

# The Monetary Value of Disability-Adjusted-Life-Years Lost in the East African Community in 2015

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## Abstract

The East African Community (EAC) member states (Burundi, Kenya, Rwanda, Tanzania and Uganda) incur annually a huge loss of disability-adjusted life years (DALY) from communicable and non-communicable diseases and injuries annually. This study estimated the monetary value of DALYs lost in the EAC in 2015 without and with UN the health Sustainable Development Goal 3. The monetary value of DALYs lost in the EAC was estimated by multiplying the estimated DALYs associated with different diseases by GDP per capita net of health expenditures. The 82,017,651 DALYs lost in EAC in 2015 had a monetary value of Int\$ 203,843,476,166. About 58.2% resulted from Communicable, maternal, perinatal and nutritional conditions; 30.3% from non-communicable diseases (NCDs); and 11.5% from injuries. Burundi incurred 2.8% of the total monetary value of DALYs, Kenya 33.9%, Rwanda 4.2%, Tanzania 39.5%, and Uganda 19.6%. The EAC could save approximately 31% of the total monetary value of DALYs lost if SDG 3 targets are fully achieved. Therefore, EAC member states should invest adequately into strengthening of national health systems and other systems that address social determinants to ensure healthy lives and promotion of well-being for all people at all ages.

## Keywords

Disability-Adjusted-Life-Year (DALY), Gross Domestic Product, Monetary Value of DALY, East African Community

## 1. Introduction

The East African Community (EAC) has five member states, *i.e.* Burundi,

Kenya, Rwanda, Tanzania and Uganda. The total population of EAC was 141,968,715 people in 2015 [1]. It was distributed as follows: 7.8% in Burundi; 32.4% in Kenya; 7.8% in Rwanda; 37.4% in Tanzania; and 14.5% in Uganda. In 2015, the total gross domestic product (GDP) for EAC was 389,311,000,000 International Dollars (Int\$) in 2015. The GDP per capita was Int\$ 836.6 for Burundi, Int\$ 3245.5 for Kenya, Int\$ 1782.6 for Rwanda, Int\$ 2900.8 for Tanzania, and Int\$ 1999.3 for Uganda [2].

In 2015 the EAC lost 82,017,651 disability-adjusted-life-years (DALY) mainly due to inadequately resourced health systems [3] and other systems that meet basic needs (e.g. education, food, shelter, sanitation, water) [4]. The per capita total expenditure on health for EAC countries is between US\$22 and US\$78 [5]; which is far much lower than US\$ 112 to US\$ 146 per person per year recommended for achieving United Nations Sustainable Development Goal 3 (SDG3) on health [6].

The low spending on health development is partially attributed to lack of evidence on monetary value of health losses for use in advocacy with Ministries of Finance, private sector and development partners to increase investments towards attainment of the SDG 3. Monetary values of health losses from various diseases and conditions have been used to raise the awareness of non-public health policy-makers and actors in developed countries [7] [8] [9] [10].

To the best of our knowledge no study has attempted to estimate the monetary value of DALYs lost from a wide spectrum of diseases and conditions in the EAC. Therefore, the specific objectives of this study were: 1) to estimate the monetary value of DALYs lost in the EAC in 2015 without SDGs; and 2) to estimate the reductions in monetary value of DALY losses in EAC assuming SDG 3 related targets are achieved by 2030.

## 2. Methods

### 2.1. Estimation of the Monetary Value of DALYs Lost in the EAC in 2015 without SDGs

**Monetary valuation of DALYs:** The methods of calculating DALY are well documented in Murray [11] and WHO [12]. The study reported in this paper focuses on monetary valuation of DALYs lost from all diseases and conditions in the EAC in 2015. The literature generally has two main methods that can be used to value a DALY lost into money. One is the willingness to pay (WTP) for a statistical life year or a DALY; which relies on asking for the maximum amount of money an individual would be willing to give up in order to avert loss of a DALY [13].

Two is the lost output or human capital approach (HCA), which was first applied by Petty in 17<sup>th</sup> century [14], and whose theoretical basis was expounded in 20<sup>th</sup> century by Landefeld and Seskin [15], Weisbrod [16], Mushkin and Collings [17], and Fein [18]. The World Health Organization guidelines on economic impact of disease and injury proposed a further refinement in the following ex-

cerpt:

“A macroeconomic approach to assessing the impact of ill-health should be concerned with establishing the aggregate impact of disease and injury across different economic agents on three areas related to economic welfare (both now and in the future): non-health consumption possibilities, leisure time and health status. ... it is important to note that GDP includes expenditure on health goods and services, so this component should be omitted and the focus of analysis be redirected towards establishing the present value of discounted aggregate flows of current and future consumption of non-health related goods and services linked to disease” [19] p.4.

In line with WHO [19] [20], this study estimates the present value of discounted aggregate flows of current and future consumption of non-health related goods and services (non-health GDP) linked to a DALY lost from any cause. We applied HCA to convert the DALYs lost in ECA in 2015 into their monetary equivalents. Our choice of HCA was influenced by availability of data on GDP per capita, total health expenditure per capita and DALYs for EAC.

