Short Communication:
The Dollar Value of Human Life Losses Associated With COVID-19 in Canada

Joses Muthuri Kirigia1, Rose Nabi Deborah Karimi Muthuri2

1. African Sustainable Development Research Consortium (ASDRC), Nairobi, Kenya.
2. Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa.

ABSTRACT

Background: The coronavirus disease 2019 (COVID-19) pandemic continues to cause morbidity and premature mortality and ravage the socio-economic sectors in Canada.

Objectives: The study aimed to appraise the Total Dollar Value of Human Life Losses (TDVHL) associated with COVID-19 in Canada.

Methods: The net output approach was applied in the dollar valuation of the 8810 human life losses associated with COVID-19 in Canada as of July 16, 2020. The economic model was rerun assuming 3%, 5%, and 10% discount rates with Canada’s life expectancy of 83 years, the world’s average life expectancy of 73 years, the world’s highest average life expectancy of 88 years, and a 3% discount rate.

Results: The human lives lost to COVID-19 had an estimated value of the international dollar (Int$) 203,702,1173 and an average of Int$ 23,121,7 per human life lost. Quebec and Ontario provinces alone accounted for 94.99% of the TDVHL. Reanalysis of the economic model with discount rates of 5% and 10% resulted in declines in TDVHL of Int$ 19,272,1390 (9%) and Int$ 53,013,2423 (26%), respectively. Substitution of the nation with the world’s average life expectancy shrank the TDVHL by Int$ 17,549,72473 (86%) while applying the world’s highest life expectancy triggered a growth in the TDVHL of Int$ 4,986,74987 (24%).

Conclusion: The average value of human life lost is 4-fold the gross domestic product per capita for Canada.
and the Gini coefficient was 34.0. The lowest 40% held about 18.9% of the national income in Canada compared to 25.3% and 13.6% held by the wealthiest 10% and 1% [2]. The International Monetary Fund (IMF) predicts that Canada’s real GDP growth would decline by 6.2% in 2020 due to the adverse impact of the ongoing Coronavirus Disease 2019 (COVID-19) pandemic [3].

As of July 16, 2020, 13699621 COVID-19 cases have been reported in the world, including 8157677 (58.2%) recoveries, 4954970 (37.4%) currently infected patients (active cases), and 586974 (4.3%) deaths [4]. Canada had 108829 COVID-19 cases that included 8810 (8.1%) deaths, 72485 (66.4%) recovered cases, and 27534 (25.4%) active cases [5]. Of the total COVID-19 cases in Canada, Quebec bore 52.35%, Ontario 34.06%, Alberta 8.16%, British Columbia 2.88%, Nova Scotia 1%, Saskatchewan 0.81%, Manitoba 0.3%, Newfoundland and Labrador 0.24%, New Brunswick 0.15%, Prince Edward Island 0.03%, Yukon 0.01%, Northwest territories 0.005%, Nunavut 0%, and repatriated traveller cases 0.01% [6].

Approximately 64.03% of the deaths in Canada occurred in Quebec, 30.96% in Ontario, 2.15% in British Columbia, 1.83% in Alberta, 0.73% in Nova Scotia, 0.17 in Saskatchewan, 0.08% in Manitoba, 0.03% in Newfoundland and Labrador, and 0.02% in New Brunswick Province [5]. The remaining provinces of Prince Edward Island and the territories of Yukon, Northwest Territories, and Nunavut had not reported any deaths at the time.

In 2017, Canada had a UnitedHealthcare (UHC) service coverage index of 89%, which was higher than the average of 79% in the ROA [7]. However, with a gap of 11% in the coverage of essential health services, Canada cannot be complacent. Around 0.5% of the Canadian population had household expenditures on health greater than 25% of total household income, which was lower than the average of 1.8% for the ROA.

In Canada, domestic general government health expenditure forms 19.3% of the general government expenditure, which is higher than an average of 13.2% in the ROA. Even in terms of current health expenditure (CHE) per capita, Canada had US$ 4755 CHE compared to an average of US$ 1019 in the ROA [8].

Canada’s health workforce densities of 23.1 medical doctors and 99.2 nursing and midwifery personnel per 10000 population were generally comparable to the average of 24.0 medical doctors and 83.3 nursing personnel in the ROA [7]. Canada’s average of the 13 International Health Regulations (IHR) core capacities score of 99% was higher than the mean of 71% for the ROA in 2019 [7].

