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Economic Evaluation

How Expensive Are Hospitalizations by COVID-19? Evidence From Colombia

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ABSTRACT

Objectives: This study aimed to estimate the direct medical costs due to hospitalizations by COVID-19 in Colombia and to identify their cost drivers in Colombia.

Methods: This is a retrospective cost-of-illness study of COVID-19 in Colombia. We estimated direct medical costs using data from patients insured to a Benefit Plan Administrator Company, between March 15, 2020 and May 29, 2020. Absolute and relative frequencies, averages, medians, and interquartile ranges (IQRs) were used to characterize the population and estimate the costs of hospitalized patients with COVID-19. We stratified the cost analysis by sex, age groups, comorbidities, and type of hospitalization (general ward and intensive care unit [ICU]). Cost drivers were calculated from a generalized linear model.

Results: We studied 113 confirmed patients, 51.3% men. On average, the hospital length of stay was 7.3 (± 6.2) days. A person hospitalized with COVID-19 reported median costs of $1688 (IQR 788-2523). In women, this cost was $1328 (IQR 463-2098); in men, this was 1.4 times greater. The median cost for ICU was $4118 (IQR 2069-5455), 3 times higher than those hospitalized only in the general ward. Admission to the ICU, having 1 comorbidity, length of stay, high blood pressure, having 5 comorbidities, and being treated in the city of Cartagena were statistically significant with direct medical costs.

Conclusions: Our study provides an idea of the magnitude of costs needed to hospitalize a COVID-19 case in Colombia. Other studies in Colombia have assessed the costs of hospitalization for infectious diseases such as influenza, costs significantly lower than those described here.

Keywords: costs and cost analysis, COVID-19, direct medical cost, hospitalization.

VALUE HEALTH REG ISSUES. 2022; 31:127–133

Introduction

The disease caused by the new COVID-19 was announced as pandemic by the World Health Organization on March 11, 2020, called for an aggressive global response to fight against the virus and its consequences.[1] Since its emergence in Wuhan (Hubei province in China), the COVID-19 has brought huge challenges in terms of the response of the economies, the surveillance systems, and effective pharmacological and nonpharmacological interventions.[2] Most of COVID-19 cases have mild symptoms and are treated at home. Nevertheless, there is a small percent that need to be hospitalized in a general ward or intensive care unit (ICU).[3,4]

One of the major concerns is the economic burden COVID-19 imposes upon the health system and the society, with regard to direct medical costs and premature deaths. In many countries, COVID-19 has exceeded the healthcare system capacity, especially in terms of ICU and ventilators.[5] As of June 30, 2020, hospitalization for COVID-19 in Colombia was 5.6% of the reported cases.[6]. The length of stay (LOS) associated with this disease is considerably long versus other respiratory viruses, especially because of several complications that patients present and the need to be assisted by a ventilator for long periods of time.[5,7]

Under this scenario, the healthcare resources used by the hospitalization of patients with COVID-19 represent a high economic burden upon the Colombian health system. Here, the aim was to describe the direct medical costs related to the attention of hospitalized confirmed patients with COVID-19 and identify their cost drivers in Colombia at the beginning of the pandemic in 2020.

Methods

Scope and Population

We conducted a retrospective cost-of-illness study of COVID-19 in Colombia from patients treated at Health Service Providers (HSPs) in 23 municipalities of 12 Colombian departments (states). This study was conducted from the third payer perspective. Included patients were low-income population insured to a

Benefit Plan Administrator Company (Empresas Administradoras de Planes de Beneficios [EAPB], in Spanish) of the subsidized regime with a ~2.6 million insured population. This EAPB offers healthcare services in 25 of the 32 Colombian states and in 304 of the 1.122 municipalities. Colombian health system comprises attention for poor population (subsidized regime), for people who works (contributive regime); for military, teachers, and others (special regime); and finally for those who have willingness to pay for healthcare attention (out-of-pocket or private expenditure).[8,9]

According to the Resolution 8430 of 1993 of the Ministry of Health, this study presented no risks to patients.[10] For this reason, no signed consent was necessary.

