

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

Raul Montalvo Otivo*, Salome Ochoa, JF Quispe-Pari, Jorge De La Cruz, Julio Rosales and Angela Gomez

Department of Human Medicine, Universidad Nacional del Centro del Peru, Avenue Mariscal Castilla 3909, Huancayo 12006, Perú, Italy

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 Computerized 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 costs 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.

**Address for Correspondence:* Otivo RM, Department of Medicine, Universidad Nacional del Centro del Peru, Avenue Mariscal Castilla 3909, Huancayo 12006, Perú, Italy, Tel: + (064)224482-7771; E-mail: otivo3@hotmail.com

Copyright: © 2020 Otivo RM, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Received 21 April 2020; Accepted 20 May 2020; Published 27 May 2020

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 burden associated with ICU was taken in the "cost per day and multiplied by 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 \$ 69.5 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.

Parameters	n = 363	%
Age (Mean, range)	47 (7-92)	–
Sex: Male	192	52.3
Population per household [13]	3.7	–
Number of inhabitants per house of productive age (18-65 years) [13]	2.1	55.6
Hospitalized in general	58	15.9
Hospitalized in isolation room	44	12.1
Intensive Care (ICU)	14	3.9
Mean of hospital stay [13]	12.9	–
Hospital stay in common room (days) [10]	10	–
Hospital stay in ICU (days) [13]	15	–
Deceased	5	1.4

Table 2. Estimation of the direct cost for the treatment of patients with COVID19 per patient, Peru.

Parameters	Cost per benefit according to Health Establishment (US\$)			Mean service per patient *	Total cost per type of service provided per patient with COVID-19 US \$ (product of cost × average)		
	SIS ¹⁰	EsSalud ¹¹	Private		SIS	EsSalud	Private
Cost of clinical bed x10 days (including personal health fee)	377	2450	2500	0.12	45.3	294	300
Bed cost in Intensive Care Unit × 15 days (including personal health fee)	5700	12000	26250	0.04	228	480	1050
Personal protection equipment	8	17	16	1	8	17	16
General Tests							
Laboratory tests for hospitalized patients (3.4 times per patient)	434.5	713	1113	0.16	69.5	114.1	178.1
Outpatient laboratory tests (baseline)**	8.1	18	24	0.78	6.3	14.1	18.7
Microbiology							
PCR for COVID19	285	285	285	1	285	285	285
Biosecurity material	860	860	860	1	860	860	860
culture and antibiogram	8,6	12	13	0.16	1.4	1.9	2.1
Images							
Radiography	6.7	12	15	0.16	1.1	1.9	2.4
Echocardiogram	20.3	68	60	0.04	0.8	2.7	2.4
Non-contrast chest computed tomography	283	311	320	0.04	11.3	12.4	12.8
Pharmacotherapy							

Antibiotic therapy #	866.9	866.9	2167.2	0.16	138.1	138.9	346.8
Symptomatic treatment	9	16	30	1	9	16	30
Invasive Procedures							
Mechanic ventilation	180	572	1200	0.04	7.2	22.9	48
Central venous catheter	80	115	130	0.04	3.2	4.6	5.2
Bladder catheterization	6	11	13	0.04	0.24	0.44	0.52
Biosecurity for invasive procedures (Tyvek)	860	860	860	0.04	34.4	34.4	34.4
Direct cost subtotal US\$					1708.8	2300.3	3192.4

SIS: Public Security of the Ministry of Health. ESSALUD: Social Security ; * Ratio of the number of patients who required the benefit and the total number of patients. ** Laboratory tests for ambulatory care patients: blood count, glucose, creatinine, urea. [†] Laboratory tests in hospitalized patients: glucose, urea, creatinine, blood count, plasma electrolytes, arterial gases, liver profile, lipid profile. [‡] Includes operating expenses and expenses for medical supplies and supplies. [§] Calculated based on 10 days of hospitalization (average hospital stay). Symptomatic used in 5 days: paracetamol, acetylcysteine, broncholytics. [¶] Tyvek, gloves, goggles, apron, boots, caps, mask, N95 respirator.

Table 3. Indirect cost and total cost for the treatment of COVID19 per patient, Peru 2020.

