Resource Utilization and Cost of Hospitalized Patients with COVID-19 in Iran: Rationale and Design of a Protocol

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Abstract

There is little data on direct medical costs and how to overcome the shock introduced by the novel Coronavirus (COVID-19) which emerged in Wuhan, China. The aim of this report is to present the methodology of an observational study for analyzing the resource utilization and direct medical costs of hospitalization. A multicenter retrospective observational study will be conducted on hospitalized patients with COVID-19 in selected hospitals of Tehran University Medical Sciences from February to June 2020. Cost calculations will be based on micro-costing approaches according to the health insurance perspective. Demographic, clinical, and cost data for the aforementioned patients will be collected through reviews of medical and financial records using a self-made checklist categorized in three parts. The first part consists of demographic characteristics, the second part includes clinical information (e.g., symptoms, comorbidities, and complications), and the third part consists of resource utilization and cost data. Descriptive statistics (means, frequencies, percentages, and 95% confidence intervals) will be used to report data. With this report we sought to provide a valuable framework for estimating the direct medical costs of COVID-19 for hospitalized-patients basis on the severity of presentation. This will be the core for an assessment of the economic burden of COVID-19 in different presentations of the disease.

Key words: Cost of Illness; Covid-19; Health Care Costs; Iran; Pandemics

INTRODUCTION

The novel coronavirus (COVID-19) has had a major effect on general health. First appearing in Wuhan, China in December 2019, COVID-19 has now affected 212 countries and territories around the world. People throughout the world are at risk for this highly contagious disease. Some under-developed countries are combatting the lack of necessary items for hygienic protection and inadequate facilities for disinfection. Evaluating the exact need for soap, disinfectants, facial masks, and shields is difficult. Since COVID-19 became pandemic, it has caused huge economic depression all around the world, even occurring in 15 rich developed countries [1-3]. The economic shock is evident, and recovery will need a long time. Most patients have mild symptoms; however, severe cases progress to acute respiratory distress syndrome (ARDS). The rate of severe presentation of this disease as reported by previous studies is high in patients over the age of 60 and in those with co-existing comorbidities such as cardiovascular disease [4, 5]. The Centers for Disease Control and Prevention (CDC) reported that the hospitalization

rate for COVID-19 was 4.6 per 100,000 people, and the rate increased with age. Hospitalization rates were highest (13.8 per 100,000 population) among adults aged ≥65 years [3]. World meters have reported that the mortality rate in all age groups was 1.8-3.4% and also increased with age. The highest rate was in those over 85 years of age (10.4-27.3%) followed by those aged 75–84 years (4.3-10.5%) [1]. There is little data on the direct medical costs of COVID-19 and how to overcome the challenge of shock it has contributed to the world. The report aims to present a brief reliable concise and practical protocol for estimating the economic impact of the hospitalization of patients with COVID-19 and outline the necessary and general features to be considered in estimating such costs in order to help healthcare policy-makers.

Methods

Study design and setting

The primary objective of the study is to estimate the average direct costs of COVID-19

hospitalization in Tehran, Iran by examining selected hospitals affiliated to Tehran University Medical Sciences (TUMS). The secondary objectives are to explore the cost of COVID-19 complications in different patient groups, identify the influence of patient characteristics on cost and resource utilization, and to explore the variation in costs across hospitals. The study will be designed, arranged, and directed by a scientific core consisting of a cardiologist, an epidemiologist, and a health economics specialist. Approval for this study has been obtained from TUMS, with the code IR.TUMS.VCR.REC.1399.242. This study will conduct a multicenter retrospective observational study on confirmed COVID-19 patients hospitalized in three university hospitals (referral centers of COVID-19 during the pandemic) in the time period February to June 2020. All hospitalized patients with clinically diagnosed COVID-19 based on the World Health Organization interim guidance will be included [6]. Cases will be confirmed by either chest computed tomography (CT) scan or reverse-transcription polymerase chain reaction testing (RT-PCR). The estimated minimum number of participants to achieve the study's primary and secondary objectives is around 300 patients.

Cost calculation

Cost calculations will be based on micro-costing approaches from the health insurance perspective. The direct medical costs will be calculated by multiplying the total amount of each medical resource by the unit cost. The total cost of an admission will be calculated as the sum of the costs of emergency department, hospital ward, and ICU stays, laboratory and other diagnostic tests, procedures, and medication. Demographic, clinical, and cost data for participating patients will be collected by reviewing medical and financial records and using a self-made checklist categorized in three parts (Appendix 1). The first part consists of items regarding demographic characteristics (e.g., age, gender, health status, nationality, employment, and geographic region); the second part is comprised of items on clinical information (e.g., symptoms such as fever, cough, fatigue, dyspnea), comorbidities (e.g., hypertension, diabetes, cardiovascular disease, and respiratory system disease), and complications (e.g., acute respiratory distress syndrome, cardiovascular complications, acute liver injury, septic shock, disseminated intravascular coagulation, acute kidney injury, and death). Complementary data regarding resource utilization and cost data will be collected in the third part of the checklist, which consists of items regarding length of hospital and/or intensive care unit (ICU) stays, days on mechanical ventilation days, and costs for emergency department, general ward and/or ICU admissions, isolation room, antibiotic and/or antiviral treatments (e.g., oseltamivir, hydroxy-chloroquine, lopinavir–ritonavir, ribavirin, clindamycin, and meropenem), and diagnostic and laboratory tests (e.g., chest x-ray and spiral chest computed tomography scans, cardiac biomarkers, electrocardiograms, and liver function tests). The estimated costs will be combined with demographic and clinical data and COVID-19 outcomes to explore determinants of the cost of COVID-19 and variations in costs across hospitals. All costs presented in Iranian Rials (IRR) and will be converted to US dollars (official price of 2020).