Approximately 99% and 82% of Canada’s population use safely-managed drinking-water and sanitation, which was significantly higher than the mean of 79% and 49% in the ROA [7]. Even though the indicators mentioned above are better than the averages for the ROA, some limited coverage gaps still lurk in Canada; therefore, the government is much aware that there is no room for complacency.

The COVID-19 pandemic had a substantial negative impact on agriculture [9], education [10, 11], wholesale trade [12], gig economy [13], small businesses [14], manufacturing and service industries [15], and labor force and work [16]. As explained in Canada’s COVID-19 economic response plan, the government of Canada is taking significant measures to mitigate the negative impact of the global pandemic on individuals, businesses, and sectors [17]. Information on the dollar value of human lives lost due to COVID-19 in Canada is missing so far.

The objective of the study was to appraise the dollar value of human life losses associated with COVID-19 in Canada.

2. Materials and Methods

Study location and subjects

The study focuses on the 8810 people in Canada who died from COVID-19 as of July 16, 2020. The analysis was done separately on the 8 Canadian provinces that had notified deaths associated with COVID-19.

Conceptual framework

The net output approach (also known as the human capital approach) was applied in the dollar valuation of human life losses associated with COVID-19 in Canada. The standard measure of national output is the GDP. A country’s GDP is the sum of total spending on consumer goods and services, investment, government, and net exports, i.e. exports minus imports. Premature death associated with COVID-19 erodes these GDP components. Death from COVID-19 (or any other cause) terminates the stock of human capital, which is the “knowledge, skills, competencies and attributes (including physical, emotional and mental health) embodied in individuals that facilitate the creation of personal, social and economic wellbeing” [18]. Following every loss of life as-
associated with COVID-19, such embodied capabilities that hitherto enabled victims to make a positive contribution to GDP, family, and community are permanently lost.

In line with past studies [19-25], the total dollar value of human life lost due to COVID-19 in Canada equals the addition of dollar values of human life lost at the age groups of 0-19 years old, 20-29 years old, 30-39 years old, 40-49 years old, 50-59 years old, 60-69 years old, 70-79 years old, and 80 years and older. In the algebraic form [21-25]:

$$TDVHL_{\text{CANADA}} = \sum_{\varepsilon=1}^{8} DVHL_{\varepsilon},$$

where $\sum_{\varepsilon=1}^{8}$ is the addition from group 1 to 8, is age group, $\varepsilon=1$ is 0-19 years old, $\varepsilon=2$ is 20-29 years old, $\varepsilon=3$ is 30-39 years old, $\varepsilon=4$ is 40-49 years old, $\varepsilon=5$ is 50-59 years old, $\varepsilon=6$ is 60-69 years old, $\varepsilon=7$ is 70-79 years old, and $\varepsilon=8$ is 80 years and older (Formula 1).

1. $DVHL_{\varepsilon} = \sum_{t=1}^{n} (V_{(1+r)^t}) \times (K_{1,t} - K_{2,t}) \times (K_{2,t} - K_{3,t}) \times (K_{3,t} - K_{4,t}) \times (K_{4,t} - K_{5,t}) \times (K_{5,t} - K_{6,t}) \times (K_{6,t} - K_{7,t}) \times (K_{7,t} - K_{8,t})$.

The dollar value of human life lost per age group was estimated using the following formula [21-25]:

$$DVHL_{\varepsilon} = \sum_{t=1}^{n} (V_{(1+r)^t}) \times (K_{1,t} - K_{2,t}) \times (K_{2,t} - K_{3,t}) \times (K_{3,t} - K_{4,t}) \times (K_{4,t} - K_{5,t}) \times (K_{5,t} - K_{6,t}) \times (K_{6,t} - K_{7,t}) \times (K_{7,t} - K_{8,t}).$$

, where: is the discount factor, r refers to the 3% discount rate, denotes the year of life lost, $\varepsilon=1$ is the first and $\varepsilon=n$ is the last year of life lost in the age group, is Canada’s per capita GDP, refers to the per capita current health expenditure of Canada; is the average life expectancy at birth of Canada, is the average age at onset of death in age group, is the number of deaths associated with COVID-19 in Canada, and is the proportion of deaths from COVID-19 borne by age group. The year 2020 was taken as the base year for the analysis [21-25]. The equations were estimated using Microsoft Excel software.

