Monetary value of disability-adjusted life years lost from all causes in Mauritius in 2019 [version 1; peer review: awaiting peer review]

Laurent Musango¹, Ajoy Nundoochan¹, Philippe Van Wilder², Joses Muthuri Kirigia³

¹World Health Organization, Country Office., Port Louis, Mauritius
²Centre de Recherche en Economie de la Santé, Gestion des Institutions de Soins et Sciences Infirmières, Ecole de Santé Publique (ULB), Bruxelles, Belgium
³African Sustainable Development Research Consortium (ASDRC), Nairobi, Kenya

Abstract

Background: The Republic of Mauritius had a total of 422,567 disability-adjusted life years (DALYs) from all causes in 2019. This study aimed to estimate the monetary value of DALYs lost in 2019 from all causes in Mauritius and those projected to be lost in 2030; and to estimate the monetary value of DALYs savings in 2030 if Mauritius were to attain the national targets related to five targets of the United Nations Sustainable Development Goal 3 on good health and well-being.

Methods: The human capital approach was used to monetarily value DALYs lost from 157 causes in 2019. The monetary value of DALYs lost in 2019 from each cause was calculated from the product of net gross domestic product (GDP) per capita in Mauritius and the number of DALYs lost from a specific cause. The percentage reductions implied in the SDG3 targets were used to project the monetary values of DALYs expected in 2030. The potential savings equal the monetary value of DALYs lost in 2019 less the monetary value of DALYs expected in 2030.

Results: The DALYs lost in 2019 had a total monetary value of Int$ 9.46 billion and a mean value of Int$ 22,389 per DALY. Of this amount, 84.2% resulted from non-communicable diseases; 8.7% from communicable, maternal, neonatal, and nutritional diseases; and 7.1% from injuries. Full attainment of national targets related to the five SDG3 targets would avert DALYs losses to the value of Int$ 2.4 billion.

Conclusions: Diseases and injuries cause a significant annual DALYs loss with substantive monetary value. Fully achieving the five SDG3 targets could save Mauritius nearly 8% of its total GDP in 2019. To achieve such savings, Mauritius needs to strengthen further the national health system, other systems that tackle the social determinants of health, and the national health research system.
Keywords
Mauritius, disability-adjusted life year, monetary value, sustainable development goal

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Corresponding author: Laurent Musango (musangol@who.int)

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Introduction

The Republic of Mauritius is one of 16 Southern African Development Community (SADC) member states. It had an estimated population of 1.279 million people; gross domestic product (GDP) of International dollars (Int$) 30.171 billion; and GDP per capita of Int$ 23,818.57 in 2019. In 2017, the country had a high human development index (HDI) of 0.79, and the income inequality Gini coefficient was 35.8.

Mauritius lost a total of 422,566.58 disability-adjusted life years (DALYs) from all causes in 2019 compared to 132,813 DALYs in 1993. Of the 2019 DALYs, 355,910.13 (84.2%) were from non-communicable diseases (NCDs); 36,780.42 (8.7%) from communicable, maternal, neonatal, and nutritional diseases (CMNNDs); and 29,876.03 (7.1%) from injuries (INJ). Figure 1 portrays the DALYs from all causes by 23 age groups. People aged between 15 and 59 years bore 49.55% of the DALYs.

Figure 2 depicts the share of DALYs by 22 disease categories in 2019. About 26.7% of the NCD DALYs resulted from diabetes and kidney diseases; 20.7% from cardiovascular diseases; 11% from neoplasms; 8.4% from musculoskeletal disorders; 6.3% from mental disorders; 5.7% from neurological disorders; 4.2% from chronic respiratory diseases; 3.9% from sense organ disease; 3.8% from digestive diseases; 2.2% from skin and subcutaneous diseases; 1.9% from substance use disorders; and 5.2% from other NCDs. Nearly 47.4% of the NCD-related DALYs were attributed to diabetes and kidney diseases, and cardiovascular diseases.

Approximately 31.2% of the CMNND DALYs lost was caused by maternal and neonatal disorders; 20.6% by respiratory infections and tuberculosis (TB); 13.7% by neglected tropical diseases (NTDs); 12.8% by HIV/AIDS and sexually transmitted infections; 10% by nutritional deficiencies; 6.9% by enteric infections; and 3.8% by other infectious diseases. Maternal and neonatal disorders, respiratory infections, and TB caused 52.8% of the CMNND DALYs.

Of the 29,876 DALYs from INJ, 33.8% were attributed to transport injuries; 39.9% to unintentional injuries; and 26.3% to self-harm and interpersonal violence.

On 25 September 2015, the United Nations General Assembly (UNGA) adopted resolution A/RES/70/1, titled Transforming our World: The 2030 Agenda for Sustainable Development, which contains 17 Sustainable Development Goals. These goals aim to end poverty, fight inequality, and stop climate change. Figure 1. Disability-adjusted life years (DALYs) from all causes by age groups in Mauritius in 2019

Source: Generated by authors using data from the Global Burden of Disease Collaborative Network. Note: The Early neonatal = 0-6 days; late neonatal = 7-27 days; and post neonatal = 28-364 days.
Development Goals (SDGs) and 169 targets. The SDG3 on ensuring healthy lives and promoting wellbeing for all at all ages has 13 targets. The following five of these SDG3 targets are intended for reducing the abovementioned disease burden:

Source: Generated by authors using data from the Global Burden of Disease Collaborative Network [4].

**Figure 2. The DALYs in Mauritius by disease categories in 2019**

Development Goals (SDGs) and 169 targets. The SDG3 on ensuring healthy lives and promoting wellbeing for all at all ages has 13 targets. The following five of these SDG3 targets are intended for reducing the abovementioned disease burden.
Target 3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.

Target 3.2: By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births.

Target 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.

Target 3.4: By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and wellbeing.

Target 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents’ (p.14).

The current health expenditure per capita (CHEPC) in Mauritius was US$ 600 in 2017. It consisted of the domestic general government health expenditure of US$ 257 per capita; domestic private health expenditure of US$ 338 per capita (of which US$ 293 was from out-of-pocket spending); and external health expenditure of US$ 5 per capita. The Mauritius CHEPC was within the range of US$ 297 (minimum) and US$ 984 (maximum) per year of health systems investment recommended for attaining SDG3 among upper-middle-income economies. The fact that out-of-pocket payments (OOPS) constitute 49% of CHEPC is a matter of concern because, according to the World Health Organization (WHO), when OOPS exceed 20% of total health expenditure, the incidence of financial catastrophe and impoverishment increases. Between 2012 and 2018, the population with households with health expenditures exceeding 25% of total household expenditure (or income) grew slightly from 1.79% to 1.8%.

The Mauritius domestic general government health expenditure is 10% of general government expenditure, which is below the African Heads of State and Government 2001 target of allocating at least 15% of the national budget to health development. Furthermore, in 2017, the Mauritius CHEPC of US$ 600 (2% of GDP) was about seven-fold lower than the average of US$ 4,003 (9% of average GDP per capita) for Organisation for Economic Co-operation and Development countries. As a result, Mauritius has a universal health service coverage index (UHSCI) of 63 (on a scale of 0 to the target of 100), denoting a gap in essential health services coverage of 37. The deficit in the UHSCI was attributed to suboptimal component scores of 69 in reproductive, maternal, newborn, and child health; 53 in infectious diseases; 52 in NCDs; and 80 in service capacity and access.

Embracing the principles of a welfare state, Mauritius ensures the provision of free healthcare at the point of use in all public facilities. Steady economic growth over the last decade has enabled the national economy to sustain social protection systems, including health. To attain SDG3, Mauritius needs to sustainably increase its investments in the national health system and other systems that address the social determinants of health. The health sector will have to keep on competing for scarce budgetary allocations with economic sectors. Thus, the health and health-related sectors ought to mount sustained evidence-based advocacy within the government and the private sector to sustain, grow, and efficiently utilize funding for health development to bridge the existing gap in access to essential health services.