Data

Healthcare resource utilization owing to hospitalization data came from the clinical records of patients with confirmed diagnosis of COVID-19 treated in the general ward or ICU of Colombian HSP. Medical records are stored in a hospital management database that details the resource use of each hospitalized patient, inventorying the health technology consumption of the patients selected for analysis. This administrative database is verified by hospital auditors through a concurrent audit process. They strictly monitor the microconsumptions of each patient to match the billing of the HSP and what is contemplated by the EAPB in their authorization databases, also comparing them with the disease management guidelines.

The analyzed database mainly has the following variables: anonymized code of the patient, sex, age, HPS, date of admission to hospitalization, date of discharge, discharge status (alive, dead), number of comorbidities, name of the activities consumed, unit value per activity, and total value.

Estimation of Direct Medical Costs

We analyzed and reported direct medical costs by the following items: consultations, drugs, material and supplies, LOS (including administrative and clinical human resources costs), procedures, emergencies, and diagnostic support, among others. We only included costs to be borne by the Colombian health system. Item costs were described as a proportion of the average direct medical cost, accounting the average of the proportions of per-item costs.

To value the use of healthcare services, we used official national prices lists, such as the official Colombian Tariff Manual (Seguro obligatorio de accidentes de tránsito, in Spanish), which standardize the maximum price of medical, surgical, and hospital prices.[11] Costs were reported in US dollars, using the exchange rate average from March 1 to May 31, 2020, reported by the Central Bank of Colombia (1 US dollar = 3903 Colombian pesos).[10]

Data were gathered and analyzed in a database using a Microsoft Excel® spreadsheet (Microsoft Corporation, Redmond, WA) and analyze in R programming using *dplyr* and *ggplot2* packages. Absolute and relative frequencies, averages, medians, and interquartile ranges (IQRs) were used to characterize the population and estimate the direct medical costs of hospitalized patients with COVID-19. We stratified the cost analysis by sex, age groups, comorbidities, and type of hospitalization (general ward and ICU).

Cost Predictors

To estimate the cost drivers that changes hospitalization costs, a generalized linear model was run considering significance levels at 10%, 5%, and 1%. The coefficients resulting from the modeling were presented in their exponentiated form, indicating a cost relationship between a category of interest and a reference category for categorical predictors or as the percent increase in the mean cost per unit increase for a continuous predictor.[12] Independent variables were the following: sex (1 = woman, 0 = man), age, ICU hospitalization (1 = yes, 0 = no), number of comorbidities (1, 2, 3, 4, and 5), high blood pressure (HBP) (1 = yes, 0 = no), number of comorbidities, discharge (1 = dead, 0 = alive), LOS in days, and city of care (Barranquilla, Cali, Cartagena, others = reference). We hypothesized that there were no statistical differences in costs between cities. This model was run on Stata 14 (StataCorp LLC, College Station, TX)

Table 1. Clinical and sociodemographic characteristics of the COVID-19 hospitalized cases.

Characteristics	N = 113	%
Age, average (SD)	49.8 (±22.9)	
Sex		
Woman	55	48.7
Man	58	51.3
Hospitalization		
General ward	79	69.9
ICU	34	30.1
Length of stay—general ward, mean (SD)	7.3 (±6.2)	
Length of stay—ICU, mean (SD)	10.2 (±7.2)	
Length of stay—total, mean (SD)	8.1 (±6.7)	
Types of comorbidities		
Without comorbidities	70	61.9
Hypertension	16	14.2
Diabetes, hypertension	7	6.2
Diabetes	3	2.7
Diabetes, hypertension, chronic kidney disease	3	2.7

ICU indicates intensive care unit.