Cost type	Total cost per type of service provided per patient in US \$		
	SIS	ESSALUD	Privates
Indirect cost			
Cost for productive loss of the hospitalized patient (lost wages) *	280	615	1136.3
Due to loss of production (GDP per capita / day) **	579	579	579
Cost for productive loss of family members due to home isolation (lost wages of 2.1 inhabitants of productive age x household).	588	1291.5	2386.7
Total indirect cost	1447	2485.5	4102
Total direct cost (Table 2)	1708	2300.3	3192
Total cost per patient (direct + indirect) in US \$	3155	4785.8	7294

*It was estimated according to the minimum living wage (US \$ 280.0) in patients belonging to the SIS and according to the average income of workers who attend ESSALUD (US \$ 615) and private care (US \$ 1,136.0). ; divided by 30 days and multiplied by the days of medical rest (average 30 days).**Pérdida de producción: PBI per cápita (US\$ 7045) dividimos entre 365 días y multiplicado por los 30 días no trabajados. Production loss: GDP per capita (US \$ 7045) we divide between 365 days and multiplied by the 30 days not worked.

during the period of illness for the patient with COVID19, it ranges from US \$ 280 in patients treated by the SIS to US \$ 1136.3 in patients who are cared for in private institutions. The loss of economic production of the family was estimated based on the average number of persons of productive age per household, which according to INEI data is 2.1 persons, who also remain in family isolation, causing a loss in production of US \$ 1,447.0 to US \$ 4,102.0 per person, according to the type of institution where they received care.

The total cost (direct and indirect) per patient attended in the Ministry of Health (SIS) was US \$ 3,155, in ESSALUD it was US \$ 4,785 and in private care US \$ 7,294 (Table 3).

Discussion

This study tries to produce an estimate of the economic burden of COVID-19 in patients in Peru, these types of studies that estimate the burden of disease at the hospital level provide data that allow decision makers to prioritize the allocation of resources. Direct comparison of the data is difficult due to the lack of standard methods for estimating costs by COVID-19. Our results indicate that affects human health and livelihoods in Peru, especially when the indirect costs represented by the loss of monthly productivity due to the disease of the affected patient and intra-household contacts due to family isolation. There is a need to make more accurate reference estimates of COVID-19 (to minimize the potential impact of the uncertainty of this parameter). There is still no effective treatment against COVID19, which despite the high costs generated by medical care, many of them are not effective, resulting in high mortality, complications and ICU admission for patients of legal age and comorbidities. , requiring an effective antiviral treatment urgently [17-19]. In the economic studies attributed to a particular disease, the direct costs generated by care several times exceed the indirect costs [20,21], in the case of the COVID-19 pandemic, where the main strategy is social isolation, indirect costs have been equal to or greater than direct costs. This social isolation has generated the paralysis of manufacturing companies, blocking tourism, since Peru is recognized as the leading destination in Latin America, this also happens in different countries of the world, which according to an estimated model, the world GDP is likely to decrease approximately 0.42% in the first quarter of the year[22]. 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

The datasets analysed during the first part of the study are available in The Ministry of health. National Tariff of the Integrated Health System 2019. Available: <http://www.sis.gob.pe/ipresspublicas/nuevotarifario.html>.

Essalud. Tariff of health benefits to third parties, central management assurance resolution: GCAS_ESSALUD-2010.

Level of attention. <http://www.docdatabase.net/more-tarifario-de-essalud-a-terceros-2011-1292882.html> and https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1151/pdf/cap001.pdf. The rest of the data are available upon reasonable request.

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.

Funding

This research was not financially supported by any institution.

Acknowledgement

Not applicable.