People who control the national resources in the public and private sectors are not public health experts, and thus, they might not fully understand the intricacies around the negative impact of disability and premature mortality (from various causes) on economic indicators, such as GDP. Therefore, health sector stakeholders will have to couch their advocacy messages in a language that those who control national resources can understand.

Evidence from the economic burden of disease studies in both economically developed and developing countries continues to be used to advocate for increased investments in health development. The WHO Regional Office for Africa (WHO/AFRO) report titled A Heavy Burden: The Productivity Cost of Illness in Africa, contains useful aggregated economic evidence for use in advocacy at global and regional forums. However, it is of limited usefulness to individual countries for two reasons: (a) it is not disaggregated by country and disease; and (b) the analysis is based on 2015 DALYs data. Mauritius policymakers require updated and contextualized economic evidence for use in making a case for increased investment in health development.

The specific objectives of this study are: (a) to estimate the monetary value of DALYs lost from all causes in Mauritius in 2019; (b) to estimate the monetary value of DALYs expected to be lost from all causes in Mauritius in 2030; and (c) to estimate the monetary value of DALYs savings in 2030 if Mauritius were to attain the SDG3 disease and injury-related targets of 3.1, 3.2, 3.3, 3.4, and 3.6.
**Methods**

**The DALYs**

The seminal application of DALYs to measure the global burden of disease was in 1993 in the World Bank report titled *World Development Report 1993: Investing in Health*, which "examined the interplay between human health, health policy, and economic development" (p. iii). However, it was only in 1994 that Professor CJL Murray developed and published in the *Bulletin of the World Health Organization* the conceptual basis for the DALYs. He defined DALY as the sum of potential years of life lost (PYLL) due to premature death and years lived with disability (YLD).

WHO further explains that DALYs for a specific cause are calculated using the following formula:

\[ \text{DALY}_{c,s,a,t} = \text{PYLL}_{c,s,a,t} + \text{YLD}_{c,s,a,t} \]

for a specific disease or injury \( c \), age \( a \), sex \( s \), and year \( t \).

Even though debate has been ranging since 1996 about various real and perceived shortcomings of the DALYs, it has withstood the test of time and continues to be a useful metric in global health discourse.

In this study, we calculate the monetary value of DALYs lost in Mauritius in 2019 from all 157 causes. The DALYs data are from the Institute for Health Metrics and Evaluation (IHME) global burden of disease (GBD) Study 2019 database. Methodological details and sources of data used in the GBD study 2019 are from an article published by the GBD 2019 Diseases and Injuries Collaborators.

**Estimating the monetary value of DALYs lost in Mauritius in 2019**

This study replicates the human capital approach initially suggested by Weisbrod, and subsequently, adapted to financially value DALYs in Kenya among the elderly and all age groups, the Arab Maghreb Union (AMU), the Central African Economic and Monetary Community (CEMAC), the East African Community (EAC), Zambia, and the African region, to estimate the economic value of DALYs lost in 2019 in Mauritius. The development of health-related human capital begins at birth and ends at death; and thus, diseases have inter-and intra-generational negative impact on the process of human capital creation.

According to Weisbrod, ‘The present value of a man at any given age may be defined operationally as his discounted expected future earnings stream net of his consumption ...’ (p.427). GDP per capita is sometimes used as an indicator of an individual’s economic contribution per year. Any loss of DALYs erodes GDP through its components of consumption of household goods and services, investment (from savings), government spending (from taxes and service fees), and net exports (i.e. exports minus imports). The WHO clarifies 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’ (p.4). As further explained by the WHO and Chisholm et al., individuals do not derive utility (pleasure or happiness) from consumption of health goods and services, but from consumption of non-health consumption commodities (goods and services), leisure time, and health status. Thus, it has become common practice to use net GDP (i.e. GDP per capita minus health expenditure per person) in the valuation of DALYs.

The total monetary value of DALYs lost in Mauritius from 157 causes is the sum of the monetary value of DALYs lost from each \( i^{th} \) disease or injury \( \text{MOVD}_{i} \), denoted arithmetically as

\[ \text{TMOV}_{2019} = \sum_{i=1}^{157} \left( \text{MOVD}_1 + \text{MOVD}_2 + \text{MOVD}_3 + \ldots + \text{MOVD}_{157} \right) \]

where \( \sum_{i=1}^{157} \) is the summation of monetary values of DALYs lost from the 1st to the 157th cause; \( \text{MOVD}_1 \) is the monetary value of DALYs lost from the 1st disease; \( \text{MOVD}_2 \) is the monetary value of DALYs lost from the 2nd disease; \( \text{MOVD}_3 \) is the monetary value of DALYs lost from the 3rd disease; and \( \text{MOVD}_{157} \) is the monetary value of DALYs lost from the 157th disease.

The monetary value of DALYs lost from each of the 157 diseases is equal to the number of DALYs lost from each disease \( \text{DALY}_i=1, \ldots, 157 \) multiplied by Mauritius GDP per capita \( \text{GDPPC} \) minus CHEPC, denoted algebraically as

\[ \text{MOVD}_1 = \{ \text{DALY}_1 \times (\text{GDPPC} - \text{CHEPC}) \} \]

\[ \text{MOVD}_2 = \{ \text{DALY}_2 \times (\text{GDPPC} - \text{CHEPC}) \} \]
\[ MOVD_3 = \{DALY_3 \times (GDPPC - CHEPC)\} \quad (4) \]
\[ MOVD_k = \{DALY_k \times (GDPPC - CHEPC)\} \quad (5) \]

where \(DALY_3\) is the number of DALYs lost from the 1st disease, \(DALY_2\) is the number of DALYs lost from the 2nd disease, \(DALY_3\) is the number of DALYs lost from the 3rd disease, and \(DALY_k\) is the number of DALYs lost from the \(k\)th disease. The DALYs acquired from the IHME GBD Study 2019 database are already discounted at 3\%\textsuperscript{43}.

**Estimating expected monetary value of DALYs lost in 2030**

In this subsection, we adapt the formulae used in past studies in Africa\textsuperscript{34,45-50} to estimate the monetary value of DALYs losses in 2030, assuming the five disease-related SDG3 targets in Table 1 are fully accomplished in Mauritius\textsuperscript{53-59}.

The reductions in the monetary value of DALYs lost from maternal disorders (SDG3 target 3.1), neonatal disorders (SDG3 target 3.2), HIV/AIDS (SDG 3 target 3.3a), TB (SDG3 target 3.3b), NTDs (SDG3 target 3.3c), viral hepatitis (SDG3 target 3.3d), NCD (SDG3 target 3.4), and transport injury (SDG3 target 3.6) are estimated using the form of equations below. For example, the equation used in estimating the SDG3 target 3.1 envisages a reduction in the monetary value of DALYs from maternal disorders (\(MD\)) as follows:

\[ MOVD_{MD,2030} = MOVD_{MD,2019} \times \left( \frac{\text{MMR}_{2019} - \text{MMRT}_{3.1}}{\text{MMR}_{2019}} \right) \quad (6) \]

where: \(MOVD_{MD,2030}\) is the projected monetary value of DALYs lost from \(MD\) in 2030; \(MOVD_{MD,2019}\) is the monetary value of DALYs lost from \(MD\) in 2019; \(\text{MMR}_{2019}\) is the maternal mortality ratio in 2019; and \(\text{MMRT}_{3.1}\) is the projected maternal mortality ratio in 2030 supposing target 3.1 is fully realized. Since, \(MOVD_{MD,2019} = \text{Int}\$ 9,782,174; \text{MMR}_{2019} = 62\) per 100,000 live births; and \(\text{MMRT}_{3.1} = 19.75806452\), the \(MOVD_{MD,2030}\) is estimated as follows:

\[ MOVD_{MD,2030} = \text{Int} 9,782,174 - \left[ \text{Int} 9,782,174 \times \left( \frac{62 - 19.75806452}{62} \right) \right] = \text{Int} 3,117,368. \]