The EAC total monetary value of total DALYs (TMVD) lost from all causes is the sum of each of the five country’s monetary value of DALYs (CMVD) lost from all causes [21]:

$$TMVD_{EAC} = \sum_{country=i}^{country=5} \{CMVD_{ij}\} \tag{1}$$

where i = Burundi, Kenya, Rwanda, Tanzania and Uganda.

Each country’s  $CMVD_{ij}$  lost due to the  $j^{th}$  disease is the sum of MVD among people aged 0 - 4 years ( $MVD_{0-4}$ ), 5 - 14 years ( $MVD_{5-14}$ ), 15 - 29 years ( $MVD_{15-29}$ ), 30 - 49 years ( $MVD_{30-49}$ ), 50 - 59 years ( $MVD_{50-59}$ ), 60 - 69 years ( $MVD_{60-69}$ ), and 70 years and above ( $MVD_{\geq 70}$ ). The MVD associated with the  $j^{th}$  disease DALYs lost among people of a specific age group are the product of the per capita non-health GDP in purchasing power parity (PPP) and the total  $j^{th}$  disease DALYs lost within a specific age group [21].

The  $i^{th}$  country’s discounted total CMVD attributable to the  $j^{th}$  disease DALYs were estimated using Equations (2) through (9) below [21]:

$$CMVD_{ij} = MVD_{0-4} + MVD_{5-14} + MVD_{15-29} + MVD_{30-49} + MVD_{50-59} + MVD_{60-69} + MVD_{\geq 70} \tag{2}$$

$$MVD_{0-4} = [NHGDPPC_{Int\$}] \times [DALY_{0-4}] \tag{3}$$

$$MVD_{5-14} = [NHGDPPC_{Int\$}] \times [DALY_{5-14}] \tag{4}$$

$$MVD_{15-29} = [NHGDPPC_{Int\$}] \times [DALY_{15-29}] \tag{5}$$

$$MVD_{30-49} = [NHGDPPC_{Int\$}] \times [DALY_{30-49}] \tag{6}$$

$$MVD_{50-59} = [NHGDPPC_{Int\$}] \times [DALY_{50-59}] \tag{7}$$

$$MVD_{60-69} = [NHGDPPC_{Int\$}] \times [DALY_{60-69}] \tag{8}$$

$$MVD_{\geq 70} = [NHGDPPC_{Int\$}] \times [DALY_{\geq 70}] \tag{9}$$

where:  $NHGDPPC_{Int\$}$  is the per capita non-health GDP in purchasing power parity (PPP), which was obtained by subtracting the per capita total health expenditure (PCTHE) from the per capita GDP ( $GDPPC_{Int\$}$ );  $DALY_{0-4}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 0 - 4 years in country  $i$  in 2015;  $DALY_{5-14}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 5 - 14 years in country  $i$  in 2015;  $DALY_{15-29}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 15 - 29 years in country  $i$  in 2015;  $DALY_{30-49}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 30 - 49 years in country  $i$  in 2015;  $DALY_{50-59}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 50 - 59 years in country  $i$  in 2015;  $DALY_{60-69}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 60 - 69 years in country  $i$  in 2015; and  $DALY_{70+}$  is the total DALYs lost to the  $j^{th}$  disease among people aged 70 years and above in country  $i$  in 2015.

Discount factor was not introduced in Equations (3) to (9) because the DALY estimates published by the WHO in the Global Health Observatory were already discounted at a 3% rate [12].

## 2.2. Estimation of the Reductions in Monetary Value of DALY Losses in EAC Assuming SDG 3 Related Targets Are Achieved

The SDG 3 is about ensuring healthy lives and promoting well-being for people of all ages. It has 13 targets. The analysis in this section focuses on five of the 13 SDG 3 targets [22]:

- SDG 3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births;
- SDG 3.2: By 2030, end the preventable deaths of new-borns and children under 5 years of age and reduce neonatal mortality to 12 per 1000 live births or lower and under-5 mortality to 25 per 1000 live births or lower in all countries;
- SDG 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and reduce hepatitis, water-borne diseases and other communicable diseases;
- SDG 3.4: By 2030, reduce premature mortality due to NCDs by one third through prevention and treatment and promote mental health and well-being;
- SDG 3.5: By 2020, halve the number of global deaths and injuries due to traffic accidents.

Since SDG 3.3 is not specific, the following WHO global and regional strategies targets for AIDS, tuberculosis, malaria and NTDs were used:

- 1) HIV-related deaths will be reduced to fewer than 287,000 from a 2014 baseline of 790,000 (*i.e.*, by 63.67%) by 2020 [23];
- 2) Malaria mortality rates will be reduced globally by at least 90% from 2015 to 2030 [24];
- 3) The number of TB deaths will be reduced by 90% from 2015 to 2030 [25];

4) Mortality due to vector-borne diseases will be reduced globally by at least 75% from 2016 to 2030 [26].

The formulas were used to estimate the reductions in EAC monetary value of DALYs lost assuming the SDG health targets are achieved.