Results

Estimating Direct Medical Costs of COVID-19

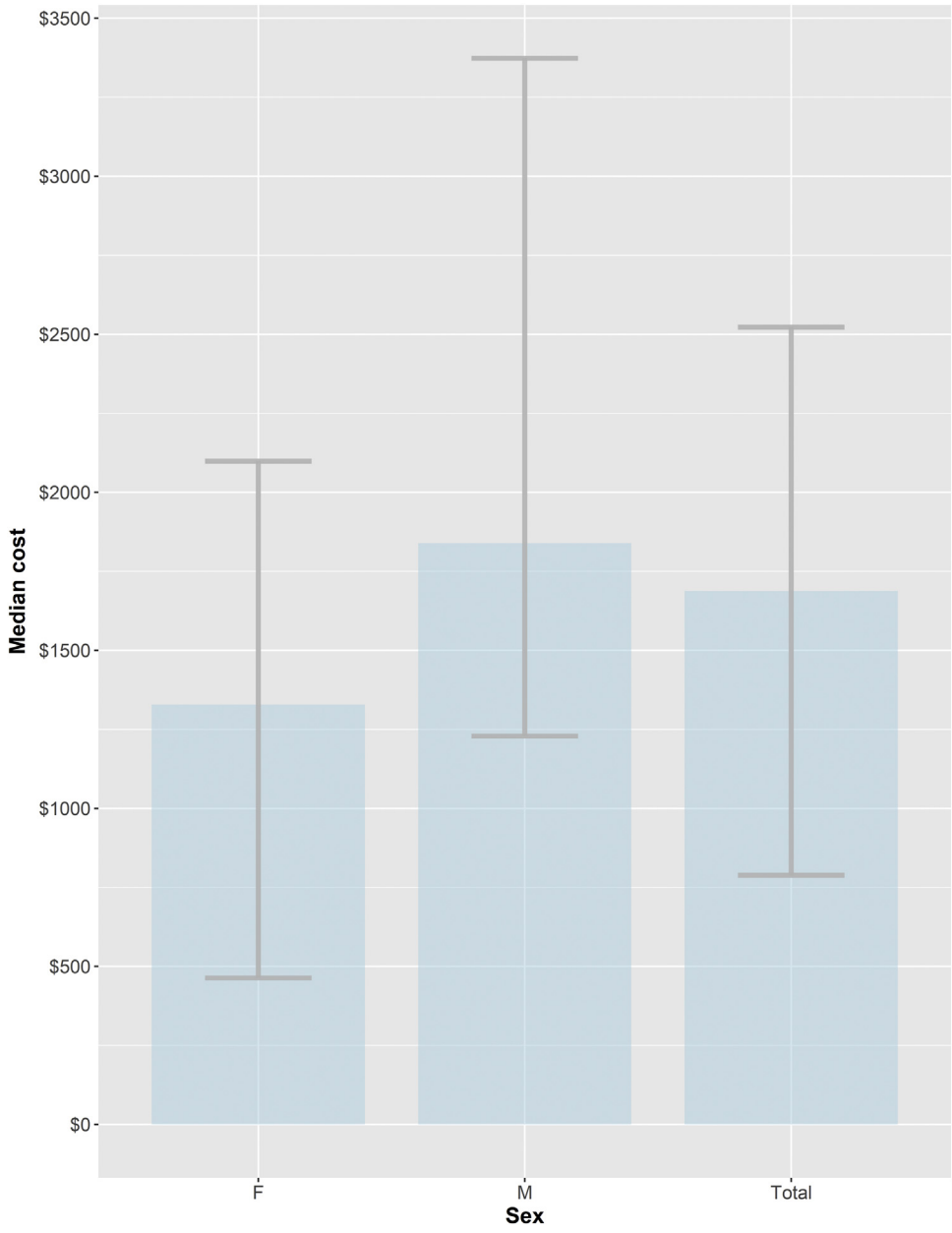
We studied 113 patients hospitalized by COVID-19, 51.3% men. The age average was 49.8 years (±22.9). Most of the patients were

Table 2. Direct medical costs related to hospitalized cases due to COVID-19 in Colombia, 2020.