**Calculate the potential monetary savings from DALYs lost averted**

By subtracting the monetary value of DALYs lost in 2019 from the monetary value of DALYs lost in 2030 from the \(i\)th disease (or injury), we obtain the potential savings in the monetary value of DALYs, assuming that the \(i\)th SDG3 disease (or injury) target is fully accomplished\textsuperscript{15-50}. For example, the projected savings in the monetary value of DALYs lost from NTDs is estimated as follows:

\[ MOVD_{NTDs,\text{SAVING}} = (MOVD_{NTDs,2019} - MOVD_{NTDs,2030}) \quad (7) \]

\[ MOVD_{NTDs,\text{SAVING}} = (\text{Int} 113,021,138 - \text{Int} 50,859,512) = \text{Int} 62,161,626. \]

where \(MOVD_{NTDs,\text{SAVING}}\) is the probable saving in the monetary value of DALYs lost to NTDs by 2030; \(MOVD_{NTDs,2019}\) is the monetary value of DALYs lost to NTDs in 2019; and \(MOVD_{NTDs,2030}\) is the monetary value of DALYs anticipated to be lost from NTDs in 2030.

**Data sources**

The DALYs data for the 157 causes are from the IHME GBD study 2019 database\textsuperscript{4}; the CHEPC data are from the WHO Global Health Expenditure Database\textsuperscript{7}; and the 2019 per capita GDP data are from the IMF World Economic Outlook database\textsuperscript{2}. A summary of the data analysed can be found in the Extended data\textsuperscript{60}.

**Data analysis**

The analysis is conducted using Excel Software developed by Microsoft (New York)\textsuperscript{61}. It is undertaken in seven steps.

**Step 1: Construct economic model on Excel software**

The economic model containing the equations is developed on an Excel spreadsheet.

**Step 2: Collate DALYs data**
| Target | Description | Percentage reduction envisaged between 2020 and 2030 |
|--------|-------------|--------------------------------------------------|
| SDG 3.1 | By 2030, reduce the global maternal mortality ratio (MMR) to less than 70 per 100,000 live births\(^6\). Mauritius in 2019 had an MMR of 62 per 100,000 live births, that is, SDG 3.1 was exceeded\(^5\). The country set an MMR target of 35 per 100,000 live births by 2024\(^5\). The change between 2020 and 2024 equals \([((62 - 35)/62) = 0.435483870967742]\). Assuming that the rate of decrease remains constant between 2025 and 2030, the MMR in 2030 equals 19.75806452 per 1,000 live births, that is, \([(35 \times (35 \times 0.435483870967742))]\). Thus, the target reduction for Mauritius between 2020 and 2030 equals 68.13%\(^6\), that is, \([((62 - 19.758064516129)/62)\times(11/11)-1]*100\times(-1)]\). | 68.13% (AARR = 9.87396890591872%) |
| SDG 3.2 | By 2030, end preventable deaths of newborns, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births\(^6\). In 2019, the neonatal mortality rate for Mauritius was 10.3 per 1,000 live births\(^5\). WHO/AFRO projected Mauritius to have a neonatal mortality of 6 per 1,000 live births by 2030\(^5\). Thus, the target reduction between 2020 and 2030 equals 41.75%, that is \([((10.3-6)/10.3)*100\times(-1)]\). AARR = \([[((6/10.3)\times(1/11)-1)*100\times(-1)]\). | 41.75% (AARR = 4.79387013350859%) |
| SDG 3.3 | By 2030, end the epidemics of AIDS, TB, malaria, and NTDs and reduce hepatitis, water-borne diseases, and other communicable diseases\(^6\). | |
| (a) | Reduce global HIV-related deaths from 1,062,352 in 2015 to below 500,000 by 2020\(^5\), implying a rate of reduction of 52.9346205400846%, that is, \([=(1062352 - 500000)/1062352]\). In 2019, there were 91.38 HIV deaths in Mauritius\(^4\). Assuming that the rate of reduction remains constant, the HIV deaths in 2030 for Mauritius equal 43.0083437504707, that is, \([=(91.38\times0.529346205400846)]\). AARR = \([[((43.0083437504707/91.38)^{1/10}-1)*100\times(-1)]\). | 52.93% (AARR= 7.25934551582492%) |
| (b) | The number of TB deaths will be reduced by 90% from 2015 to 2030\(^5\), meaning a reduction rate of 0.06% per year, that is, \([=0.9/15\text{ years}]\). In 2019, there were 14.689 TB deaths in Mauritius\(^4\), projected to decrease to 4.99426 by 2030, that is, 14.689 - \([(14.689\times0.06*11\text{ years})]= \|[4.99426/14.689])\times(1/11)-1)*100\times(-1)]\). AARR = \([[((4.99426/14.689)^{1/11}-1)*100\times(-1)]\). | 66% (AARR= 9.341782821%) |
| (c) | Mortality due to vector-borne diseases will be reduced globally by at least 75% from 2016 to 2030\(^5\), meaning a reduction rate of 5% per year, that is 0.75/15 years. In 2019, there were 5048.08 TB-related DALYs in Mauritius\(^4\); projected to be 2271.636 DALYs in 2030, that is, \((5048.08 - (5048.08\times0.05*11\text{ years}))\). AARR=7.00194515949536, that is, \([(2271.636/5048.08)^{1/11}-1)*100\times(-1)]\). | 55% (AARR = 7.00194515949536%) |
| (d) | Globally reduce viral hepatitis B and C deaths from 1.4 million deaths in 2015 reduced to less than 500,000 by 2030\(^5\), meaning a rate of reduction of 64.28571429, that is, \([=(1400000 - 500000)/1400000]\). Thus, the annual rate of reduction between 2016 and 2030 equals 4.28571428571429, that is, 64.28571429\%\times15\text{ years}. In 2019, there were 91.69 hepatitis deaths in Mauritius\(^4\), meaning between 2016 and 2019, deaths reduced by 17.1428571428571, that is, \(4.28571428571429\%\times4\text{ years}\). Thus, the reduction between 2020 and 2030 equals 47.14285714 - 17.1428571428571\%\times4\text{ years}. The hepatitis deaths in 2030 equal 48.4647142857143, that is, \|(91.69 - 91.69\times0.471428571428571))\times(1/11)-1)*100\times(-1)]\). | 47.14% (AARR = 5.63137924952368%) |
The 2019 data on DALYs lost from 157 causes are extracted from the IHME GBD and saved in an Excel spreadsheet. The data are then sorted by the three broad categories of health conditions (i.e. NCDs, CMNND, and INJ). Then, the 157 causes are organized under the relevant broad category.

**Step 3: Collate health expenditure data**

The Mauritius 2017 CHEPC of Int$ 1,278.01147461 was from the WHO Global Health Expenditure Database. The latest expenditure data available are for 2017, and thus, it is necessary to project the CHEPC for 2019 (the baseline year of the analysis) in three sub-steps:

a) Calculate CHEPC growth rate between 2016 and 2017 = \(\frac{(\text{CHEPC}_{2017} - \text{CHEPC}_{2016})}{\text{CHEPC}_{2016}}\) = \(\frac{(\text{Int$1,278.01147461} - \text{Int$1208.34094238})}{\text{Int$1208.34094238}}\) = 0.0576580084200196.

b) Projection of CHEPC\(_{2018}\) = \((\text{CHEPC}_{2017} + (\text{CHEPC}_{2017}/0.0576580084200196))\) = \((\text{Int$1,278.01147461} + (\text{Int$1,278.01147461} / 0.0576580084200196))\) = \(\text{Int$1351.69907097395}\).

c) Projection of CHEPC\(_{2019}\) = \((\text{CHEPC}_{2018} + (\text{CHEPC}_{2018}/0.0576580084200196))\) = \((\text{Int$1351.69907097395} + (\text{Int$1351.69907097395} / 0.0576580084200196))\) = \(\text{Int$1429.63534738949}\).