**Data and resources**

Table 1 contains the data and data sources used in the Canada analysis.

**3. Results**

Findings from analysis assuming Canada’s average life expectancy of 82.96 years and 3% discount rate

A total of 8810 human lives lost to COVID-19 had an estimated value of Int$ 2037021173 and an average of Int$ 231217 per human life lost. Of the TDVHL, 0.1% occurred to 0-19 years old, 0.6% to 20-29 years old, 0.9% to 30-39 years old, 2.4% to 40-49 years old, 8.8% to 50-59 years old, 19.9% to 60-69 years old, 25.9% to 70-79 years old, and 41.4% to 80 years and older. About 54.6% of the TDVHL was among persons aged 50 to 79 years. The dollar value per human life lost decreased substantially with an increase in age. For example, the dollar value per human lost in the age group 80 years and above was 9.7 times lower than 20-29 years old (Table 2).

| Variables | Data | Data Sources |
|-----------|------|--------------|
| Per capita Gross Domestic Product (GDP) in Canada | International dollar (Int$) 52144.4 | International Monetary Fund (IMF) [1] |
| Cumulative number of deaths due to COVID-19 in Canada by July 16, 2020 | 8810 | Worldometer [5] |
| Proportion of deaths from COVID-19 per age group in Canada | | Statistics Canada [6] |
| Share of COVID-19 deaths by Canadian provinces and territories | | Government of Canada [6] |
| Average Life Expectancy at birth in years (ALE) | Canada ALE =82.96 years; global ALE=73.2 years; Japanese Females ALE (world highest)=88.09 years [25]. | Wordometer [26] |
| Discount rate | 3%, 5%, 10% | Kirigia and Muthuri [21, 22, 24, 25]; Kirigia, Muthuri, and Nkanata [23] |
| Canada’s per capita current health expenditure in International Dollars (Int$) or Purchasing Power Parity (PPP) | Int$ 4929 | World Health Organization (WHO) [8] |
Distribution of the TDVHL by provinces and territories of Canada

Figure 1 shows the share of TDVHL across 9 Canadian provinces that had recorded COVID-19 deaths by July 16, 2020.

Out of Int$ 2037021173 TDVHL, 64.03% occurred in Quebec, 30.97% in Ontario, 2.15% in British Columbia, 1.83% in Alberta, 0.72% in Nova Scotia, 0.08% in Manitoba, 0.17% in Saskatchewan, 0.03% in Newfoundland and Labrador, and 0.02% in New Brunswick Canadian provinces. The provinces of Quebec and Ontario alone bore Int$ 1935054243 (94.99%) of TDVHL. The remaining province of Prince Edward Island and the three Canadian territories (Yukon, Northwest, and Nunavut) had not recorded any loss of lives associated with COVID-19 by July 16, 2020.

The sensitivity of TDVHL to changes in the discount rate

As shown in Table 3, a reanalysis of the economic model with a discount rate of 5% resulted in a decline in TDVHL of Int$ 192721390 (9%), and the average dollar value per human life lost decreased by Int$ 21875. Use a discount rate of 10% reduced TDVHL by Int$ 530132423 (26%) and the average value per human life of Int$ 60174.

Table 2. The dollar value of human lives lost from COVID-19 in Canada using the national average life expectancy and a 3% discount rate

| Age Group          | The Dollar Value of Human Lives Lost at a 3% Discount Rate (Int$ or PPP) | Average Discounted Dollar Value per Human Life Lost per Age Group (Int$ or PPP) |
|--------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| 0-19 years         | 1410028                                                                 | 1391943                                                                        |
| 20-29 years        | 11764911                                                                | 1290446                                                                        |
| 30-39 years        | 18127188                                                                | 1192979                                                                        |
| 40-49 years        | 49486342                                                                | 1061992                                                                        |
| 50-59 years        | 179493390                                                               | 885956                                                                         |
| 60-69 years        | 405214420                                                               | 649378                                                                         |
| 70-79 years        | 527454241                                                               | 331438                                                                         |
| 80 years and older | 844070653                                                               | 133554                                                                         |
| Total              | 2037021173                                                              | 231217                                                                         |

Figure 1. The discounted value of human lives lost to COVID-19 by provinces in Canada (Int$ 2020)
The sensitivity of TDVHL to variations in life expectancy

As portrayed in Table 4, re-calculation of the model with the world’s average life expectancy induced a contraction in the TDVHL of Int$ 1754972473 (86%) and a decrease in the average value per human life of Int$ 199202. Replacement of the national life expectancy with the world’s highest life expectancy triggered a growth in the TDVHL of Int$ 498674987 (24%) and an Int$ 56603 increase in the average dollar value per human life lost.