Cost item	%	Mean, $	Median (IQR), $
Others	0.7	15	11 (5-17)
Emergencies	1.8	41	30 (14-45)
Procedures	1.0	22	16 (8-24)
Consults	3.1	72	53 (25-79)
Diagnostic support	10.7	244	180 (84-269)
Drugs	15.0	341	252 (118-377)
LOS	67.8	1549	1145 (535-1711)
Total	100.0	2283	1688 (788-2523)

IQR indicates interquartile range; LOS, length of stay.

Figure 1. Direct medical costs owing to COVID-19 hospitalization by sex.



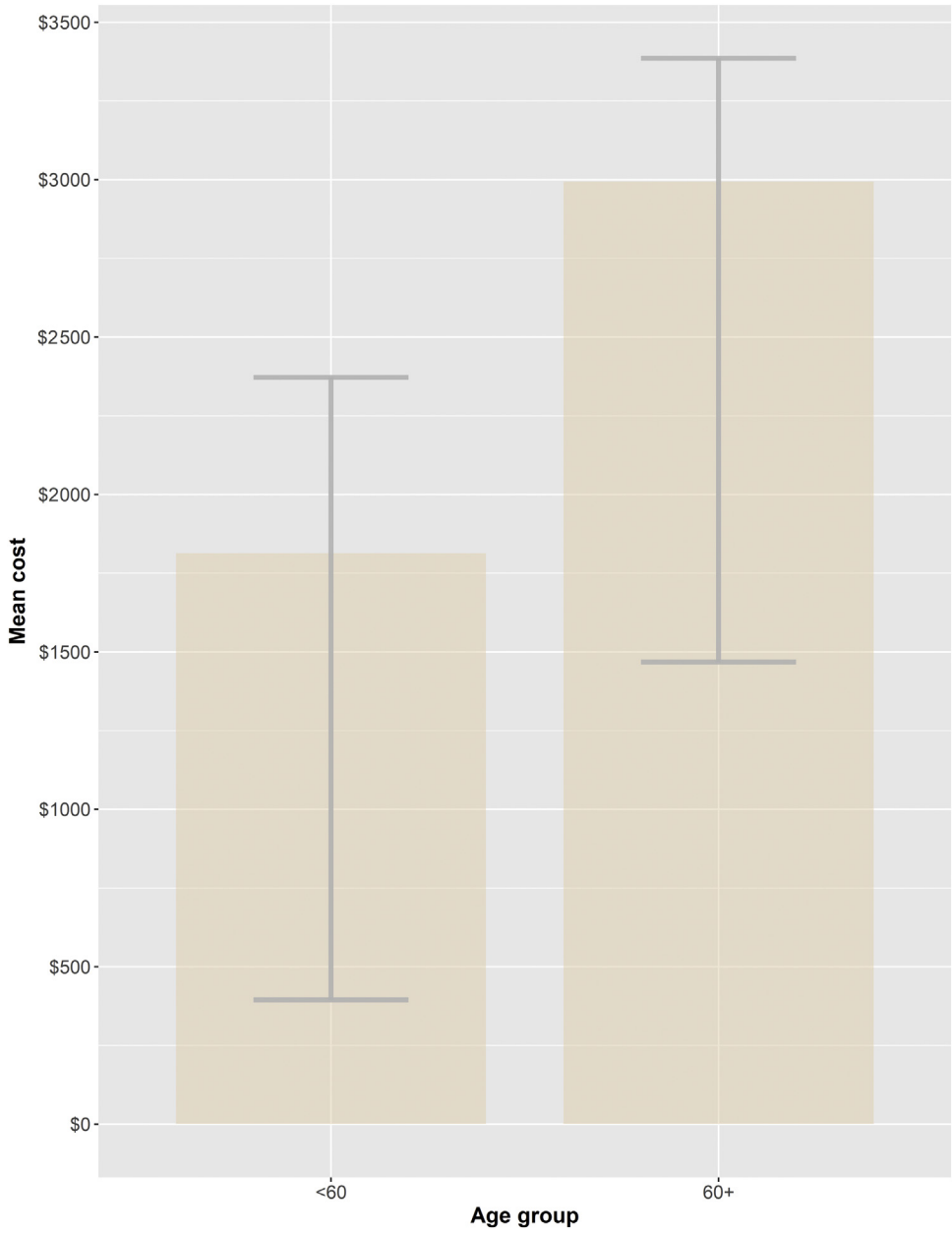
F indicates female; M, male.