**Step 3: Collate per capita GDP data**

The Mauritius GDP per capita (GDPPC) of Int$ 23,818.571 in 2019 is from the IMF World Economic Outlook Database.

**Step 4: Calculate non-health per capita GDP**

Non-health GDP per capita is estimated as the difference between GDP per capita and CHEPC. The non-health per capita GDP (NHGDPPC) = GDPPC - CHEPC = \(\text{Int$23,818.571} - \text{Int$1,429.63534738949}\) = \(\text{Int$22,388.9356526105}\).

**Step 5: Estimate 2019 monetary value of DALYs lost from each cause**

The monetary value of DALYs lost from a specific cause \(i\) equals the number of DALYs lost multiplied by non-health per capita GDP\(^6\). For example, the monetary value of DALYs from neonatal disorders \(\text{MOVD}_{ND}\) is estimated as follows:

\[\text{MOVD}_{ND} = \{(\text{DALY}_{ND} \times \text{NHGDPPC})\} = \{11,044.07 \times 22,388.9356526105\} = 247,264,973.\]

**Step 6: Project 2030 potential monetary value of DALYs lost from SDG3-related causes**

The 2019 data on DALYs lost from 157 causes are extracted from the IHME GBD and saved in an Excel spreadsheet. The data are then sorted by the three broad categories of health conditions (i.e. NCDs, CMNND, and INJ). Then, the 157 causes are organized under the relevant broad category.

### Table 1. Continued

| Target | Description | Percentage reduction envisaged between 2020 and 2030 |
|--------|-------------|-----------------------------------------------------|
| 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\(^7\), meaning a reduction rate of 2.2221323900836% per year, that is, 33.3316985851254/15. In 2019, there were 355910.13 NCD-related DALYs in Mauritius\(^9\), which were projected to reduce to 268914.142705279 DALYs by 2030, that is, 355910.13 - (355910.13\times0.24443245629092), AARR = ((268914.142705279/355910.13)\times(1/11)-1)\times100\% = | 24.44% (AARR = 2.51586648621783%) |
| SDG 3.6 | By 2020, halve the number of global deaths and injuries from road traffic accidents\(^8\), meaning a rate of reduction of 10% per year, that is, 50%/5 years. In 2019, there were 9585.76 DALYs from transport injuries\(^6\). Assuming that Mauritius maintains momentum of 9.082% reduction per year between 2020 and 2030 (i.e. 11 years), transport injuries would lead to 9.58576000000176 DALYs by 2030, that is, 9585.76 - (9585.76\times0.9999), AARR = (((9.58576/9585.76)\times(1/11)-1)\times100\%) = | 99.9% (AARR = 46.6330076879369%) |
We use an example of neonatal disorders to illustrate how the 2030 monetary value of DALYs lost from each of the SDG3 causes is projected:

\[
\text{MOV}D_{\text{ND2030}} = \text{MOV}D_{\text{ND2019}} - \left[ \text{MOV}D_{\text{ND2019}} \times \left( \frac{\text{ND}_{2019} - \text{ND}_{F3.2}}{\text{ND}_{2019}} \right) \right]
\]

\[
\text{MOV}D_{\text{ND2030}} = 247,264,973 - \left[ 247,264,973 \times \left( \frac{10.3 - 6}{10.3} \right) \right] = \text{Int} 144,037,848.
\]

All the abbreviations are as defined earlier.

Step 7: Estimate the savings in the monetary value of DALYs

We obtain the potential savings in the monetary value of DALYs lost prevented, assuming that the \(i\)th SDG3 (or national) disease target is fully realized, by subtracting the monetary value of DALYs lost in 2019 from the monetary value of DALYs projected to be lost in 2030 from the \(i\)th disease. We demonstrate, using target SDG 3.2 on neonatal disorders, how savings for all the SDG3-related causes are estimated:

\[
\text{MOV}D_{\text{ND,SAVING}} = (\text{MOV}D_{\text{ND2019}} \times \text{MOV}D_{\text{ND2030}}) = 247,264,973 - 144,037,848 = \text{Int} 103,227,124.
\]

Results

The monetary value of the DALYs lost in Mauritius in 2019

All causes:

In 2019, Mauritius lost a total of 422,566.58 DALYs from all causes\(^4\) valued at Int\$ 9,460,815,967, and with a mean value of Int\$ 22,389 per DALY. About 84.2% resulted from NCD, 8.7% from CMNND, and 7.1% to INJ.

Figure 3 portrays the monetary value of DALYs accruing to all causes by age. People aged 14 years and lower sustained DALYs with a value of Int\$ 575,675,182 (6.1%); 15-59-year-olds bore DALYs valued at Int\$ 4,687,590,169 (49.5%); and those aged 60 years and above incurred DALYs valued at Int\$ 4,197,550,617 (44.4%).

Communicable, maternal, neonatal, and nutritional diseases

Figure 4 presents the monetary value of DALYs from CMNND. Out of the total monetary value of DALYs from CMNNND of Int\$ 823.47 million, 31.2% ensued from maternal and neonatal disorders; 21.6% from respiratory infections and TB; 13.7% from NTDs; 12.8% from HIV/AIDS and sexually transmitted infections; 10% from nutritional deficiencies; 6.9% from enteric infections; and 3.8% from other infectious diseases. About Int\$ 642 million (78%) accrued to DALYs from neonatal disorders, lower respiratory infections, HIV/AIDS, schistosomiasis, and dietary iron deficiency. The detailed monetary value of DALYs per CMNND health condition is contained in the Extended data\(^62\).

Non-communicable diseases

Figure 5 shows the monetary value of the DALYs associated with NCDs. As alluded to in the first subsection, the NCDs combined caused a loss of 355,910.13 DALYs, with a total monetary value of about Int\$ 7.968 billion. Approximately, 26.7% of that monetary value was attributed to diabetes and kidney diseases; 20.7% to cardiovascular diseases; 11% to neoplasms/cancers; 8.5% to musculoskeletal disorders; 6.3% to mental disorders; 5.7% to neurological disorders; 4.1% to chronic respiratory diseases; 3.9% to sense organ diseases; 3.8% to digestive diseases; 2.2% to skin and subcutaneous diseases; 1.9% to substance use disorders; and 5.2% to other NCDs. Therefore, 58.4% of the total monetary value of DALYs from NCDs was attributed to diabetes and kidney diseases, cardiovascular diseases, and neoplasms (cancers). The monetary value of DALYs by each NCD is available in the Extended data\(^63\).

Injuries

Figure 6 depicts the monetary value of DALYs from various forms of injuries in Mauritius. The 29,876 DALYs from injuries had a total monetary value of Int\$ 668.9 million. Out of the latter estimate, Int\$ 225.9 million (33.8%) accrued to transport injuries; Int\$ 266.7 million (39.9%) to unintentional injuries; and Int\$ 176.3 million (26.3%) to self-harm and interpersonal violence. About Int\$ 531.3 million (79.4%) of the total monetary value of DALYs associated with injuries emanated from road injuries (32.1%), self-harm (19.1%), falls (15.3%), interpersonal violence (7.2%), and drowning (5.7%). The monetary value of DALYs by each type of injury can be found in the Extended data\(^64\).
The monetary value of DALYs in 2019 from five SDG3 related targets

Table 2 shows that the five SDG3-related health conditions analysed in this study resulted in 387,235 DALYs in 2019 with a value of Int$ 8.67 billion, which is 91.6% of the national total monetary value from all causes. About 97.24% of the monetary value of SDG3-related DALYs was attributed to NCDs, neonatal disorders, and transport injuries.

