-of-illness or human capital method, as used here, estimates the value of human lives lost due to specific diseases (illness) and does not provide the estimates of costs and consequences of alternative interventions into those diseases. Therefore, estimates from these approaches should strictly be used for raising public awareness of policy-makers, development partners and the public on the economic magnitudes of disease and health conditions for advocacy. The estimates should never be used as a guide for decision-making.

Furthermore, the burden of disease estimates also provide a disaggregation of the disease burden by gender. This study is limited, in that it did not assess the distribution of productivity losses by gender, which could strategically guide investments for health in Africa.

Finally, WHO and the Institute for Health Metrics and Evaluation (IHME) DALY and mortality statistics for various African countries are estimates derived using a battery of methods. This is because the vital registration of births and deaths and the national health information systems in many countries are still weak. However, they are the only sources of internationally comparable data today.

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> " Approximately 47% (**Int$ 796 144 038 564**) of the total productivity cost of illness could be avoided (or spared) in 2030 if the SDG targets related to those health conditions are fully achieved "

Chapter 5. Conclusions

This study estimated the total productivity cost of illness from all causes by age group, economic classification of countries and regional economic communities. The yearly productivity cost is substantial. A majority of 56.61% of the total productivity cost is attributed to maternal conditions, AIDS, TB, malaria, NTDs, NCDs and road traffic injuries. Approximately 47% (Int$ 796 144 038 564) of that cost could be avoided (or spared) in 2030 if the SDG targets related to those health conditions are fully achieved.

The health SDG targets will be fully achieved if and only if countries invest adequately in the development of resilient national and local health systems to effectively, affordably and efficiently deliver the integrated packages of proven cost-effective interventions contained in relevant programmatic global strategies and plans to target populations in need (50–52).

Since health is wealth, the full achievement of health SDG targets will lift the poor from poverty, reduce inequities, tackle exclusion, enhance economic productivity and enhance different population groups capacities to flourish (52).

The findings contained in this report suggest that health systems strengthening should focus on rich as well as on poor countries, on all ages, and on specific disease categories. The rationale for this policy stance is outlined below.

Low-income countries: Since DALYs are highest in these countries, the health of the African population cannot be improved substantially without reducing disease prevalence and premature deaths.

Middle and upper-income countries: Since economic productivities are highest in these countries, the economic losses associated with ill-health and premature deaths are also high. Thus, the returns on investments that reduce DALYs are highest in high-income economies.

Age groups: For health equity reasons, health-improving interventions should be implemented in all age groups, in proportion to group shares in total DALYs.

Specific diseases: Maternal, perinatal and nutrition conditions are associated with nearly 50% of DALYs in Africa. Thus, health SDG goals cannot be achieved without investing heavily in interventions that target these conditions.

These results add to the evidence base on the need for greater investment for health in the WHO African Region considering the likely returns on investment. The additional costs of achieving the SDGs in LICs entail and increment per annum of 671 billion dollars. For Africa, the study shows that this is less than three trillion that was lost in 2015 alone due to ill-health and premature mortality.

Finally, given the externalities associated with some health conditions, such as Ebola Virus Disease (EVD), effective control of diseases in the WHO African Region is not possible without collaboration across regional groups, national governments and continental institutions, such as the African Development Bank and the African Union. Partnerships across different funders of national health systems are also needed for success in the fight against morbidity and premature mortality in Africa. Africa's very large share in global DALYs is arguably responsible for the widespread poverty on the continent.

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Annex 1. Indirect costs associated with DALYs by disease or condition

Table 12.   Productivity losses due to infectious and parasitic diseases, 2015

Infectious and parasitic diseases		Productivity costs (in 2015 Int$ or PPP)	%
A.	Tuberculosis	83 427 759 883	10.3
B.	STDs excluding HIV	22 741 067 312	2.8
C.	HIV/AIDS	230 410 682 552	28.5
D.	Diarrhoeal diseases	169 088 528 093	20.9
E.	Childhood-cluster diseases	47 501 150 910	5.9
F.	Meningitis	55 005 269 470	6.8
G.	Encephalitis	5 821 261 425	0.7
H.	Hepatitis	6 295 190 966	0.8
I.	Parasitic and vector diseases	146 998 562 781	18.2
J.	Malaria	116 896 902 182	79.5
K.	Others	30 101 660 599	20.5
L.	Intestinal nematode infections	4 412 890 689	0.5
M.	Leprosy	223 829 651	0.0
N.	Other infectious diseases	36 744 720 026	4.5

Table 13.   Productivity losses due to maternal, neonatal and nutrition-related conditions