Target 3.1: Reduce the global maternal mortality ratio (MMR) to less than 70 per 100,000 live births by 2030 [22]. EAC's 2030 monetary value of DALYs lost due to MMR under SDG scenario were estimated as follows:

$$MVD_{MMR2030} = \sum_{country=1}^{country=5} \left\{ MVD_{MMR2015} - \left[ MVD_{MMR2015} \times \frac{MMR2015 - SDG3.1}{MMR2015} \right] \right\}$$

where:  $MVD_{MMR2030}$  represents the monetary value of DALYs lost due to maternal conditions in 2030;  $MVD_{MMR2015}$  denotes the monetary value of DALYs lost due to maternal conditions in 2015; and  $MMR2015$  is the maternal mortality ratio in 2015; and  $SDG3.1$  is the value of Target 3.1, which is 70 per 100,000 live births.

Target 3.2: End the preventable deaths of new-borns and children under 5 years of age and reduce neonatal mortality to 12 per 1000 live births or lower and under-5 mortality to 25 per 1000 live births or lower in all countries by 2030. EAC's 2030 monetary value of DALYs lost due to neonatal mortality (NM) [22] under scenario 2 were estimated as follows:

$$MVD_{NM2030} = \sum_{country=1}^{country=5} \left\{ MVD_{NM2015} - \left[ MVD_{NM2015} \times \frac{NM2015 - SDG3.2}{NM2015} \right] \right\}$$

where:  $MVD_{NM2030}$  represents the monetary value of DALYs lost due to neonatal mortality in 2030;  $MVD_{NM2015}$  denotes the monetary value of DALYs lost due to neonatal mortality in 2015; and  $NM2015$  is the neonatal mortality rate in 2015; and  $SDG3.2$  is the value of Target 3.2, which is 12 per 1000 live births.

EAC's 2030 monetary value of DALYs lost due to under-five morbidity and mortality (U5M) was estimated as follows:

$$MVD_{U5M2030} = \sum_{country=i}^{country=5} \left\{ MVD_{U5M2015} - \left[ MVD_{U5M2015} \times \frac{U5M2015 - SDG3.2}{U5M2015} \right] \right\}$$

where:  $MVD_{U5M2030}$  represents the monetary value of DALYs lost due to neonatal mortality in 2030;  $MVD_{U5M2015}$  denotes the monetary value of DALYs lost due to neonatal mortality in 2015; and  $U5M2015$  is the neonatal mortality rate in 2015; and  $SDG3.2$  is the value of Target 3.2, which is 25 per 1000 live births.

Target 3.3: End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and reduce hepatitis, water-borne diseases and other communicable diseases by 2030. HIV-related deaths will be reduced to fewer than 287,000 from a 2014 baseline of 790,000 (*i.e.*, by 63.67%) by 2020 [23]. EAC's 2030 monetary value of DALYs lost due to AIDS morbidity and mortality (AID) were estimated as follows:

$$MVD_{AID2030} = \sum_{country=i}^{country=5} \left\{ MVD_{AID2015} - \left[ MVD_{AID2015} \times \frac{AID2014 - AID2020}{AID2014} \right] \right\}$$

where:  $MVD_{AID2030}$  represents the monetary value of DALYs lost due to HIV/AIDS-related mortality in 2030;  $MVD_{AID2015}$  denotes the monetary value of DALYs lost due to HIV/AIDS-related mortality in 2015;  $AID2014$  is the HIV/AIDS-related mortality in 2014; and  $AID2020$  is the HIV/AIDS-related mortality in 2020.

The WHO's End TB Strategy target is "By 2030, reduce number of TB deaths by 90% compared with 2015" [25]. EAC's 2030 monetary value of DALYs lost due to DALYs lost to tuberculosis morbidity and mortality were estimated as follows:

$$MVD_{TB2030} = \sum_{country=i}^{country=5} \left\{ MVD_{TB2015} - [MVD_{TB2015} \times SDG3.3_{TB}] \right\}$$

where:  $MVD_{TB2030}$  represents the monetary value of DALYs lost due to TB mortality in 2030;  $MVD_{TB2015}$  denotes the monetary value of DALYs lost due to TB mortality in 2015; and  $SDG3.3_{TB}$  is the value of Target 3.3, which is 90% reduction.

The WHO's Global Technical Strategy for Malaria 2016-2030 target is "By 2030, reduce malaria mortality rates globally by at least 90% compared with 2015" [24]. EAC's 2030 monetary value of DALYs lost due to DALYs lost to malaria morbidity and mortality were estimated as follows:

$$MVD_{MAL2030} = \sum_{country=i}^{country=5} \left\{ MVD_{MAL2015} - [MVD_{MAL2015} \times SDG3.3_{MAL}] \right\}$$

where:  $MVD_{MAL2030}$  represents the monetary value of DALYs lost due to malaria mortality in 2030;  $MVD_{MAL2015}$  denotes the monetary value of DALYs lost due to malaria mortality in 2015; and  $SDG3.3_{MAL}$  is the value of Target 3.3, which is 90% reduction.

The WHO's 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]. EAC's 2030 monetary value of DALYs lost due to DALYs lost to NTD morbidity and mortality were estimated as follows:

$$MVD_{NTD2030} = \sum_{country=i}^{country=5} \left\{ MVD_{NTD2015} - [MVD_{NTD2015} \times SDG3.3_{NTD}] \right\}$$

where:  $MVD_{NTD2030}$  represents the monetary value of DALYs lost due to NTD mortality in 2030;  $MVD_{NTD2015}$  denotes the monetary value of DALYs lost due to NTD mortality in 2015; and  $SDG3.3_{NTD}$  is the value of Target 3.3, which is 75% reduction.