Estimates of reductions in the monetary value of DALYs in Mauritius between 2020 and 2030 assuming the five SDG3-related targets are attained

Table 3 shows the monetary value of DALYs in 2019, the monetary value of DALYs lost in 2030, and the potential savings from DALY losses prevented assuming that the five disease-related SDG3 targets analysed in this study are attained.

![Monetary value of DALYs from all causes by age group in Mauritius (Int$ 2019)](image-url)

**Figure 3.** Monetary value of DALYs from all causes by age group in Mauritius (Int$ 2019)
The DALYs lost from the five SDG3 health conditions (MDs, neonatal disorders, TB, HIV/AIDS, acute hepatitis, NTD, NCD and injuries) in 2019 were valued at Int$ 8.67 billion. Assuming that the five SDG3 targets (3.1, 3.2, 3.3, 3.4, and 3.6) are fully achieved by 2030, there would still be DALYs losses of Int$ 6.27 billion. Therefore, the reduction/savings in the monetary value of DALYs lost by 2030 would be Int$ 2.4 billion.

Figure 4. Monetary value of DALYs from communicable, maternal, neonatal, and nutritional diseases in Mauritius (Int$ 2019)

The DALYs lost from the five SDG3 health conditions (MDs, neonatal disorders, TB, HIV/AIDS, acute hepatitis, NTD, NCD and injuries) in 2019 were valued at Int$ 8.67 billion. Assuming that the five SDG3 targets (3.1, 3.2, 3.3, 3.4, and 3.6) are fully achieved by 2030, there would still be DALYs losses of Int$ 6.27 billion. Therefore, the reduction/savings in the monetary value of DALYs lost by 2030 would be Int$ 2.4 billion.
Figure 5. Monetary value of DALYs from non-communicable diseases in Mauritius (Int$ 2019)

Figure 6. Monetary value of DALYs lost from injuries in Mauritius (Int$ 2019)
Discussion

Key findings and comparison with similar studies
In 2019, Mauritius lost a total of 402,565 DALYs from all causes with a total monetary value of Int$ 9.46 billion. About 84.2% of the latter was attributed to NCDs, 8.7% to CMNNDs, and 7.1% to INJ. By comparison, 67.3%, 21.9%, and 10.8% of the total monetary value of DALYs lost in the AMU emanated from NCDs, CMNNDs, and INJ, respectively. Approximately 61.3%, 28.4%, and 10.3% of the total monetary value of DALYs lost in the CEMAC was due to CMNNDs, NCDs, and INJ, respectively. In the EAC, approximately 58.2%, 30.3%, and 11.5% of the total monetary value of DALYs lost in 2015 was attributed to CMNNDs, NCDs, and INJ, respectively. In Kenya, about 56.6%, 35.9%, and 7.4% of the total monetary value of DALYs was ascribed to CMNND, NCDs, and INJ, respectively. In Zambia, 62.5%, 31.2%, and 6.3% was attributed to CMNNDs, NCDs, and INJ, respectively. Therefore, it is evident that the lion’s share of the monetary value of DALYs lost in Mauritius was from NCDs, unlike in the AMU, CEMAC, EAC, Kenya, and Zambia, where CMNNDs dominated.

The diseases and injuries related to SDG 3 targets 3.1-3.4 and 3.6 caused DALY loss valued at Int$ 8.67 billion, that is, 91.6% of the total monetary value of DALYs lost in Mauritius. We found that full attainment of the five targets would yield an estimated Int$ 2.4 billion saving in monetary value of SDG-related DALYs lost by 2030. This saving is about 27.7% of SDG-related DALYs.

SDG Targets 3.1 and 3.2: Maternal and neonatal disorders
Attainment of the national targets related to SDG3 targets 3.1 and 3.2 by 2030 would avert DALYs with a monetary value of Int$ 109.9 million. The projected savings could be achieved assuming full implementation of the national sexual and reproductive health policy, the health sector strategic plan 2020-2024, the sexual and reproductive health strategy and plan of action, and the white paper on health sector development and reform. The existing national legal framework underpins the implementation of those policy and strategic documents.

Mauritius’ efforts to reduce child and maternal morbidity, disability, and deaths are informed and supported by various pertinent WHO Governing Bodies resolutions, for example, the Regional Committee for Africa strategic plan for immunization and its resolution; the World Health Assembly (WHA) resolution on reduction of perinatal and neonatal mortality; the global vaccine action plan and related WHA resolution; and the global strategy for women’s, children’s, and adolescents’ health 2016-2030, plus the associated WHA resolution.

The UNGA resolutions on the rights of the child and preventable maternal mortality and morbidity and human rights provide high-level political backing for full implementation of Mauritius’ policies and strategies.
Table 3. Monetary value of DALYs by SDG3 health conditions in Mauritius (2019 Int$)

| Health conditions/diseases | (A). Monetary value of DALYs in 2019 (Int$) | (B). Monetary value of DALYs in 2030 (Int$) | (C). Reduction in monetary value of DALYs by 2030 (Int$) [C=(A-B)] |
|----------------------------|------------------------------------------|------------------------------------------|-------------------------------------------------------------|
| SDG3.1: Maternal disorders | 9,782,174                                | 3,117,368                                | 6,664,806                                                   |
| SDG3.2: Neonatal disorders | 247,264,973                              | 144,037,848                              | 103,227,124                                                |
| SDG3.3a: TB                | 13,625,906                               | 4,632,808                                | 8,993,098                                                   |
| SDG3.3b: HIV/AIDS          | 100,971,413                              | 47,522,579                               | 53,448,834                                                  |
| SDG3.3c: Malaria           | -                                        | -                                        | -                                                          |
| SDG3.3d: Acute hepatitis   | 2,052,842                                | 1,085,073                                | 967,768                                                     |
| SDG3.3e: Neglected tropical diseases (NTDs) | 113,021,138 | 50,859,512 | 62,161,626 |
| (a). Schistosomiasis       | 99,720,319                               | 44,874,144                               | 54,846,176                                                 |
| (b). Cysticercosis         | 5,255,131                                | 2,364,809                                | 2,890,322                                                   |
| (c). Cystic echinococcosis | 29,106                                   | 13,098                                   | 16,008                                                     |
| (d). Dengue                | 3,377,371                                | 1,519,817                                | 1,857,554                                                   |
| (e). Rabies                | 1,791                                    | 806                                      | 985                                                        |
| (f). Intestinal nematode infections | 527,707 | 237,468 | 290,239 |
| (g). Leprosy               | 15,672                                   | 7,053                                    | 8,620                                                      |
| (h). Other NTDs            | 4,094,041                                | 1,842,318                                | 2,251,722                                                   |
| SDG3.4: Noncommunicable diseases (NCDs) | 7,968,448,999 | 6,020,701,437 | 1,947,747,562 |
| (a). Neoplasms             | 877,208,126                              | 662,789,989                              | 214,418,137                                                |
| (b). Cardiovascular diseases | 1,646,611,288 | 1,244,126,046 | 402,485,242 |
| (c). Chronic respiratory diseases | 332,103,590 | 250,926,694 | 81,176,896 |
| (d). Digestive diseases    | 302,965,062                              | 228,910,568                              | 74,054,494                                                 |
| (e). Neurological disorders | 453,328,259 | 342,520,119 | 110,808,140 |
| (f). Mental disorders      | 498,531,520                              | 376,674,236                              | 121,857,284                                                |
| (g). Substance use disorders | 152,027,142 | 114,866,774 | 37,160,368 |
| (h). Diabetes and kidney diseases | 2,128,328,045 | 1,608,095,593 | 520,232,452 |
| (i). Skin and subcutaneous diseases | 178,323,171 | 134,735,200 | 43,587,971 |
| (j). Sense organ diseases  | 309,495,915                              | 233,845,068                              | 75,650,847                                                 |
| (k). Musculoskeletal disorders | 674,076,000 | 509,309,947 | 164,766,052 |
| (l). Other NCDs            | 415,450,881                              | 313,901,202                              | 101,549,679                                                |
| SDG3.6: Road injuries      | 214,614,964                              | 214,615                                  | 214,400,349                                                |
| TOTAL (Int$)               | 8,669,782,408                            | 6,272,171,241                            | 2,397,611,167                                              |