4. Discussion

The main findings of this study are as follows: The 8810 human lives losses associated with COVID-19 had an estimated value of Int$ 2037021173, which equiva-
lent to 0.10% of the total GDP of Canada. The dollar value per human life lost due to COVID-19 is Int$ 231217. The dollar value per human life lost in the age group 80 years and above was 9.7 times lower than that of 20-29 years old. Application of discount rates of 5% and 10% led to contractions in the TDVHL of Int$ 192721390 (9%) and Int$ 530132423 (26%), respectively. The higher the discount rate, the lower the TDVHL, indicating an inverse relationship. Use of the world’s average life expectancy of 73 years decreased the TDVHL by Int$ 1754972473 (86%), while application of the world’s highest life expectancy of 88 years grew the TDVHL by Int$ 498674987 (24%). The higher the life expectancy assumed, the higher the estimated TDVHL, which denotes a positive relationship.

**Comparison with other studies**

What does value per human life lost from COVID-19 in Canada compare with those of other countries? The estimated discounted money value per human life lost due to COVID-19 was Int$ 356203 [21] in China, Int$ 292889 [22] in the USA, Int$ 228514 in Turkey [23], Int$ 470798 in Spain [24], and Int$ 225104 in the UK [25]. Thus, the estimated dollar value per human life lost due to COVID-19 in Canada of Int$ 231217 was lower than those of China, the USA, and Spain by Int$ 124986, Int$ 61672, and Int$ 239581, respectively. However, the value per human life lost for Canada was Int$ 2703 and Int$ 6113 higher than that of Turkey and the UK, respectively.

**Table 4. A comparison of Canada’s cumulative COVID-19 cases (as of July 16, 2020) with those of other major advanced economies (G-7 countries)**

| COVID-19                | Canada | France | Germany | Italy | Japan | The UK | The USA |
|------------------------|--------|--------|---------|-------|-------|--------|---------|
| (A). Total cases       | 108829 | 173304 | 201252  | 243506| 22508 | 291911 | 3617040 |
| (B). Deaths            | 8810   | 30120  | 9148    | 34997 | 984   | 45053  | 140150  |
| (C). Recovered cases   | 72485  | 78820  | 186000  | 196016| 18545 | N/A    | 1645966 |
| (D). Active cases      | 27534  | 64364  | 6104    | 12493 | 2979  | N/A    | 1830924 |
| (E). Cases which had an outcome [E=B+C] | 81295 | 108940 | 195148  | 231013| 19529 | N/A    | 1786116 |
| (F). Percentage of dead [F=(B/E)x100] | 10.8 | 27.6   | 4.7     | 15.1  | 5.0   | N/A    | 7.8     |
| (G). Percentage of recovered [G=(C/E)x100] | 89.2 | 72.4   | 95.3    | 84.9  | 95.0  | N/A    | 92.2    |
| (H). Total cases per million population | 2882 | 2655   | 2402    | 4028  | 178   | 4299   | 10925   |
| (I). Deaths per million population | 233  | 461    | 109     | 579   | 8     | 664    | 423     |
| Tests per million population | 88515| 38790  | 76091   | 100120| 4639  | 183531 | 135459  |

Source: Worldometer [4].

Comparison of Canada’s COVID-19 morbidity and mortality against 6 other G-7 countries

Table 4 provides a comparison of Canada’s total COVID-19 cases, deaths, recovered cases, active cases, total cases per million population, deaths per million population, and tests per million population with those of the other 6 G-7 countries (also called the major advanced economies).

Among the G-7 countries, Canada has the fourth-highest total cases of COVID-19 per million population, i.e. after Italy, the UK, and the USA. The total cases per million population in Canada are 16-fold more than those of Japan but 4-fold lower than those of the USA.

Contrastingly, Canada had the third-lowest number of deaths per million population, after Germany and Japan. The percentage of deaths among cases with an outcome in Canada of 11% was 6 points, 6 points, and 3 percentage points higher than those of Germany, Japan, and the USA. However, 17 and 4 percentage points lower than those of France and Italy. The percentage of recoveries from COVID-19 was higher in Germany, Japan, and the USA than in Canada.