The health SDG Target 3.4 states, "By 2030, reduce by one third premature mortality from non-communicable diseases (NCDs) through prevention and treatment and promote mental health and well-being" [22]. EAC's 2030 monetary value of DALYs lost due to DALYs lost to NCD morbidity and mortality were estimated as follows:

$$MVD_{NCD2030} = \sum_{country=i}^{country=5} \{MVD_{NCD2015} - [MVD_{NCD2015} \times SDG3.4_{NCD}]\}$$

where:  $MVD_{NCD2030}$  represents the monetary value of DALYs lost due to NCD mortality in 2030;  $MVD_{NCD2015}$  denotes the monetary value of DALYs lost due to NCD mortality in 2015; and  $SDG3.4_{NCD}$  is the value of Target 3.4, which is one third reduction.

Health SDG Target 3.6 states, “By 2020, halve the number of global deaths and injuries from road traffic accidents” [22]. EAC’s 2030 monetary value of DALYs lost due to DALYs lost to injury (INJ) morbidity and mortality were estimated as follows:

$$MVD_{INJ2030} = \sum_{country=i}^{country=5} \{MVD_{INJ2015} - [MVD_{INJ2015} \times SDG3.6_{INJ}]\}$$

where:  $MVD_{INJ2030}$  represents the monetary value of DALYs lost due to injuries mortality in 2030;  $MVD_{INJ2015}$  denotes the monetary value of DALYs lost due to injuries mortality in 2015; and  $SDG3.6_{INJ}$  is the value of Target 3.6, which is 50% reduction.

### 2.3. Sources of Data

The abovementioned nine equations were estimated using secondary per capita GDP data from the International Monetary Fund (IMF) World Economic Outlook database [2], per capita total health expenditure from the WHO Global Health Expenditure Database [27], and DALYs data from the WHO Global Health Observatory [1]. The Excel Software developed by Microsoft (New York) was used to estimate equations in subsections 2.1 and 2.2.

## 3. Empirical Results

### 3.1. Estimates of Monetary Value of DALYs Lost in the EAC in 2015 without SDGs

**Table 1** shows the monetary value of DALYs lost by each of the five EAC countries. The 82,017,651 DALYs lost in EAC sub-region in 2015 was valued at Int\$ 203,843,476,166; which is equivalent to 48.75% of the sub-region’s 2015 GDP. Out of the total monetary value of DALYs lost in EAC, Burundi incurred 2.8%, Kenya 33.9%, Rwanda 4.2%, Tanzania 39.5% and Uganda 19.6%. Kenya and Tanzania bore 73.4% of the EAC countries monetary value of DALYs lost. The average monetary value per DALY lost in the EAC is Int\$ 2485. However, monetary value per DALY ranges from Int\$764 in Burundi to Int\$ 3167 in Kenya.

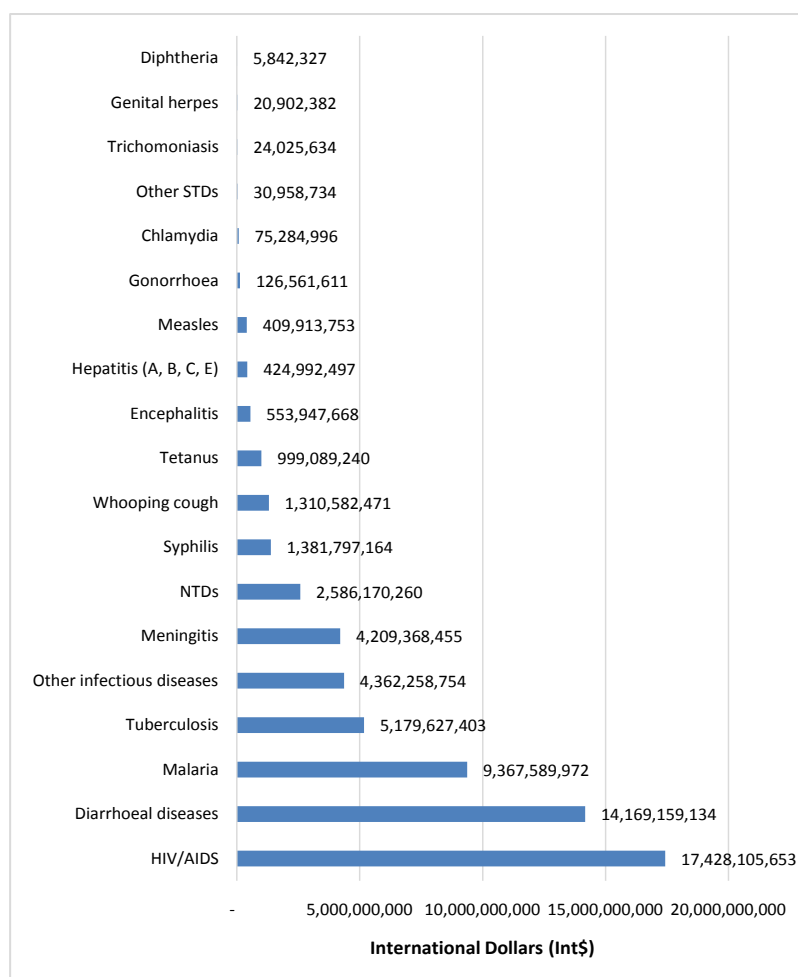
Approximately Int\$ 118,575,096,576 (58.2%) of total EAC monetary value of DALYs lost was attributed to communicable, maternal, perinatal and nutritional conditions (CMN); Int\$ 61,806,147,501 (30.3%) to non-communicable diseases (NCD); and Int\$ 23,462,232,089 (11.5%) to injuries (INJ).