References

1. Na Zhu, Dingyu Zhang, Wenling Wang and Xingwang Li, et al. "A novel coronavirus from patients with pneumonia in China, 2019." *N Engl J Med* 382 (2020): 727-733.
2. Marta Giovanetti, Domenico Benvenuto, Silvia Angeletti and Massimo Ciccozzi. "The first two cases of 2019-nCoV in Italy: Where they come from?" *J Med Virol* 92 (2020): 518-521.
3. World Health Organization. "WHO Director-General's remarks at the media briefing on 2019-nCoV." 2020. <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19--11-march-2020>
4. World Health Organization. "Novel coronavirus (2019-nCoV): situation reports". 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200201-sitrep-12-ncov.pdf?sfvrsn=273c5d35_2.
5. Jeffrey P. Kanne. "Chest CT findings in 2019 novel coronavirus (2019-nCoV) infections from Wuhan, China: key points for the radiologist". *Radiology* 295 (2020): 16-17.
6. Xiaojing Wu, Ying Cai, Xu Huang and Xin Yu, et al. "Co-infection with SARS-CoV-2 and Influenza A Virus in Patient with Pneumonia, China". *Emerg Infect Dis* 26 (2020).
7. Bingwen Eugene Fan, Kian Guan Eric Lim, Vanessa Cui Lian Chong and Stephrene Seok Wei Chan, et al. "COVID-19 and mycoplasma pneumoniae coinfection." *Am J Hematol* 95 (2020): 723-724.
8. Seth Flaxman, Swapnil Mishra, Axel Gandy and H Juliette T Unwin, et al. "Estimating the number of infections and the impact of nonpharmaceutical interventions on COVID-19 in 11 European countries". Imperial College London (2020). <https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-13-europe-npi-impact/>
9. National Center for Epidemiology, prevention and control of diseases. Report of cases of COVID-19 infection hospitalized for pneumonia. 2020. https://www.dge.gob.pe/portal/index.php?option=com_content&view=article&id=650&Itemid=377
10. Qun Li, Xuhua Guan, Peng Wu and Xiaoye Wang, et al. "Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia". *N Engl J Med* 382 (2020): 1199-1207.
11. Ministry of Health "National Tariff of the Integrated Health System 2019". 2019. <http://www.sis.gob.pe/presspublicas/nuevotarifario.html>
12. Essalud. "Tariff of health benefits to third parties, central management assurance resolution: GCAS_ESSALUD-2010." Level of attention. <http://www.docdatabase.net/more-tarifario-de-essalud-a-terceros-2011-1292882.html>
13. Qirong Ruan, Kun Yang, Wenxia Wang and Lingyu Jiang, et al. "Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China." *Intensive Care Med* (2020).
14. Michelle L. Holshue, Chas DeBolt, Scott Lindquist and Kathy H. Lofy, et al. "First Case of 2019 Novel Coronavirus in the United States." *N Engl J Med* 382 (2020): 929-936.
15. Household and population characteristics. "National Institute of Statistics in Informatics Peru, National Census 2017." https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1151/pdf/cap001.pdf
16. Ministry of Labor and Employment Promotion (MTPE). "Annual Economic Income Report in Peru, January 2014." http://www.trabajo.gob.pe/archivos/file/estadisticas/peel/enaho/Informe_Anuar_Empleo_Enaho_2014.pdf
17. Xingchen Pan, David M Ojcius, Tianyue Gao and Zhongsheng Li, et al. "Lessons learned from the 2019-nCoV epidemic on prevention of future infectious diseases." *Microbes Infect.* 22 (2020): 86-91.
18. Hao Yu, Xu Sun, Wei Deng Solvang and Xu Zhao, et al. "Reverse Logistics Network Design for Effective Management of Medical Waste in Epidemic Outbreaks: Insights from the Coronavirus Disease 2019 (COVID-19) Outbreak in Wuhan (China)." *Int J Environ Res Public Health* 17 (2020): E1770.
19. Lum LHW and Tambyah PA. Outbreak of COVID-19 - an urgent need for good science to silence our fears?. *Singapore Med J* 61 2020: 55-57.
20. Raúl Montalvo and Víctor Tiza. "Evaluation of economic expenditure related to human hydatidosis in Junin, Peru." *Rev Peru Med Exp Salud Publica* 34 (2017): 445-450.
21. Foster K. Ayittey, Matthew K. Ayittey, Nyasha B. Chiweroc and Japhet S. Kamasah, et al. "Economic impacts of Wuhan 2019-nCoV on China and the world". *J Med Virol* 92 (2020): 473-475.
22. Bloomberg. "Charting the Global Economic Impact of the Coronavirus". 2020. <https://www.bloomberg.com/graphics/2020-global-economic-impact-of-wuhan-novel-coronavirus/>
23. CNN Business. 2020. <https://edition.cnn.com/2020/01/31/economy/china-economy-coronavirus/index.html>

How to cite this article: Raul Montalvo Otivo, Salome Ochoa, JF Quispe-Pari, Jorge De La Cruz, Julio Rosales and Angela Gomez. "Evaluation of the Economic Impact for the Management of Patients Confirmed by COVID-19 Infection in Peru." *Pharmacoeconomics* 5 (2020): 1-4.