hospitalized at institutions providing health services in Cartagena (n = 48), Cali (n = 24), and Barranquilla (n = 13). Nearly 1 in 3 patients was admitted to the ICU, where the average LOS was slightly greater than in general ward. A total of 70 (61.9%) patients had no history of comorbidities at the time of hospitalization; 24 reported 1 comorbidity, whereas 19 patients had at least 2 comorbidities. The most frequent comorbidity was HBP, followed by diabetes (Table 1).

Table 2 and Figures 1 to 3 give a breakdown of the direct medical costs related to COVID-19 hospitalizations. A person hospitalized with this disease reported median costs of $1688 (IQR 788-2523). In women, the median direct medical cost of hospitalization was $1328 (IQR 463-2098), whereas the median cost in men was 1.4 times greater (Fig. 1). Figure 2 shows the average cost of treating a hospitalized COVID-19 case according to age groups. Being 60 years of age or older triggers hospitalization costs almost twice as high as those under this age, and when the cost is compared by type of hospitalization, this difference is >3 times (Fig. 3). Appendix Figure 1 in Supplemental Materials found at https://dx.doi.org/10.1016/j.vhri.2022.04.005 shows how as the number of comorbidities increases, there is a greater direct medical cost of COVID-19 hospitalization.

On average, the hospital LOS for patients hospitalized with confirmed COVID-19 was 7.3 (±6.2) days (ICU: 10.2 days, ±7.2). A total of 41 patients (36.3%) spent 5 days hospitalized or less, whereas 23.0% (n = 26) spent 13 days or more. Appendix Figure 2 in Supplemental Materials found at https://dx.doi.org/10.1016/j.vhri.2022.04.005 describes the number of hospitalized patients per hospitalization day and the average direct medical cost of all activities consumed by these patients, depending on the LOS. A

Figure 2. Direct medical costs due to COVID-19 by age groups.