SDG Target 3.3: HIV/AIDS, TB, acute hepatitis, and neglected tropical diseases
The achievement of national targets for SDG target 3.3 by 2030 would avert DALYs with a monetary value of Int$ 53.45 million from HIV/AIDS, Int$ 9 million from TB, Int$ 0.97 million from acute hepatitis, and Int$ 62.2 million from NTDs.
Therefore, the full attainment of target 3.3 could enable Mauritius to save DALYs with a total monetary value of Int$ 125.6 million. These savings are achievable if the following plans are made universally accessible to all people in need: communicable disease prevention and control services planned in chapter 7 of the Mauritius health sector strategy; the national HIV and AIDS policy; the national HIV action plan; and the national multi-sectoral HIV and AIDS strategic framework. The implementation of pertinent policies, strategies, and plans is augmented with the national legal framework.

Mauritius’ battle against HIV/AIDS, TB, and hepatitis is also guided by the SADC strategy for HIV prevention, treatment, and care and sexual and reproductive health; the framework for the prevention and control of sexually transmitted infections; the strategic plan for the control of TB; and the advocacy strategy on HIV/AIDS, TB, and sexually transmitted infections.

Moreover, communicable disease control policies, strategies, and plans in Mauritius and the SADC are informed and reinforced by the WHO Governing Bodies documents and resolutions, including the end TB strategy; the global health sector strategy on HIV; the HIV/AIDS strategy for the African Region; the global health sector strategy on viral hepatitis; the framework for action on prevention, care and treatment of viral hepatitis in the African region; the global health sector strategy on sexually transmitted infections; the national HIV and AIDS policy; the national HIV action plan; and the national multi-sectoral HIV and AIDS strategic framework. The implementation of pertinent policies, strategies, and plans is augmented with the national legal framework.

SDG Target 3.4: Non-communicable diseases

We estimate that Mauritius could avert DALYs worth Int$ 1.95 billion if it successfully decreases the NCD burden by 24.4% between 2020 and 2030. Such savings can be realized if Mauritius were to make accessible, to everyone in need (i.e. with the capacity to benefit), the prevention and control health interventions and services planned in the health sector strategic plan; the national sport and physical activity policy; the national cancer control programme action plan; and the national action plan on tobacco control. The implementation of NCD strategies and plans is supported by the set of national legislation; and the UNGA Political Declaration on the prevention and control of NCDs as well as the AU commitment on NCDs.

The Mauritius NCD strategies and plans were partially informed by various WHA and RC resolutions on global strategy for the prevention and control; its resolution WHA53.17; the global action plan for the prevention and control of NCDs; and its endorsing resolution WHA66.10; the global action plan on the public health response to dementia; and related resolution WHA70(17); the comprehensive mental health action plan; its resolution WHA66.8; the WHO Framework Convention on Tobacco Control; its resolution WHA53.16; and related resolution WHA53.17; strategies to reduce the harmful use of alcohol; its resolution WHA61.4; cancer prevention and control resolution WHA70.2; the global action plan 2014-2019 on universal eye health; its resolution WHA66.4; the comprehensive mental health action plan; its resolution WHA53.17; the global action plan on physical activity; its resolution WHA71.6; the NCD regional strategy for the African region; its resolution AFR/RC50/R4; the Brazzaville declaration on NCD prevention and control in the African region; its resolution AFR/RC50/R4; the NCD regional strategy for the African region; its resolution AFR/RC50/R4; and the health promotion strategy for the African region; its resolution AFR/RC62/R4.

The UNGA Declaration on NCDs, ageing, food, and nutrition commits the Mauritius government to provide high-level political leadership and requisite resources to prevent and control NCDs.

SDG Target 3.6: Road injuries

Mauritius could avert DALYs with a monetary value of Int$ 214.4 million if it were to successfully reduce road injuries by 99.9% between 2020 and 2030. With a view to realizing those potential savings, related to the attainment of SDG target 3.6, the government would need to fully implement its national road safety strategy 2016-2025, whose overarching objective is to achieve a 50% reduction in the number of non-fatal injuries and deaths by 2025. The strategy has 10 strategic fields of action, namely, improving safety standards of road infrastructure; reorganising control of roadworthy vehicles; strengthening of road traffic law and enforcement; re-engineering of the driving licensing scheme; improving medical testing of fitness to drive; provision of post-crash trauma care; starting a road safety academy; creating...
a transport and road safety research and development programme; launching an effective education and communication strategy; and funding implementation of the road safety strategy\textsuperscript{156}. The institutions mandated by the Road Traffic Act to spearhead the implementation of the strategy are the National Transport Authority and National Road Safety Council\textsuperscript{151}.

The development of Mauritius’ national road safety strategy was informed by the AU road safety charter\textsuperscript{152}, the AU road safety action plan 2011-2020\textsuperscript{153}, the WHO global plan for the decade of action for road safety\textsuperscript{154}, the WHO global 2018 status report on road safety\textsuperscript{155}, the 69\textsuperscript{th} WHA resolution on the outcome of the second global high-level conference on road safety\textsuperscript{156}, and the status report on the implementation of the decade of action for road safety in the African region\textsuperscript{157}.

The UNGA resolutions A/RES/64/255\textsuperscript{158}, A/RES/66/260\textsuperscript{159}, A/RES/68/269\textsuperscript{160}, A/RES/70/260\textsuperscript{161}, A/RES/72/271\textsuperscript{162}, and A/RES/70/1\textsuperscript{16} provide high-level political support for full implementation of the Mauritian national road safety strategy 2016-2025 to at least halve the number of transport-related non-fatal injuries and human lives.

Limitations

This study has limitations related to the GDP calculations, the human capital approach, and the DALYs index.

Limitations in GDP calculations: The per capita GDP was used in this study as a numeraire for converting DALYs lost into their monetary equivalent. The current systems of national accounts measure GDP without considering unpaid household production (e.g. full-time homemakers’ services in a household, including cooking, cleaning, childcare, and nursing ailing household members) and leisure; or the contribution of the elderly in reconciling differences among family members (social cohesion) and transmitting community values and indigenous knowledge to children and youth\textsuperscript{163}. The index also does not capture the adverse effects of economic production processes on the environment, animal health, and human health\textsuperscript{164}. Moreover, GDP does not account for inequalities in the distribution of income and wealth across households and individuals\textsuperscript{165}, and its growth does not indicate whether the societal quality of life has improved\textsuperscript{166}.