Why was the number of deaths per million population in Canada about 2-fold and 29-fold those of Germany and Japan, respectively? Could the variance be due to underlying variations in the Universal Health Coverage (UHC), the International Health Regulations (IHR), and social determinants of health?
Comparing the health system and social determinants of health indicators in Canada with those of the other 6 G-7 countries. Table 5 compares the health system, water, sanitation, and secondary indicators in Canada with those of the other 6 G-7 countries.

Human resources for health

Regarding human resources for health, Canada has a lower density of skilled health professionals per 10000 population than those for France, Germany, and Japan [27]. Also, the country has lower densities of medical doctors and nursing personnel compared to France, Germany, and the USA [7]. The lower densities of key health workforce cadres may have reduced, albeit slightly, Canada’s capacity to provide optimal care for COVID-19 patients in serious or critical condition, leading to a higher number of deaths compared to Germany and Japan. On the other hand, Canada’s higher ratio of psychiatrists and social workers (per 100000 population) practicing in the mental health sector might enable the country to manage better (than most other G-7 countries) the recovered COVID-19 patients with mental disorders.

Table 5. A comparison of the health system, water, sanitation, and secondary education indicators in Canada with those of other G-7 countries

| Health System, Water, Sanitation, And Secondary Education Indicators | Canada | France | Germany | Italy | Japan | The UK | The USA |
|---|---|---|---|---|---|---|---|
| Medical doctors per 10000 population [7] | 23.1 | 32.7 | 42.5 | 39.8 | 24.1 | 28.1 | 26.1 |
| Nursing and midwifery personnel per 10000 population [7] | 99.4 | 114.7 | 132.4 | 57.4 | 121.5 | 81.7 | 145.5 |
| Dentists per 10000 population [7] | 6.4 | 6.7 | 8.5 | 8.2 | 8.0 | 5.2 | 5.8 |
| Pharmacists per 10000 population [7] | 11.2 | 10.6 | 6.5 | 10.9 | 18.0 | 8.9 | 9.2 |
| Psychologists working in mental health sector per 100000 population [27] | 48.7 | 48.74 | 49.55 | 3.8 | 3.04 | N/A | 29.86 |
| Psychiatrists working in mental health sector per 100000 population [27] | 14.68 | 20.91 | 13.2 | 5.98 | 11.87 | N/A | 10.54 |
| Nurses working in mental health sector per 100000 population [27] | 68.66 | 98.02 | N/A | 23.49 | 83.81 | N/A | 4.28 |
| Social workers working in the mental health sector per 100000 population [27] | 145.4 | N/A | N/A | 2.59 | 8.33 | N/A | 60.34 |
| Skilled health professionals per 10000 population [27] | 123.8 | 138 | 179.8 | 97.39 | 136.1 | 112.5 | 117.3 |
| Radiotherapy units per million population [28] | 8.1 | 7.5 | 6.4 | 6.4 | 7.2 | 5.0 | 12.4 |
| Hospital beds (per 10000 population) [28] | 27 | 64.77 | 82.78 | 34.22 | 134 | 27.58 | 29 |
| Current health expenditure as % gross domestic product [8] | 10.6 | 11.3 | 11.2 | 8.8 | 10.9 | 9.6 | 17.1 |
| Domestic general government health expenditure as % current health expenditure [8] | 73.7 | 77.1 | 77.7 | 73.9 | 84.1 | 79.4 | 50.1 |
| Out-of-pocket as % of current health expenditure [8] | 14.2 | 9.4 | 12.7 | 23.5 | 12.8 | 16.0 | 11.0 |
| Out-of-pocket expenditure per capita in international dollars (Int$) or purchasing power parity PPP [8] | 700.8 | 470.3 | 750.6 | 850.1 | 586.3 | 692.3 | 1,126.3 |
| Current health expenditure (CHE) per capita in (PPP) [8] | 4929 | 5011 | 5923 | 3620 | 4563 | 4338 | 10246 |
| Percentage of population with household expenditure on health greater 25% of income [29] | 0.5 | 0.22 | 0.11 | 1.08 | 0.6 | 0.48 | 0.78 |
| Universal health coverage index [29] | 89 | 78 | 83 | 82 | 83 | 87 | 84 |
| Proportion of population using safely-managed drinking-water services (%) [7] | 99 | 98 | >99 | 95 | 98 | >99 | >99 |
| Proportion of population using safely-managed sanitation services (%) [7] | 82 | 88 | 97 | 96 | 99 | 98 | 90 |
| Population with at least some secondary education (% ages 25 and older) [2] | | | | | | | |
| Female | 100 | 81.0 | 96.0 | 76.6 | 95.2 | 82.9 | 95.7 |
| Male | 100 | 86.3 | 96.6 | 83.0 | 92.2 | 85.7 | 95.5 |