About 52.8% of the monetary value of CMN DALY loss was from infectious and parasitic diseases (**Figure 1**); 14.5% from respiratory infections; 3.7% from

**Table 1.** Monetary value of DALYs lost in East African Community (2015 INT\$).

Country	DALYS in 2015*	Total monetary value of DALYs lost (in 2015 Int\$ or PPP)**	Monetary value of DALYs lost per person in population (Int\$)**	Monetary value per DALY lost (Int\$)**
Burundi	7,368,677	5,631,659,221	504	764
Kenya	21,854,898	69,219,515,912	1503	3167
Rwanda	4,801,888	8,502,103,047	732	1771
Tanzania	27,373,473	80,608,363,554	1508	2945
Uganda	20,618,715	39,881,834,432	1022	1934
<b>TOTAL</b>	<b>82,017,651</b>	<b>203,843,476,166</b>	<b>1263</b>	<b>2485</b>

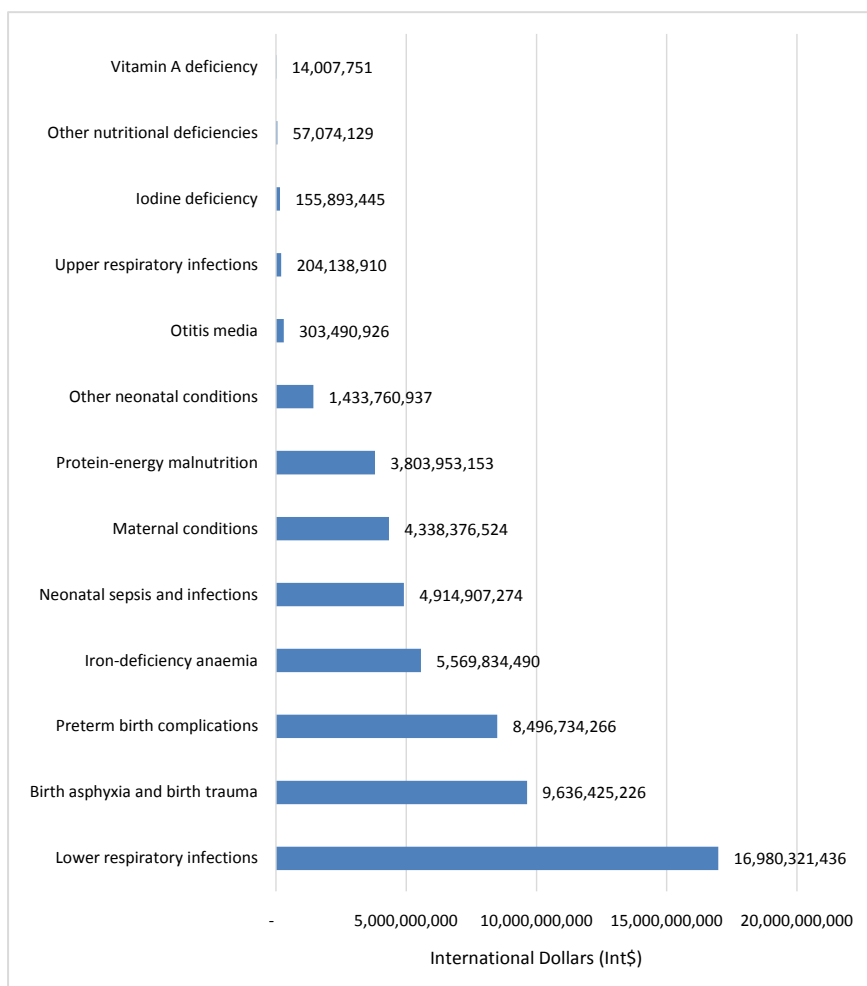
Source: \*Statistics obtained from WHO [1]. \*\*Results from authors calculations.



**Figure 1.** Monetary value of DALY losses from infectious and parasitic diseases in EAC (2015 Int\$ or PPP) Source: Authors estimates.

maternal conditions; 20.9% from neonatal conditions; and 8.1% by nutritional deficiencies (Figure 2). HIV/AIDS, diarrhoeal diseases, malaria, and Tuberculosis were responsible for 73.6% of the monetary value of DALYs lost from infectious and parasitic diseases.

