Evaluation of the Economic Impact for the Management of Patients Confirmed by COVID-19 Infection in Peru

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Abstract

Background: Since the emergence of the pandemic caused by Coronavirus disease-19 (COVID-19), Social isolation is one of the measures adopted by the countries in order to flatten the curve, thus reducing the productive capacity of the affected cities, while allowing health systems to manage care capacity. The objective of this study was to estimate the economic losses due to COVID-19 in Peru.

Methods: To estimate the economic loss, direct and indirect costs were determined from the health system perspective. The direct cost was represented by the expenses caused by the care provided by the health facility to the patient and the indirect cost is represented by the loss of economic production.

Results: Of a total of 363 confirmed cases of COVID-19 in Peru, the percentage of patients requiring hospitalization was 12.3%, and those requiring admission to Intensive Care was 3.9%. The direct cost was $1708 for each patient who received care in a hospital of the Ministry of health through the comprehensive health insurance (SIS); $2,300 if the patient received treatment from Social Security (EsSalud) and US $ 3,192 if he went to a private clinic. In relation to the indirect cost, it ranged from $1447.0 in the patients that are treated by the SIS to $4102.0 for each patient that is attended in private institutions.

Conclusion: Our findings indicate that caring for a patient with COVID-19 imposes a heavy economic burden on Peru.

Keywords: COVID-19• Evaluation • Economic Impact • Pandemic • Direct cost • Indirect cost

Introduction

Since the discovered of a novel coronavirus (SARS-CoV-2) in December 2019 causing severe acute respiratory syndrome, lately named Coronavirus Disease-19 (COVID-19) [1] that quickly spread to the rest of the world [2], Peru reported the first case on March 6, 2020, quickly affecting many departments. On March 11, 2020, the World Health Organization (WHO) declared a coronavirus pandemic COVID-19 [3] and the time of submitting this manuscript, the WHO confirmed more than three hundred thousand infected with COVID-19 worldwide [4]. Currently the method used for the diagnosis of COVID-19 is the real-time reverse transcription polymerase chain reaction (rt-PCR) for SARS-Cov-2, supported by Chest X-rays and Computarized Tomography. The latter is used in hospitalized patients because it helps to identify the infectious process in early stages as well as complications [5]. The strategies adopted by the countries to stop the progression of the disease was the family isolation or quarantine of all the inhabitants, border closures, school closures, measures to isolate symptomatic individuals and their contacts; thus reducing the productive capacity of the affected cities, which added to the losses generated by the diagnosis and treatment of the Affected by COVID19 will increase poverty in many nations [6-8]. The objective of this study was to estimate the economic losses due to COVID-19 in Peru.

Research Methodology

Human parameters

The epidemiological parameters used for the analysis were the confirmed positive cases carried out by the laboratory of the National Institute of Health of Peru (by means of rt-PCR analysis of the samples obtained by nasopharyngeal swab).

The number of reported cases was obtained from the epidemiological surveillance network and was used to estimate productivity losses in patients. We assume that the proportion of reported cases and the frequency of the different types of treatment were uniform across age and gender, we also calculated the proportion of COVID-19 cases admitted to general ward and to the ICU according to what was reported by the General Directorate of Epidemiology [9]. The number of cases and the proportion of patients requiring admission to the ICU was calculated on the basis of the average ICU stay. The average number of cases of COVID19 infected at home was 2.2 [10], the percentage of patients admitted to General ward was 12.3% and the percentage of patients requiring admission to the ICU was 3.9%, the rest of patients had home management[9]. The decreased of productivity corresponded to the loss of productive time due to illness or isolation, assuming as monthly income the minimum living wage in Peru for 2019 in patients who go to the Ministry of Health.