Health conditions and deficiencies		Productivity cost (in 2015 Int$ or PPP)	%
A.	Maternal conditions	45 589 121 253	2.9
B.	Neonatal conditions (1+2+3+4)	347 336 223 573	21.9
	1. Birth asphyxia and birth trauma	142 717 295 793	41.1
	2. Birth asphyxia and birth trauma	121 514 495 532	35.0
	3. Neonatal sepsis and infections	60 640 236 622	17.5
	4. Other neonatal conditions	22 464 195 626	6.5
C.	Nutritional deficiencies (1+2+3+4+5)	110 312 390 441	7.0
	1. Protein-energy malnutrition	52 298 305 505	47.4
	2. Iodine deficiency	2 491 039 464	2.3
	3. Vitamin A deficiency	288 821 409	0.3
	4. Iron-deficiency anaemia	54 343 374 668	49.3
	5. Other nutritional deficiencies	890 849 395	0.8

Table 14.   Productivity losses due to NCDs

NCDs		Productivity costs (in 2015 Int$ or PPP)	%
A.	Malignant neoplasms (Cancers)	126 314 230 767	11.4
B.	Other neoplasms	4 997 795 276	0.5
C.	Diabetes mellitus	7 182 064 105	6.1
D.	Endocrine, blood, immune disorders (include sickle cell disease and other haemoglobinopathies)	54 584 182 184	4.9
E.	Mental and substance use disorders	119 565 812 126	10.8
F.	Neurological conditions	56 124 454 590	5.1
G.	Sense organ diseases (include vision and hearing loss)	42 927 720 788	3.9
H.	Cardiovascular diseases (include hypertension, stroke etc)	253 714 773 003	22.9
I.	Respiratory diseases (asthma, chronic obstructive pulmonary disease, etc.)	56 617 076 488	5.1
J.	Digestive diseases (include peptic ulcer disease, inflammatory bowel disease, pancreatitis appendicitis, etc.)	87 031 457 876	7.9
K.	Genitourinary diseases (include kidney disease, Benign prostatic hyperplasia, infertility and gynaecological conditions)	48 140 815 180	4.3
L.	Skin diseases	19 055 759 214	1.7
M.	Musculoskeletal diseases	60 ,867 569 248	5.5
N.	Congenital anomalies	97 857 016 235	8.8
O.	Oral conditions	10 474 228 738	0.9
P.	Sudden infant death syndrome	2 034 176 558	0.2
Total productivity losses due to NCDs		**1 047 489 132 376**	100

Table 15.   Productivity losses due to injuries in 2015

Injuries	Productivity costs (in 2015 Int$ or PPP)	%
A. Unintentional injuries *(include road traffic accidents, drowning, natural disasters, falls, etc.)*	225 680 494 649	77.8
B. Intentional injuries *(include self-harm and interpersonal violence)*	64 359 791 441	22.2

Annex 2. Equations for other diseases or conditions under scenario 2

1. Target 3.2: By 2030, end preventable deaths of new-borns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under 5 mortality to at least as low as 25 per 1000live births. Africa's 2030 non-health GDP loss from neonatal mortality (NM) [3] under scenario 2 was estimated as follows:

$$NHGDPLoss_{NM2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{NM2015} - \left[NHGDPLoss_{NM2015} \times \left(\left(NM2015 - SDG3.2 \right) / NM2015 \right) \right] \right\}$$

$NHGDPLoss_{NM2015}$ = Int\$ 347 336 223 573 in Scenario 1 [20,21]

NM2015 = 28 per 1000 live births in the WHO African Region 2015 [22]

SDG3.2 = 12 per 1000 live births [3]

$NHGDPLoss_{NM2030}$ = 347 336 223 573 - (347 336 223 573 ×((28-12)/28))) = Int\$ 148 858 381 531 .

Africa's 2030 non-health GDP loss from under five morbidity and mortality (U5M) was estimated as follows:

$$NHGDPLoss_{U5M2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{U5NM2015} - \left[NHGDPLoss_{U5M2015} \times \left(\left(U5M2015 - SDG3.2 \right) / U5M2015 \right) \right] \right\}.$$

$NHGDPLoss_{U5M2015}$ = Int\$ 1,100,363,226,951 in Scenario 1[20,21]

U5M2015 = 81.3per 1,000 live births in the WHO African Region 2015 [22]

SDG3.2 =25 per 1,000 live births [3]

$NHGDPLoss_{NM2030}$ = 1 100 363 226 951 - (1 100 363 226 951 ×((81.3-25)/81.3))) = Int\$ 338 365 075 938.

2. Target 3: By 2030, end epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases. By 2020, HIV-related deaths reduced to below 287 000 from a 2014 baseline of 790 000, i.e. 63.67% [23].Africa's 2030 non-health GDP loss from AIDs morbidity and mortality (AM) was estimated as follows:

$$NHGDPLoss_{AID2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{AID2015} - \left[NHGDPLoss_{AID2015} \times \left(\left(AM2014 - A2020 \right) / AM2014 \right) \right] \right\}.$$

$NHGDPLoss_{AID2015}$ = Int\$ 230 410 682 552 in Scenario 1[20,21]

AM2014 = 790 000 deaths in the WHO African Region 2015 [23]

AM2020 = 287 000 deaths in the WHO African Region 2020 [23]

$NHGDPLoss_{AID2030}$ = 230 410 682 552 - (230 410 682 552 ×((790 000-)/287 000))) = Int\$ 83 706 159 357.