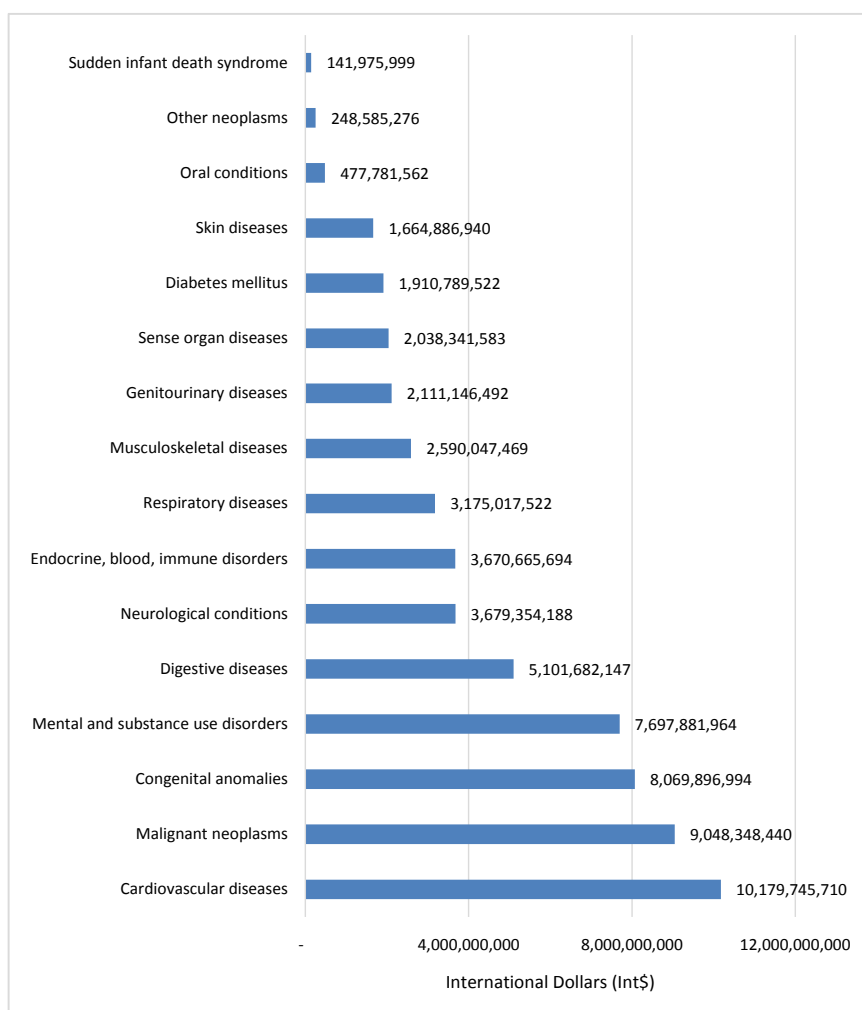




**Figure 2.** Monetary value of DALYs lost from respiratory infections, maternal conditions, neonatal conditions and nutritional deficiencies in EAC (2015 Int\$ or PPP). Source: Authors estimates.

Approximately 14.6% of the monetary value of NCD DALY loss resulted from malignant neoplasms (cancers); 0.4% from other neoplasms; 3.1% from diabetes mellitus; 5.9% from endocrine, blood and immune disorders; 12.5% from mental and substance use disorders; 6.0% from neurological conditions; 3.3% from sense organ diseases; 16.5% from cardiovascular diseases; 5.1% from respiratory diseases; 8.3% from digestive diseases; 3.4% from genitourinary diseases; 2.7% from skin diseases; 4.2% from musculoskeletal diseases; 13.1% from congenital anomalies; 0.8% from oral conditions; and 0.2% from sudden infant death syndrome (**Figure 3**). About 56.6% of NCD-related monetary value of DALY losses resulted from cardiovascular diseases, malignant neoplasms, congenital anomalies and mental and substance abuse disorders.

Almost 82.0% of the monetary value of INJ DALY losses resulted from unintentional injuries and the remaining 18.0% from intentional injuries (**Figure 4**). Almost 39.7% of unintentional injury monetary value of DALY losses emanated from road injuries. Fifty-four percent of monetary value of unintentional injury



**Figure 3.** Monetary value of losses from non-communicable diseases in EAC (2015 Int\$ or PPP). Source: Authors estimates.