Source: UNDP [2], WHO [7, 8, 26, 27, 28, 29].

Muthuri Kirigia J. Value of Human Life Losses Associated With COVID-19 in Canada. PBR. 2020; 6(Special Issue on COVID-19):93-104.
Concerning health infrastructure, Canada has a lower number of hospital beds per 10000 population than all the other G-7 countries [29]. For instance, the ratios of hospital beds in France, Germany, and Japan were 2-fold, 3-fold, and 5-fold, respectively. Hospitals are crucial for the provision of hospital-based emergency care services [30, 31], strengthening of capacities and supervision of other levels of care, and efficient functions of the referral system. Concerning medical devices, Canada had a higher density of radiotherapy units (per million population) than France, Germany, Italy, Japan, and the UK [28]. The density of health infrastructure may be a proxy (albeit imperfect) for the capacity to accommodate and provide hotel services for COVID-19 cases in need of inpatient care.

**Figure 2.** A comparison of Canada’s and the other G-7 countries IHR core capacities

**Infrastructure and medical devices**

Radiation emergencies
Chemical events
Zoonotic events and the human-animal interface
Food safety
Points of entry
Risk communication
Health service provision
National emergency framework
Human resources
Surveillance
Laboratory
Coordination and national focal point functions
Legislation and financing

USA, UK, Japan, Italy, Germany, France, Canada
Service delivery

In the Declaration of Astana [32], the WHO Member States and stakeholders are committed to these issues:

“… strengthen health systems by investing in Primary Health Care (PHC) [to] provide a comprehensive range of services and care, including but not limited to vaccination; screenings; prevention, control and management of non-communicable and communicable diseases; care and services that promote, maintain and improve maternal, newborn, child and adolescent health; and mental health and sexual and reproductive health” (operative paragraph V).

According to the Declaration of Alma Ata [33], PHC also encompasses health education about current health challenges (such as COVID-19) and how to prevent and control them, improve food security and healthy diet, and safe water and basic sanitation. The PHC strategy is vitally important for preventing, diagnosing, contact tracing, containing the spread/transmission, and managing mild and moderate COVID-19 cases [34]. The Declaration of Astana views PHC as a cornerstone of a sustainable health system for the attainment of Universal Health Coverage (UHC) and health-related Sustainable Development Goals (SDG) [32].

The UN SDG 3, target 3.8, is about achieving UHC, which encompasses “financial risk protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all” (p.16) [35]. According to the WHO and the World Bank [36], the SDG indicator 3.8.1 is about coverage of essential health services, which is defined as the “… average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn, child and adolescent health; infectious diseases; noncommunicable diseases; and service capacity and access” (p. xiii). The SDG indicator 3.8.1 is tracked using the UHC service coverage index presented on a scale of 0% to 100% (target). As shown in Table 5, by subtracting the actual score from the target (100%), we realize that 11%, 22%, 17%, 18%, 17%, 13%, and 16% of people in need of essential health services in Canada, France, Germany, Italy, Japan, the UK, and the USA did not have access.

Health financing

As portrayed in Table 5, the portion of GDP (total output) spent on health in Canada of 10.6% was lower than those of France, Germany, Japan, and the USA. McIntyre, Meheus, and Røttingen [37] recommended: “… a target of government spending on health of at least 5% of GDP for progressing towards UHC” (p. 125). The government spending on health as a proportion of GDP was 7.8% in Canada, 8.7% in France, 8.7% in Germany, 6.5% in Italy, 9.2% in Japan, 7.6% in the UK, and 8.6% in the USA. Thus, all G-7 countries governments surpassed the threshold of spending 5% of GDP on health. It is worth noting that government spending as a percentage of GDP in France, Germany, Japan, and the USA is higher than Canada’s.