Human cost estimation

Direct costs were obtained from the prices of standard care procedures, the average cost of clinical treatment and the interventions carried out in the ICU in Peru were obtained from the health care rates for services in public hospitals [11,12]. For this study we did not determine the external epidemiological parameters of patients with COVID-19, because it was directed at economic losses due
to the human factor. The direct cost was determined by the expenses caused by the care provided by the health facility to the patient, which included health care, hospital bed by type of service, laboratory tests, radiology, treatment, procedures, and the expenses caused by the biosafety materials for health personnel (Tyvek, gloves, goggles, apron, boots, caps, mask, N95 respirator). To determine the cost by type of service provided, the cost of each service was multiplied with the average number of services per patient. These values are obtained from each Health Institution independently.

Results

The Peruvian health system is made up of three types of care distributed differently in health facilities: comprehensive health insurance hospitals (SIS) that serve people with low economic resources, social insurance hospitals that serve people who work in the public sector and private clinics that serve people with high economic incomes. As reported by the National Center for Epidemiology, prevention and control of diseases until March 22, 2020, 363 confirmed cases of COVID-19 were identified in Peru, 75% of them were male, the mean age was 52 years (range 25 to 92 years), 12.3% of patients entered the general ward and 3.9% entered the ICU, the average days of hospitalization for uncomplicated patients was 10 days and in patients admitted to the Intensive Care Unit it was 15 days [13,14] (Table 1). To determine the cost of providing the bed in the ICU, the proportion of patients admitted to the ICU (0.04) was multiplied by the cost of the hospital bed in Intensive Care (including medical salaries, nurses salaries, diagnostic tests, supplies and other medications such as sedatives and vasopressors), obtaining $ 228 in the care of patients with COVID-19 attended in the Ministry of health (SIS), $ 480 in EsSalud social security establishments and $ 1050 in private clinics, according to the cost of the dollar at 3.5 soles (estimated price based on March 2020). The cost of the pharmacological treatment, as well as the entire procedure for making these estimates, are described in Table 2. The direct cost due to the treatment of patients with COVID-19 infection included auxiliary diagnostic examinations, which each unit value was estimated by the average number of examinations performed on patients, was US $ 98.5 in the public health system, while in the private sector it was US $ 178. The direct cost of caring for patients with COVID-19 was US $ 1708 for each patient who received care in a hospital of the Ministry of health through the comprehensive health insurance (SIS); US $ 2,300 if the patient received treatment from Social Security (EsSalud) and US $ 3,192 if he went to a private clinic. For the estimation of the loss of the productive capacity of the hospitalized patient (lost wages), the minimum living wage (US $ 280) was considered for the patients insured by the SIS; In the case of the patients attended by EsSalud, the average monthly income of US $ 615 was considered, and the patients seen in a particular clinic were considered the average monthly income of US $ 1,136 [15-16]. The cost of production deficit was calculated considering a Gross Domestic Product (GDP) per capita for the year 2018 (US $ 7045), the GDP per capita is the gross domestic product divided by the population in the middle of the year 2018, this GDP we divide by 365 days, US $ 19.3 was obtained multiplied by 30 days not worked due to the time of illness, considering hospitalization and isolation for 14 days. The result was US $ 579 as the cost for production deficit. Regarding the indirect cost, which represents the economic loss due to non-production