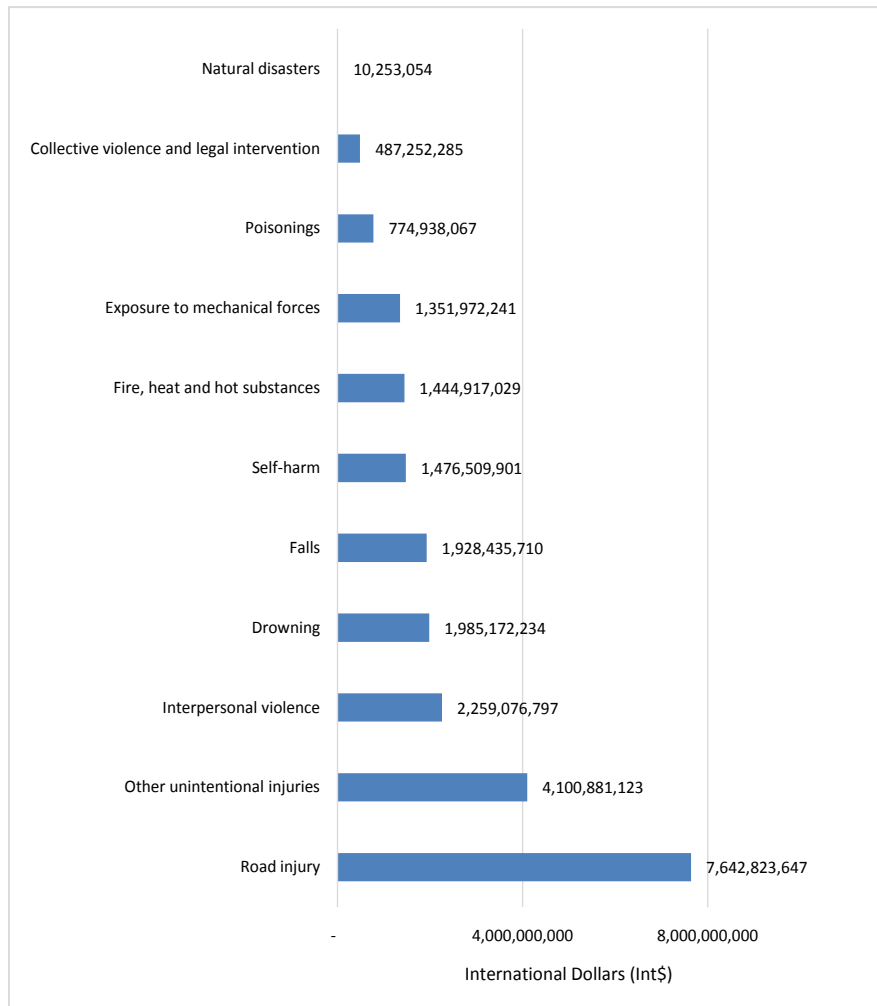
DALY losses were from interpersonal violence. Road injuries and interpersonal violence together account for 42.2% of the total EAC monetary value of DALY losses from violence.

### 3.2. Estimates of Reductions in Monetary Value of DALY Losses in EAC If the Five SDG 3 Related Targets Are Achieved

About Int\$ 132,718,749,155 (65.1%) of the total monetary value of DALYs lost in EAC in 2015 resulted from the SDG3 health conditions listed in **Table 2**. If the disease targets in **Table 2** were fully attained, the SDG3-related monetary value of DALYs lost would be reduced by Int\$ 62,554,855,010 (47.13%).

#### 3.2.1. SDG Target 3.1 and 3.2: Maternal and Neonatal Health Conditions

The EAC would lose DALYs worth Int\$ 28,820,204,227 per year if status quo maternal and neonatal health conditions interventions are sustained. Nevertheless, full achievement of Target 3.2 would enable EAC to save DALYs worth Int\$ 14,146,940,365 per year following reductions in the maternal and neonatal



**Figure 4.** Monetary value of DALYs lost from injuries in EAC (2015 Int\$ or PPP). Source: Authors estimates.

conditions DALY burden. Such savings might be realized if the Global strategy for women’s, children’s and adolescents’ health (2016-2030) [30], recommendations of the Commission on Women’s Health in the African Region [31], and the regional strategic plan for immunization [32] are fully implemented in countries.

**3.2.2. SDG Target 3.3: AIDS, Tuberculosis, Malaria and Neglected Tropical Diseases**

Assuming that the current epidemiological trends do not change, continuing the status quo intervention strategies for AIDS, TB, malaria and NTDs up to 2030 will make EAC incur a loss in DALYs worth Int\$ 34,449,573,780 every year. Nonetheless, full achievement of the SDG 3 targets related to AIDS, TB, malaria and NTDs would save EAC DALYs valued at Int\$26,044,658,571 per year. That saving could be realized if EAC fully achieved SDG Target 3.3 of ending the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases by 2030. Its achievement may be feasible if countries accelerate and intensify the

**Table 2.** Estimate of reductions in monetary value of DALY losses in EAC if the five SDG 3 related targets are achieved.

SDG 3 Target	Description		Percentage reduction envisaged in SDG targets*	Reduction in monetary value of DALYs lost (Int\$)**
3.1	By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births [22] [28]		84%	3,644,236,280
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 [22] [29]	Neonatal mortality	42.9%	10,502,704,085
		Under-5 mortality	52.5%	-
3.3	By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases [22]	HIV-related deaths	63.67%	11,096,474,869
		Malaria mortality	90%	8,430,830,975
		Tuberculosis	90%	4,661,664,663
		NTDs	75%	1,855,688,064
3.4	By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being [22]		30%	18,541,844,250
3.6	By 2020, halve the number of global deaths and injuries from road traffic accidents [22]		50%	3,821,411,824
	TOTAL			62,554,855,010

Sources: \*Percentage reductions envisaged in SDG targets were obtained from UN [22], UNICEF [28] and UNICEF [29]. \*\*Reductions in monetary value of DALYs lost (Int\$) are authors estimates.

implementation of the cost-effective interventions contained in various relevant global and regional strategies and plans adopted by the World Health Assembly and Regional Committees. Such strategies include:

- 1) The Global health sector strategies on HIV, viral hepatitis and sexually transmitted infections [33] [34] [35].
- 2) The end TB Strategy [25].
- 3) The Global technical strategy for malaria 2016-2030 [24].
- 4) The global plan to combat neglected tropical diseases 2008-2015 [36] and its roadmap for accelerated implementation [37]; and The Global vector control response 2017-2030 [26]. The African Region has a NTD regional strategy and plan [38] [39].