Limitations in the human capital approach: Strictly applied, the use of the human capital approach would have confined the analysis only to marketed production and working population. Therefore, DALYs lost within the age groups below the minimum legal age for working\textsuperscript{167} and above retirement age of 60 years and above\textsuperscript{168} would have been monetarily valued at zero. Furthermore, the DALYs lost among people who cannot work due to disability would be valued at zero. However, since the constitution of Mauritius\textsuperscript{68,119}, the constitution of the WHO\textsuperscript{169}, and the UN Universal Declaration of Human Rights\textsuperscript{170} prohibit discrimination against any person, we value every DALYs lost (irrespective of age group) at the same non-health GDP per capita. Our approach is consistent with the lifetime income-based approach developed and applied by Jorgenson and Fraumeni\textsuperscript{171-174} in the context of education-related human capital.

Limitations in the DALYs calculations: We summarize some of the limitations, already discussed by the GBD Study, that are inherent in the calculation of the two components (YLD and YLL) of the DALYs. According to the GBD 2017 Mortality Collaborators\textsuperscript{175}, the mortality data used ‘include vital registration systems, sample registration systems, household surveys (complete birth histories, summary birth histories, sibling histories), censuses (summary birth histories, household deaths), and Demographic Surveillance Sites’ (p. 1684). Some of the limitations include the use of sibling history data, which may introduce survivor bias and recall bias; estimates of the completeness of vital registration are based on the use of uncertain death distribution methods; and they cannot capture all fatal discontinuities\textsuperscript{176}. Unlike the rest of the WHO African region, where the completeness of the primary cause of death data is 6% owing to fragile vital registration systems, in Mauritius, the proportion is 100\%\textsuperscript{11}, meaning that mortality estimates are likely to be more accurate than in the rest of the region.

According to the GBD 2017 Disease and Injury Incidence and Prevalence Collaborators\textsuperscript{176}, ‘YLDs were estimated as the product of a prevalence estimate and a disability weight for health states of each mutually exclusive sequela, adjusted for comorbidity’ (p.1789). Some of the limitations highlighted by authors include the fact that even though comorbidity distributions are known to vary by cause, age, sex, location, and time, the comorbidity adjustment in GBD 2017 assumes independent distributions of comorbid conditions. In addition, calculations of GBD for some causes depend strongly on clinical data, which are prone to selection bias for segments of the population that have disproportionate access to health services\textsuperscript{179}.

In the DALY calculations, the GBD 2017 DALYs and HALE Collaborators\textsuperscript{42} assume independence of uncertainty between YLLs and YLDs, even though this assumption may lead to underestimation of the total uncertainty for DALYs. The authors also highlight that DALY estimates are influenced by the availability of data for YLL and YLD estimations.
**Conclusion**

The DALYs lost had a substantive monetary value equivalent to 31.4% of GDP for Mauritius in 2019. Full achievement of the national targets related to SDG3 targets 3.1-3.4 and 3.6 would save the country about Int$ 2.4 billion, or 8% of total GDP in 2019. If fully implemented, Mauritius’ health-related policies, strategies, and plans might give the country a high chance of averting a significant number of DALYs. The implementation process is also buttressed with a robust legislative framework aimed at addressing the causes of ill-health in Mauritius.

However, as the AU ministers of health underscored in their commitment on an accountability mechanism, the existence of policies, strategies, declarations, decisions, and resolutions does not necessarily assure attainment of national and internationally agreed health development goals\(^\text{177}\). The health ministers called on governments and other relevant stakeholders at national, regional, and continental levels to provide committed, sustained, and aligned resources for accelerated and monitored implementation of a national health development policy framework.

In terms of all socioeconomic indicators, Mauritius has accomplished substantially more than the other 46 WHO African region countries\(^\text{11}\). However, to sustain the health (and related) gains, it is essential not to be complacent. Therefore, it is vital for the Mauritius government and the domestic private sector to work together to strengthen further the national health system (including the social protection mechanisms to reduce reliance on OOPS), the other systems that tackle social determinants of health\(^\text{16}\), and the national health research system\(^\text{178,179}\) to reduce the burden of disease further and to advance the quality of life of the people of Mauritius. Finally, given the negative economic impact of the ongoing COVID-19 global pandemic\(^\text{180}\), all health-related systems ought to ensure that all resources are utilized efficiently\(^\text{23,181}\).

**Abbreviations**

- **AARR**: Average annual rate of reduction
- **AMU**: Arab Maghreb Union
- **AU**: African Union
- **CEMAC**: Central African Economic and Monetary Community
- **CHEPC**: Current health expenditure per capita
- **CMNNND**: Communicable, maternal, neonatal, and nutritional diseases
- **DALY**: Disability-adjusted life year
- **DALY\(_1\)**: DALYs lost from first disease
- **DALY\(_2\)**: DALYs lost from second disease
- **DALY\(_3\)**: DALYs lost from third disease
- **DALY\(_\gamma\)**: DALYs lost from \(\gamma\)th disease
- **DALY\(_{ND}\)**: DALYs lost from neonatal disorders
- **EAC**: East African Community
- **GBD**: Global burden of disease
- **GDPPC**: Mauritius GDP per capita
- **GDP**: Gross domestic product
- **HDI**: Human development index
- **HIV/AIDS**: Human immunodeficiency virus/acquired immunodeficiency syndrome
- **IMF**: International Monetary Fund
- **INJ**: Injuries
- **IHME**: Institute for Health Metrics and Evaluation
- **IntS**: International dollars or purchasing power parity (PPP)
- **LBs**: Live births
- **MD**: Maternal disorders
- **MMR**: Maternal mortality ratio
- **MMR\(_{2019}\)**: Maternal mortality ratio in 2019
- **MMR\(_{3.1}\)**: Projected maternal mortality ratio in 2030 supposing target 3.1 is fully realized
- **MOVD\(_1\)**: Monetary value of DALYs from the first disease
- **MOVD\(_2\)**: Monetary value of DALYs from the second disease
- **MOVD\(_3\)**: Monetary value of DALYs from the third disease
- **MOVD\(_\gamma\)**: Monetary value of DALYs from the \(\gamma\)th disease
- **MOVD\(_{MD2030}\)**: Projected monetary value of DALYs lost from MDs in 2030
- **MOVD\(_{MD2019}\)**: Monetary value of DALYs lost from MDs in 2019
- **MOVD\(_{ND2030}\)**: Projected monetary value of DALYs lost from neonatal disorders in 2030
- **MOVD\(_{ND2019}\)**: Monetary value of DALYs lost from neonatal disorders in 2019
**MOVDND**

Projected monetary value of DALYs savings upon attainment of national SDG3.2-related target

**MOVDNTD2030**

Projected monetary value of DALYs lost from NTDs in 2030

**MOVDNTD2019**

Monetary value of DALYs lost from NTDs in 2019

**MOVDNTDSAVING**

Probable saving in monetary value of DALYs lost to NTDs by 2030

**NCD**

Non-communicable disease

**ND**

Neonatal disorder

**ND2019**

Neonatal mortality rate in 2019

**ND3.2**

Projected neonatal mortality rate in 2030 assuming target 3.2 is realized

**NHGPPC**

Non-health gross domestic product per capita

**NTD**

Neglected tropical disease

**NTPD2019**

Number of deaths from NTDs in 2019

**NTPD3.3C**

Projected number of deaths from NTDs in 2030, assuming target 3.3c is reached

**OOPS**

Out-of-pocket payments

**PYLL**

Potential years of life lost

**RC**

WHO Regional Committee for Africa

**SADC**

Southern African Development Community

**SDG**

United Nations Sustainable Development Goal

**SDG3**

Sustainable Development Goal 3

**TB**

Tuberculosis

**TMOVD**

Total monetary value of DALYs from all 157 causes in Mauritius in 2019

**UN**

United Nations Organization

**UNDP**

United Nations Development Programme

**UNGA**

United Nations General Assembly

**UHSCI**

Universal health service coverage index

**UNICEF**

United Nations Children’s Fund

**USS**

United States dollar

**WHA**

World Health Assembly

**WHO**

World Health Organization

**WHO/AFRO**

World Health Organization Regional Office for Africa

**YLD**

Years lived with disability

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**Data availability**

**Underlying data**

The DALYs data are from the Institute for Health Metrics and Evaluation (IHME) global burden of disease (GBD) Study 2019 database: [http://ghdx.healthdata.org/gbd-results-tool](http://ghdx.healthdata.org/gbd-results-tool).