The WHO End TB Strategy target is "By 2030, reduce number of TB deaths by 90% compared with 2015" [24]. Africa's 2030 non-health GDP loss from DALYs accrued to Tuberculosis morbidity and mortality was estimated as follows:

$$NHGDPLoss_{TB2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{TB2015} - \left[NHGDPLoss_{TB2015} \times SDG3.2_{TB} \right] \right\}.$$

$NHGDPLoss_{TB2015}$ = Int\$ 83 427 759 883 in Scenario 1[20,21]

SDG3.2TB= 90% reducion in number of TB deaths by 2030 compared with 2015 [24]

$NHGDPLoss_{TB2030}$ = Int\$ 83 427 759 883 - (Int\$ 83 427 759 883 × 0.9) = Int\$ 8 342 775 988.

The WHO Global technical strategy for malaria 2016-2030 target is "By 2030, reduce malaria mortality rates globally by at least 90% compared with 2015" [25]. Africa's 2030 non-health GDP loss from DALYs accrued to malaria morbidity and mortality was estimated as follows:

$$NHGDPLoss_{MAL2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{MAL2015} - \left[NHGDPLoss_{MAL2015} \times SDG3.2_{MAL} \right] \right\}.$$

$NHGDPLoss_{MAL2015}$ = Int\$ 116,896,902,182 in Scenario 1[20,21]

$SDG3.2_{MAL}$ = 90% reduction in malaria mortality rates globally by 2030 compared with 2015 [25]

$NHGDPLoss_{MAL2030}$ = Int\$ 116,896,902,182 - (Int\$ 116,896,902,182 × 0.9) = Int\$11,689,690,218.

The WHO Draft Global Vector Control Response at a Glance target is "By 2030, reduce mortality due to vector-borne diseases globally by at least 75% relative to 2015[26]. Africa's 2030 non-health GDP loss from DALYs accrued to NTDs morbidity and mortality was estimated as follows:

$$NHGDPLoss_{NTD2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{NTD2015} - \left[NHGDPLoss_{NTD2015} \times SDG3.2_{NTD} \right] \right\}.$$

$NHGDPLoss_{NTD2015}$ = Int\$ 31,217,670,130 in Scenario 1[20,21]

$SDG3.2_{NTD}$ = 75% reduction in mortality due to vector-borne diseases globally by 2030 compared with 2015 [26]

$NHGDPLoss_{NTD2030}$ = Int\$ 31,217,670,130 - (Int\$ 31,217,670,130 × 0.75) = Int\$7,804,417,533 .

3. The health SDG Target 3.4 indicates "By 2030, reduce by one third premature mortality from non-communicable diseases (NCD) through prevention and treatment and promote mental health and well-being" [3]. Africa's 2030 non-health GDP loss from DALYs accrued to NCD morbidity and mortality was estimated as follows:

$$NHGDPLoss_{NCD2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{NCD2015} - \left[NHGDPLoss_{NCD2015} \times SDG3.4_{NCD} \right] \right\}.$$

$NHGDPLoss_{NCD2015}$ = Int\$ 1,107,489,132,375 in Scenario 1[20,21]

$SDG3.4_{NCD}$ = 33.333333% reduction in premature mortality from NCDs by 2030 compared with 2015 [3]

$NHGDPLoss_{NCD2030}$ = Int\$ 1,107,489,132,375 - (Int\$1,107,489,132,375 × 0.333333) = Int\$738,326,088,250 .

4. The health SDG Target 3.6 indicates "By 2020, halve the number of global deaths and injuries from road traffic accidents" [3]. Africa's 2030 non-health GDP loss from DALYs accrued to injuries (INJ) morbidity and mortality was estimated as follows:

$$NHGDPLoss_{INJ2030} = \sum_{country=1}^{country=n} \left\{ NHGDPLoss_{INJ2015} - \left[NHGDPLoss_{INJ2015} \times SDG3.6_{INJ} \right] \right\}.$$

$NHGDPLoss_{INJ2015}$ = Int\$73,739,590,850 in Scenario 1 [20,21]

$SDG3.6_{INJ}$ = halve (50%) the number of global deaths and injuries from road traffic accidents by 2030 compared with 2015[3]

$NHGDPLoss_{NCD2030}$ = Int\$73,739,590,850 - (Int\$73,739,590,850 × 0.5) = Int\$36,869,795,425 .

The diseases afflicting the African population are responsible for a substantial loss in health, estimated at 704 765 879 DALYs (disability-adjusted life years) in 2015 alone.

This study quantifies the GDP losses associated with DALYs, with estimates for all causes of DALYs by age group, by World Bank income group classification of countries and by regional economic community.

These estimates make a case for countries in the Region to invest sustainably in health. This study illustrates how achievement of critical health SDG targets would contribute to poverty eradication efforts on a large scale, reduce disparities in lifespan, tackle social exclusion and promote political stability and economic development in the WHO African Region.

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