### 3.2.3. SDG Target 3.4: Non-Communicable Diseases

This study estimates EAC lost DALYs worth Int\$ 61,806,147,501 in 2015. The envisaged SDG target 3.4 reduction, by one third, of the burden of NCDs translates into annual prevention of DALYs valued at Int\$ 18,541,844,250. Such sav-

ings might be achieved through expanded coverage of the interventions contained in various NCD-related global and regional strategies and plans adopted in the past.

Examples of such strategies and plans include: Global strategy for the prevention and control of NCDs [40]; Global action plan for the prevention and control of NCDs [41]; the Global strategy on diet, physical activity and health [42]; Global 2004 oral health action plan [43]; tobacco control [44]; mental health action plan [36]; health promotion strategy [45]; and regional determinants of health strategy [46]. These strategies are buttressed by the UN General Assembly political resolution A/RES/64/265 on Prevention and control of NCDs [47].

### **3.2.4. Target 3.6: Road Traffic Injuries**

The road traffic injuries sustained in EAC in 2015 led to loss of DALYs worth Int\$ 7,642,823,647. We estimate that the sub-region might prevent DALYs worth Int\$ 3,821,411,824 per year over the 2030 if SDG Target 3.6 is fully achieved. These savings are achievable through implementation of policy interventions contained in the Global Plan for the Decade of Action for Road Safety 2011-2020 [48] [49] [50].

## **4. Conclusions**

The annual monetary value of DALYs lost in EAC from all causes is considerable. Sixty-five percent (Int\$132.72 billion) of the total monetary value of DALYs lost in the sub-region is attributed to maternal and neonatal conditions, AIDS, NCDs, NTDs, malaria, TB and road traffic injuries. Approximately, 47.13% (Int\$ 62,554,855,010) of that economic loss can be avoided every year if the SDG targets related to those health conditions are fully achieved. The health SDG targets would be realised, if and only if, EAC member states invest adequately into strengthening of health systems and other systems that address social determinants of health to ensure healthy lives and promotion of well-being for all people at all ages.

We wish to draw the attention of readers to a number of limitations that characterize these kinds of studies. First, the use of per capita GDP masks inequalities in income and health expenditure distribution across individuals and households [21]. Second, the human capital method estimates the value of health losses due to specific diseases and does not provide the estimates of costs and consequences of alternative interventions into those diseases [51] [52]. Third, the HCA is not consistent with the basic rationale of the economic calculus used in cost-benefit analysis, *i.e.* the notion of a Pareto improvement [53]. Fourth, if HCA is applied strictly in developing countries it would discriminate against women (majority of whom are full-time home makers), the retired, the children, the handicapped and the unemployed since they do not feature in GDP calculations [54]. Future studies should use WTP approach, which arguably, captures better the impact of disease or injury on key domains of economic welfare, *i.e.* the consumption of non-health goods and services, leisure, and health itself [19].

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## List of Abbreviations

CMN: Communicable, Maternal, Perinatal and Nutritional Conditions

DALY: Disability-adjusted-life-year

DALY<sub>0-4</sub>: number of disability-adjusted-life years lost among those aged 0 - 4 years

DALY<sub>5-14</sub>: number of disability-adjusted-life years lost among those aged 5 - 14 years

DALY<sub>15-29</sub>: number of disability-adjusted-life years lost among those aged 15 - 29 years

DALY<sub>30-49</sub>: number of disability-adjusted-life years lost among those aged 30 - 49 years

DALY<sub>50-59</sub>: number of disability-adjusted-life years lost among those aged 50 - 59 years

DALY<sub>60-69</sub>: number of disability-adjusted-life years lost among those aged 60 - 69 years

DALY<sub>70+</sub>: number of disability-adjusted-life years lost among those aged 70 years and above

EAC: East African Community

GDP: Gross domestic product

HCA: Human capital approach

HIV/AIDS: Human immunodeficiency virus infection and acquired immune deficiency syndrome

IMF: International Monetary Fund

INT\$: International Dollars or Purchasing Power Parity (PPP)

MVD: Monetary value of DALYs lost

NCD: Non-Communicable Disease

NTD: Neglected Tropical Disease

MVD<sub>0-4</sub>: Monetary value of DALYs lost among people aged 0 - 4 years

MVD<sub>5-14</sub>: Monetary value of DALYs lost among people aged 5 - 14 years

MVD<sub>15-29</sub>: Monetary value of DALYs lost among people aged 15 - 29 years

MVD<sub>30-49</sub>: Monetary value of DALYs lost among people aged 30 - 49 years

MVD<sub>50-59</sub>: Monetary value of DALYs lost among people aged 50 - 59 years

MVD<sub>60-69</sub>: Monetary value of DALYs lost among people aged 60 - 69 years

MVD<sub>70+</sub>: Monetary value of DALYs lost among people aged 70 years and above

NHGDPPC<sub>int\$</sub>: per capita non-health GDP in purchasing power parity (PPP)

PCTHE: per capita total health expenditure

SDG: Sustainable Development Goal

TB: Tuberculosis

TMVD: Total monetary value of total DALYs lost in EAC

UN: United Nations

UNICEF: United Nations International Children's Emergency Fund

WHO: World Health Organization

WHO/AFRO: World Health Organization Regional Office for Africa