Table 1. Epidemiological parameters used to estimate the economic losses from COVID19, Peru.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>n = 363</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean, range)</td>
<td>47 (7-92)</td>
<td>--</td>
</tr>
<tr>
<td>Sex: Male</td>
<td>192</td>
<td>52.3</td>
</tr>
<tr>
<td>Population per household [13]</td>
<td>3.7</td>
<td>--</td>
</tr>
<tr>
<td>Number of inhabitants per house of productive age (18-65 years) [13]</td>
<td>2.1</td>
<td>55.5</td>
</tr>
<tr>
<td>Hospitalized in general</td>
<td>58</td>
<td>15.9</td>
</tr>
<tr>
<td>Hospitalized in isolation room</td>
<td>44</td>
<td>12.1</td>
</tr>
<tr>
<td>Intensive Care (ICU)</td>
<td>14</td>
<td>3.9</td>
</tr>
<tr>
<td>Mean of hospital stay [13]</td>
<td>12.9</td>
<td>--</td>
</tr>
<tr>
<td>Hospital stay in common room (days) [10]</td>
<td>10</td>
<td>--</td>
</tr>
<tr>
<td>Hospital stay in ICU (days) [13]</td>
<td>15</td>
<td>--</td>
</tr>
<tr>
<td>Deceased</td>
<td>5</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Table 2. Estimation of the direct cost for the treatment of patients with COVID-19 per patient, Peru.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cost per benefit according to Health Establishment (US$)</th>
<th>Mean service per patient *</th>
<th>Total cost per type of service provided per patient with COVID-19 US $ (product of cost × average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of clinical bed x10 days (including personal health fee)</td>
<td>SIS34 EsSalud22 Private</td>
<td>SIS EsSalud Private</td>
<td>SIS EsSalud Private</td>
</tr>
<tr>
<td>Cost of clinical bed x10 days (including personal health fee)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed cost in Intensive Care Unit x 15 days (including personal health fee)</td>
<td>377 2450 2500</td>
<td>0.12</td>
<td>45.3 294 300</td>
</tr>
<tr>
<td>Personal protection equipment</td>
<td>5700 12000 26250</td>
<td>0.04</td>
<td>228 480 1050</td>
</tr>
<tr>
<td>Personal protection equipment</td>
<td>8 17 16</td>
<td>1</td>
<td>8 17 18</td>
</tr>
<tr>
<td>General Tests</td>
<td>434.5 713 1113</td>
<td>0.16</td>
<td>69.5 114.1 178.1</td>
</tr>
<tr>
<td>Outpatient laboratory tests (baseline)**</td>
<td>8.1 18 24</td>
<td>0.78</td>
<td>6.3 14.1 18.7</td>
</tr>
<tr>
<td>Microbiology</td>
<td>860 860 860</td>
<td>1</td>
<td>860 860 860</td>
</tr>
<tr>
<td>Microbiology</td>
<td>8.6 12 13</td>
<td>0.16</td>
<td>1.4 1.9 2.1</td>
</tr>
<tr>
<td>Images</td>
<td>6.7 12 15</td>
<td>0.18</td>
<td>1.1 1.9 2.4</td>
</tr>
<tr>
<td>Images</td>
<td>20.3 68 60</td>
<td>0.04</td>
<td>0.8 2.7 2.4</td>
</tr>
<tr>
<td>Images</td>
<td>283 311 320</td>
<td>0.04</td>
<td>11.3 12.4 12.8</td>
</tr>
</tbody>
</table>

Pharmacotherapy
In some countries like China they are likely to lose as much as $62 billion in the first quarter of year, while the world will likely lose more than $280 billion in the same period [23]. The limitation of this study is that we have used the national average of economic income (salary) to estimate lost utility costs, however this value does not reflect the value of the labor of the informal or unregulated employer (independent worker). Likewise, the social burden of the patient has not been estimated.

**Conclusion**

Our findings indicate that caring for a patient with COVID19 imposes a heavy financial burden on Peru. We also emphasize the importance of strengthening current treatment and control measures to reduce infection rates. Likewise, additional studies are necessary to evaluate the cost-effectiveness and cost-benefit of control programs and to guide decision-makers and stakeholders.

**Declarations**

**Ethics approval and consent to participate**

Not applicable.

**Consent for publication**

Not applicable.

**Availability of data and materials**

Author Contributions
R.M. S.O. and QP initiated and led the study, designed the literature review, reviewed the literature, extracted and tabulated data, interpreted the results and drafted the manuscript. J.D and AG. assisted with the interpretation of the results, and reviewed and modified the manuscript for important intellectual content. All authors approved the final manuscript. J. R. is the guarantor for the paper.

Competing Interests
The authors declare that they have no competing interests.

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