Methodological details and sources of data used in the GBD study 2019 are from: [https://doi.org/10.1016/S0140-6736(20)30925-9](https://doi.org/10.1016/S0140-6736(20)30925-9).

**Figshare**: Data used to estimate the monetary value of Disability-Adjusted Life Years (DALYs) lost from all causes in Mauritius in 2019. [https://doi.org/10.6084/m9.figshare.1357339160](https://doi.org/10.6084/m9.figshare.1357339160).

**Figshare**: Excel template used to estimate monetary value of Disability-Adjusted Life Years (DALYs) lost from all causes in Mauritius in 2019. [https://doi.org/10.6084/m9.figshare.1357398561](https://doi.org/10.6084/m9.figshare.1357398561).

**Extended data**

**Figshare**: The monetary value of DALYs associated with communicable, maternal, neonatal, and nutritional diseases in Mauritius in 2019. Online Resource (Extended results data). [https://doi.org/10.6084/m9.figshare.1357343962](https://doi.org/10.6084/m9.figshare.1357343962).

**Figshare**: The monetary values of DALYs associated with noncommunicable diseases in Mauritius in 2019. Online Resource (Extended results data). [https://doi.org/10.6084/m9.figshare.1357346963](https://doi.org/10.6084/m9.figshare.1357346963).

**Figshare**: The monetary value of DALYs associated with injuries in Mauritius in 2019. Extended results data. [https://doi.org/10.6084/m9.figshare.1357348164](https://doi.org/10.6084/m9.figshare.1357348164).

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147. UN: Follow-up to the Second World Assembly on Ageing. UNGA resolution ARES/73/143. New York: UN; 2018f.

148. UN: The right to food. UNGA resolution ARES/73/171. New York: UN; 2018f.

149. UN: Implementation of the United Nations Decade of Action on Nutrition (2016-2025). UNGA resolution ARES/72/306. New York: UN; 2018g.

150. Republic of Mauritius: National Road Safety Strategy 2015 - 2025. Port Louis: Ministry of Public Infrastructure and Land Transport; 2015b.

151. Republic of Mauritius: Road Traffic Act 1962. Port Louis: Ministry of Public Infrastructure and Land Transport; 1962.

152. AU: African Road Safety Charter. Adopted by decision Assembly/AU Dec.589(IXV) of the Assembly of the Union Twenty-Sixth Ordinary Session 30 - 31 January 2016. Addis Ababa, Ethiopia Addis Ababa: AU; 2016.

153. AU: African road safety action plan 2011-2020. Addis Ababa: AU; 2010.

154. WHO: Global Plan for the Decade of Action for Road Safety 2011-2020. Geneva: WHO; 2011.

155. WHO: Global status report on road safety 2018. Geneva: World Health Organization; 2018c.

156. WHO: Addressing the challenges of the United Nations Decade of Action for Road Safety (2011-2020): outcome of the second Global High-level Conference on Road Safety - Time for Results. Sixty-ninth World Health Assembly resolution WHA69.7. Geneva: WHO; 2016c.

157. WHO/AFRO: Status report on the implementation of the decade of action for road safety in the African region. Sixty-seventh Regional Committee for Africa document AFR/RC67/13. Brazzaville: WHO/AFRO; 2017h.

158. UN: Improving global road safety. UNGA resolution ARES/64/255. New York: UN; 2010.

159. UN: Improving global road safety. UNGA resolution ARES/65/260. New York: UN; 2012b.

160. UN: Improving global road safety. UNGA resolution ARES/67/269. New York: UN; 2014.

161. UN: Improving global road safety. UNGA resolution ARES/70/260. New York: UN; 2016c.

162. UN: Improving global road safety. UNGA resolution ARES/72/271. New York: UN; 2018h.

163. Giannetti BF, Agostinho F, Almeida CMVB, et al.: A review of limitations of GDP and alternative indices to monitor human wellbeing and to manage eco-system functionality. J Clean Prod 2015; 87: 11–25. Publisher Full Text

164. Kubiszewski I: The genuine progress indicator: a measure of net economic welfare. Encyclopedia of Ecology 2015; 4: 327–335. Publisher Full Text

165. Palumbo L: A post-GDP critique of the Europe 2020 strategy. Procedia Soc Behav Sci 2013; 72: 47–63. Publisher Full Text

166. Kubiszewski I, Costanza R, Franco C, et al.: Beyond GDP: Measuring and achieving global genuine progress. Ecol Econ 2013; 93: 57-68. Publisher Full Text

167. Republic of Mauritius: The national employment Act No. 12 of 2017. Port Louis: Republic of Mauritius; 2017.

168. Republic of Mauritius: The National Pensions Act 1976. Port Louis: Republic of Mauritius; 1976.

169. WHO: Constitution of the World Health Organization. Basic Documents, Forty-fifth edition, Supplement, October 2006. Geneva: WHO; 2006.

170. United Nations: Universal declaration of human rights. New York: UN; 1948.

171. Jorgenson DW, Fraumeni BM: The accumulation of human and nonhuman capital, 1948-1984. In: Lipsey RL, Tice HS, eds. The measurement of savings, investment and wealth studies in income and wealth. 1989; Vol. 52. Chicago: University of Chicago Press.

172. Jorgenson DW, Fraumeni BM: Investment in Education and U.S. Economic Growth. Scand J Econ 1992a; 94: 51–70. Publisher Full Text

173. Jorgenson DW, Fraumeni BM: The output of the education sector. In: Grilli L, Z, editor. Output measurement in the service sectors. National Bureau of Economic Research Studies in Income and Wealth. Chicago: University of Chicago Press; 1992b.

174. Jorgenson DW, Fraumeni BM: Investment in education and U.S. economic growth. Scand J Econ 1992b; 94(Supplement): 51–70. Publisher Full Text

175. GBD 2017 Mortality Collaborators: Global, regional, and national age-specific mortality and life expectancy, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018; 392: 1684–1735. PubMed Abstract | Publisher Full Text | Free Full Text

176. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators: Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018; 392: 1789–1823. PubMed Abstract | Publisher Full Text | Free Full Text

177. African Union and WHO: Commitment on accountability mechanism to assess the implementation of commitments made by African ministers of health. First meeting of African Ministers of Health jointly convened by the AUC and WHO (Luanda, Angola, 16-17 April, 2014) Commitment AUC-WHO/COM.6/2014. Addis Ababa: AU; 2014c.

178. Kirigia JM, Ota MO, Senkubuge F, et al.: Developing the African national health research systems barometer. Health Res Policy Syst 2016; 14: 53. PubMed Abstract | Publisher Full Text | Free Full Text

179. Rusakanka S, Makanza M, Ota M, et al.: Strengthening National Health Research Systems in the WHO African Region - Progress towards Universal Health Coverage. Global Health 2019; 15: 50. PubMed Abstract | Publisher Full Text | Free Full Text

180. Musango L, Nundoochan A, Kirigia JM: The Discounted Money Value of Human Life Losses Associated With COVID-19 in Mauritius. Front Public Health 2020; 8: 604934. PubMed Abstract | Publisher Full Text | Free Full Text

181. Nundoochan A: Improving public hospital efficiency and fiscal space implications: the case of Mauritius. Int J Equity Health 2020; 19(1): 152. PubMed Abstract | Publisher Full Text | Free Full Text
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