Also, Canada’s current health expenditure of Int$ 4929 per person was less than those of France, Germany, and the USA by Int$ 82, Int$ 994, and Int$ 5317 (Table 5). Canada’s spending on PHC as a percentage of total health spending in Canada of 47% was reasonably comparable to 48% in Germany [38]. Thus, the PHC spending per person is almost Int$ 2,317 in Canada.

According to WHO [39], “It is only when the reliance on direct payments falls to less than 15%–20% of total health expenditures that the incidence of financial catastrophe routinely falls to negligible levels.” Among the G-7 countries, only Italy whose out-of-pocket spending on health as a percentage of current health expenditure is higher than the threshold mentioned above. Canada and the other 5 G-7 countries have achieved those levels (Table 5). Nevertheless, 189,070 (0.5%) Canadians with household expenditure on health greater than 25% of income are exposed to a high incidence of financial catastrophe and impoverishment [39].

Comparison of Canada’s IHR core capacities with those of the other 6 G-7 countries

The 58 World Health Assembly adopted the revised International Health Regulations (IHR) [40] in 2005 through Resolution WHA58.3 [41]. The Resolution WHA58.3 [41], operative paragraph 5(1), called upon the Member States to “to build, strengthen and maintain the capacities (to detect, assess, notify and report public health events/emergencies) required under the IHR, and to mobilize the resources necessary for that purpose” (p. 4).

According to WHO [42], there are 13 IHR core capacities: national legislation, policy and financing; coordination and national focal point functions; national emergency framework; surveillance; response; preparedness (public health emergency response plans, mapping of potential hazards and hazard sites, development of appropriate national stockpiles of resources); risk communication (establish communication policies and procedures, develop communication plans, dissemination of health risk information to the public); human resources (skills
and competencies of public health personnel; laboratory (for reliable and timely laboratory identification of infectious agents and other hazards); zoonotic events; food safety events; chemical events; and radiological and nuclear emergencies. Each member state self-assesses on a scale of 0 (non-existent) to 100 (target) each of the abovementioned IHR core capacities, and then an average score is calculated. Figure 2 provides a comparison of the G-7 countries IHR core capacity scores.

Source: Generated by authors using data from WHO [43]

In 2019, Canada self-assessed the 13 core capacities in Figure 2 to be on target or optimal (100) [43]. The average of 13 IHR core capacities score for Canada of 99% was higher than 82% in France, 88% in Germany, 85% in Italy, 95% in Japan, 93% in the UK, and 92% in the USA [6]. However, how come that the total COVID-19 cases and deaths per million population in Canada are higher compared to those of, for example, Germany and Japan. According to Althubaiti [44], “… self-reported data are often argued to be unreliable and threatened by self-reporting bias. … bias can arise from social desirability, recall period, sampling approach, or selective recall”.

Study limitations

There are some study limitations. First, the current study excluded the resources used in COVID-19 testing, contact tracing and quarantine, transportation, hospitalization (bed, food, water, soap, towels), treatment (time on ventilators, medicines), interment [21, 22], and psychological effects on the dead (fear, anxiety, and pain before death) and family members (grief and social stigma) [45].

Second, per capita GDP ignores the contribution of economic production processes to environmental degradation, improvements of ozone layer following COVID-related economic lockdown, inequalities in the distribution of income and wealth within society, and quality of life [46, 47].

Third, some critics may take issue with the approach taken by the researchers to value the years of life lost among the elderly (60 years and older) at the same net GDP per capita as the younger folk. The same net GDP per capita was used even for the elderly because they contribute to society through consumption of goods and services, participation in the formal (or informal) workforce, payment of taxes, cash and asset transfer to younger generations, entrepreneurship and investment, innovation, social and cultural contribution, and social cohesion [48, 49].

5. Conclusion

The study succeeded in assessing the dollar value of human life losses associated with COVID-19 in Canada. The average value of human life lost is 4-fold the GDP per person in Canada. Therefore, to prevent human life and economic losses from the ongoing and future pandemics, Canada needs to grow its investments into the national health system to bridge the existing gap of 11% in the UHC service coverage index; the 1% gap in IHR capacities; and the 1% and 18% gaps coverage gaps of Canada’s population without access to safely-managed drinking-water and sanitation [7]. It is vital that Canada bridges the remaining gaps in coverage of essential health services and safely managed drinking water and sanitation services not only for economic reasons but also because those services are human rights [50].