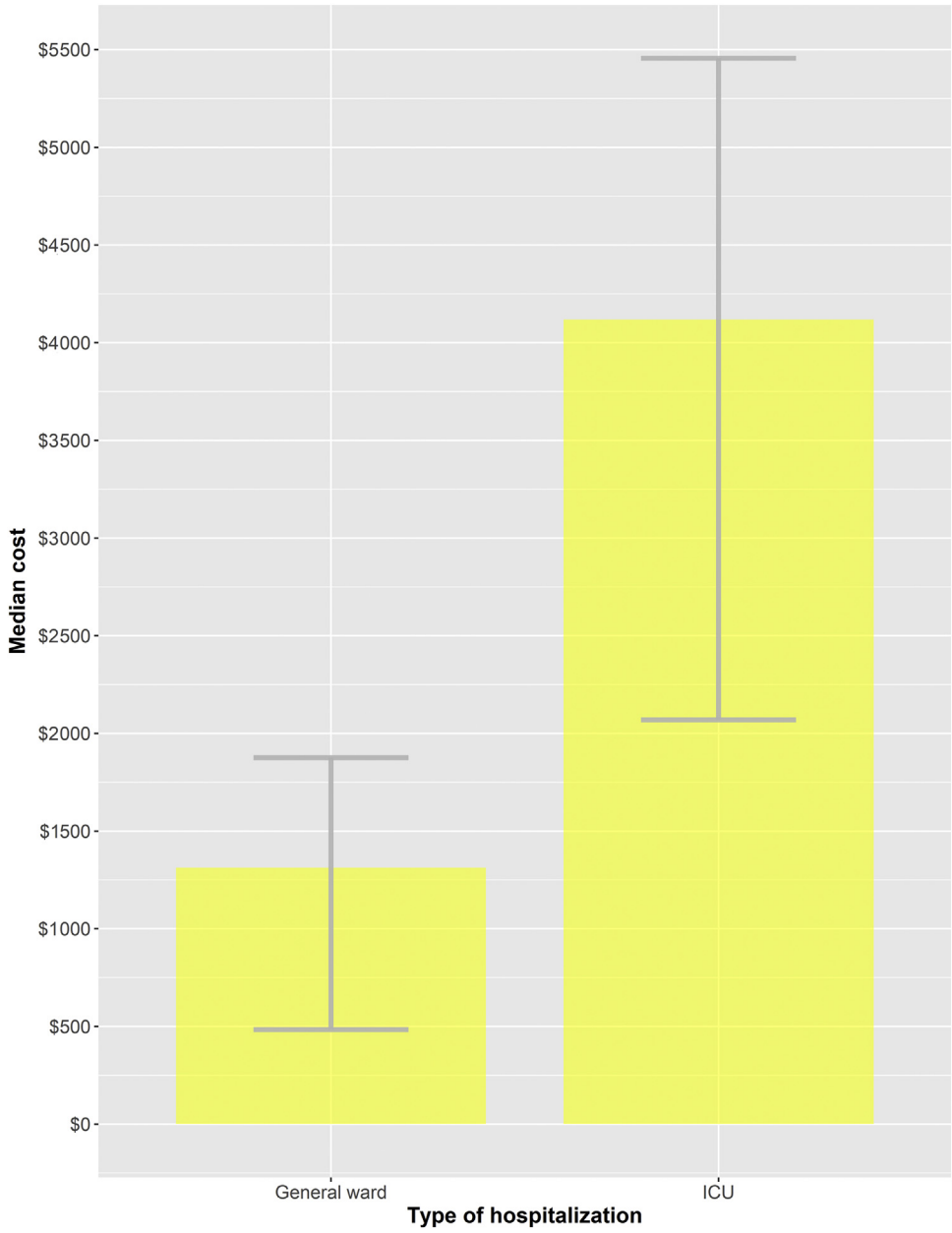
total of 24 people were hospitalized for 1 day, with an average cost of $468; 12 people were hospitalized for 9 days, with an average cost of $2456; and 12 people had a hospital LOS of 16+, with an average direct medical cost of $4856. The red line in Appendix Figure 2 in Supplemental Materials found at https://dx.doi.org/10.1016/j.vhri.2022.04.00 displays the exponential trend in average COVID-19 costs of care as the number of hospital days increases.

The generalized linear model of the cost per patient hospitalized for COVID-19 is presented in Table 3.[1] The following variables were significant at 1%: admission to the ICU, having 1 comorbidity, and the days of hospital stay. The following variables were statistically significant at 5%: HBP, 5 comorbidities, and being treated in the city of Cartagena. A case admitted to the ICU increases the direct medical cost by 2.5 times compared with being admitted to the general ward. Having between 4 and 5 comorbidities produces a cost per patient 1.5 times higher than having no comorbidities. The days of hospital LOS increase 1.1 times the cost per patient. On the contrary, being female reduces the cost per patient (0.8 times lower than the average). Being hospitalized in Cartagena was 1.23 times more expensive than being hospitalized for COVID-19 in another Colombian city.