Ethical Considerations

Compliance with ethical guidelines

The ethical approval was unnecessary because the study analyzed data from the Canada Government, Worldometer, IMF, and WHO databases. Those databases are freely available to the public.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors’ contributions

Conceptualization and supervision, and writing – original draft: Joses Muthuri Kirigia; Writing – original draft, writing – review & editing: Rose Nabi Deborah Karimi Muthur; Methodology, data collection, data analysis: Both authors.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

We are grateful to Lenity Honesty Kainyu Nkanata for creating an enabling living and working environment. The Pharmaceutical and Biomedical Research Editor-in-Chief and anonymous peer reviewers’ valuable suggestions helped improve this paper’s quality.
[31] WHO. Health systems: Emergency-care systems. World Health Assembly Resolution WHA60.22. Geneva: WHO; 2007.

[32] WHO and the United Nations Children’s Fund (UNICEF). Declaration of Astana. Global Conference on Primary Health Care: From Alma-Ata towards universal health coverage and the Sustainable Development Goals, Astana, Kazakhstan, 25 and 26 October 2018. Geneva/New York: WHO and UNICEF; 2018.

[33] WHO. Declaration of Alma-Ata International Conference on Primary Health Care, Alma-Ata, USSR, 6-12 September 1978. Geneva: WHO; 1978.

[34] The Primary Health Care Performance Initiative (PHCPI). Key Messages: COVID-19 and Primary Health Care [Internet]. 2020 [Updated 2020 Jul 07]. Available from: https://improvingphc.org/key-messages-covid-19-and-primary-health-care

[35] United Nations (UN). Transforming our world: the 2030 Agenda for Sustainable Development. UN General Assembly (UNGA) Resolution A/RES/70/1. New York: UN; 2015.

[36] WHO and The World Bank. Tracking universal health coverage: 2017 global monitoring report. Geneva: WHO; 2017.

[37] McIntyre D, Meheus F, Røttingen JA. What level of domestic government health expenditure should we aspire to for universal health coverage? Health Econ Policy Law. 2017; 12:125-37. [DOI:10.1017/S1744133116000414] [PMID] [PMCID]

[38] WHO. Global spending on health: a world in transition. Document WHO/HIS/HGF/HFWorkingPaper/19.4. Geneva: WHO; 2019.

[39] WHO. The world health report: health systems financing: the path to universal coverage. Geneva: WHO; 2010.

[40] WHO. International health regulations (2005) – 3rd ed. Geneva: WHO; 2005.

[41] WHO. Revision of the International Health Regulations. World Health Assembly Resolution WHA58.3. Geneva: WHO; 2005.

[42] WHO. International Health Regulations (IHR) (2005) core capacity monitoring framework: Checklist and indicators for monitoring progress in the development of IHR core capacities in States Parties. Geneva: WHO; 2013.

[43] WHO. Global Health Observatory. Health Emergencies. International Health Regulations (2005) monitoring framework (IHR SPAR) [Internet]. 2020 [Updated 2020 Jul 01]. Available from: https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/IHR—all-capacities

[44] Althubaiti A. Information bias in health research: Definition, pitfalls, and adjustment methods. J Multidiscip Healthc. 2016; 9:211-7. [DOI:10.2147/JMDH.S104807] [PMID] [PMCID]

[45] Blake H, Bermingham F, Johnson G, Tabner A. Mitigating the psychological impact of COVID19 on healthcare workers: A digital learning package. Int J Environ Res Public Health. 2020; 17(9):2997. [DOI:10.3390/ijerph17092997] [PMID] [PMCID]

[46] Stiglitz, Joseph E, Amartya Sen, Jean-Paul Fitoussi. Mismeasuring our lives: Why GDP doesn’t add up: The report. New York: The New Press; 2010.

[47] Fleurbaey M. Beyond GDP: The Quest for a measure of social welfare. J Econ Lit. 2009; 47(4):1029-75. [DOI:10.1257/jel.47.4.1029]

[48] WHO. World report on ageing and health. Geneva: WHO; 2015.

[49] Cook J. The socio-economic contribution of older people in the UK. Working with Older People. 2011; 15(4):141-6. [DOI:10.1108/13663661111191257]

[50] United Nations (UN). The universal declaration of human rights. New York: UN; 2015.