Discussion

Our study provides an idea of the magnitude of costs needed to hospitalize a COVID-19 case in Colombia. Characteristics such as the distribution by sex of the cases studied and their average age are similar to those previously published in other Colombian

Figure 3. Direct medical costs due to COVID-19 by type of hospitalization.



ICU indicates intensive care unit.

studies.[13] The median cost of caring for a patient hospitalized for COVID-19 in the ICU is $4118 (IQR 2069-5455), 3 times higher than those hospitalized only in the general ward. In addition, it is highlighted how costs increased as age and the number of comorbidities increased. Although at this time there are no studies showing this relationship, there is evidence that suggests worse health outcomes in patients with comorbidities.[14,15] Given the high cost associated with age and comorbidities and that a very high mortality rate in the ICU has been widely demonstrated in patients older than 65 years of age,[5,16] it is important to develop cost-effectiveness analyzes that help decision making in these cases.

Costs for COVID-19 in Colombia and the world are still scarce. Hospitalizing a COVID-19 case in the United States has been calculated at $14 366,[17] remarkably superior than our estimation. Other studies in Colombia have assessed the costs of hospitalization for infectious diseases such as influenza,[18] valuing median costs in the general ward for severe acute respiratory infection of $484 (2020 values) and in the ICU of $3044 (2020 values),[18] costs significantly lower than those described in our study.

The results of the present study should be viewed with caution. This article was drafted at the beginning of the COVID-19 pandemic, and the first protocol for the clinical management of patients with new COVID-19 infection in the country was published in July 2020,[19] 1 month after the data capture date. These and future changes on it could significantly affect the costs associated with the healthcare resource utilization for the disease.

This study has limitations. The analyzed sample of patients could be relatively small to have a representative hospitalization cost for COVID-19 at the country level. Nevertheless, the data were

Table 3. Generalized linear model of COVID-19 hospitalizations costs.

Variables	GLM (exponentiated)
ICU	2.521* (0.265)
HTN	1.696† (0.418)
Comorbidities	
1	0.595* (0.119)
2	0.898 (0.122)
3	1.318 (0.319)
4	1.512‡ (0.370)
5	1.468† (0.201)
Death	1.063 (0.156)
Length of stay	1.096* (0.014)
Age	0.998 (0.002)
Women	0.808‡ (0.090)
City of attention	
Barranquilla	0.979 (0.185)
Cali	1.589 (0.290)
Cartagena	1.235† (0.187)
Constant	556.9
Observations	113

GLM indicates generalized linear model; HTN, hypertension; ICU, intensive care unit.
*Significant at 1%.
†Significant at 5%.
‡Significant at 10%.

provided by a Colombian EAPB with a presence in 25 departments and 304 municipalities of the country. The latest would guarantee national representativeness. Additionally, to complete the analysis of the economic burden produced by COVID-19, the indirect and intangible costs must be considered. For example, these costs for COVID-19 in the United States have been estimated at $16 trillion.[20]

We provided evidence to estimate the economic burden attributable to COVID-19 from the Colombian health system perspective. To complete this economic burden, out-of-pocket health expenditures assumed by the mild symptomatic patients would be missing, as well as those costs paid by the government used in conducting tests, promotion and prevention, supplies (mask, antibacterial gel, alcohol, etc), new human resources, and indirect costs (owing to productivity losses caused by work days lost and premature death), among other costs in charge of the Colombian health system throughout the pandemic.

Supplemental Materials

Supplementary data associated with this article can be found in the online version at https://dx.doi.org/10.1016/j.vhri.2022.04.005.

Article and Author Information

Accepted for Publication: April 14, 2022

Published Online:,

doi: https://doi.org/10.1016/j.vhri.2022.04.005

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Conflict of Interest Disclosures: Dr De la Hoz is an editor for *Value in Health Regional Issues* and had no role in the peer-review process of this article. No other disclosures were reported.

Funding/Support: Funding was provided by the Instituto Nacional de Salud of Colombia.

Role of the Funder/Sponsor: The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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