Measures and outcomes

This study will analyze the economic burden of COVID-19 in hospitalized patients by age, gender, and comorbidities by investigating the following outcomes: hospitalization rates, length of hospital stays (LOS), mechanical ventilation days, complications including death, and costs (inpatient, outpatient and total costs) by hospital. Finally, a 3-week follow-up will be done for all patients, and the data on the amount of time it takes a patient to return to work, clinical results, and costs for further visits will be collected.

Discussion

This study will analyze the resource utilization and direct medical costs of hospitalization for a large cohort of confirmed COVID-19 patients in Iran. Using hospital billing data and patient medical records, we seek to fully illustrate the resources utilized in caring for hospitalized patients with COVID-19 and to identify factors associated with higher inpatient costs. The Al-Ruthia study conducted in Saudi Arabia evaluated confirmed patients of the Middle East respiratory syndrome coronavirus (MERS-CoV) and calculated the mean direct medical cost to be 19.923 ± 12.947 US $ [7]. Since ARDS is the most common final presentation in patients who require hospitalization in an intensive care unit, it is highly recommended to profoundly increase the number of intensive care unit (ICU) beds [8]. In a study by Murray, profound increases in hospital and ICU beds and in ventilator usage were predicted as the impact of COVID-19 [9]. The most frequent hospital costs included hospital stay, diagnostic and laboratory costs, medications including antiviral treatment and antibiotics, and the cost for other admissions. To the best of our knowledge, no previous economic study has estimated the cost of COVID-19 hospitalizations in

Iran. It could be suggested that prioritizing preventive strategies and immunization procedures may potentially be cost-saving. The results of the present study could be useful to economic evaluations of COVID-19. Moreover, the results may be applied as long-term strategies for the management of resource utilization, especially for ICU beds, ventilator use, and a temporary increase in hospital capacities to meet the excess demand in the COVID-19 pandemic era.

CONCLUSIONS

With this report we seek to provide a valuable framework for estimating the direct medical costs of COVID-19 for hospitalized patients with either severe or mild patterns of presentation. However, it should be kept in mind that there is no documented treatment or management strategy for these patients, and indeed, the costs will differ based on the defined approach to the medical treatment strategy. This will be the basis for an assessment of the economic burden of different presentations of the COVID-19 disease.

AUTHORS' CONTRIBUTION

All the authors met the standard criteria of authorship based on the recommendation of International Committee of Medical Journal Editors.

CONFLICT OF INTEREST

The authors declare they have no competing interests.

REFERENCES

1. Worldometers. Coronavirus (COVID-19) Mortality Rate 2020. [Available from: https://www.worldometers.info/coronavirus/coronavirus-death-rate/].

2. Jones L, Palumbo D, Brown D. Coronavirus: A visual guide to the economic impact London: BBC News; 2020. [Available from: https://www.bbc.com/news/business-51706225].

3. Garg S, Kim L, Whitaker M, O'Halloran A, Cummings C, Holstein R, et al. Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019-COVID-NET, 14 States, March 1-30, 2020. MMWR Morb Mortal Wkly Rep. 2020; 69(15):458.

4. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. JAMA. 2020;323(11):1061-9.

5. Zheng YY, Ma YT, Zhang JY, Xie X. COVID-19 and the cardiovascular system. Nat Rev Cardiol. 2020;17(5):259-60.

6. World Health Organization. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected: interim guidance, 13 March 2020. [Available from: http://apps.who.int/iris/rest/bitstreams/1272156/retrieve].

7. AlRuthia Y, Somily AM, Alkhamali AS, Bahari OH, AlJuhani RJ, Alsenaidy M, et al. Estimation Of Direct Medical Costs Of Middle East Respiratory Syndrome Coronavirus Infection: A Single-Center Retrospective Chart Review Study. Infect Drug Resist. 2019;12:3463-73.

8. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020:382(18):1708-20

9. IHME COVID-19 health service utilization forecasting team, Murray CJ. Forecasting COVID-19 impact on hospital bed-days, ICU-days, ventilator-days and deaths by US state in the next 4 months. medRxiv. 2020: Preprint.

Appendix 1: The checklist for calculating direct medical cost for COVID-19 patients in TUMS selected hospitals

Hospital stays	Length of stay (LOS), day
	ISO-Room
	ICU
	Personal protective equipment
	Health care workers fee
Diagnostic and laboratory tests	CBC, Diff, blood group
	CRP
	AST, ALT
	BNP if myocarditis suspected
	Hb-A1C if diabetic
	CPK if myocarditis suspected
	LDH if myocarditis suspected
	Echocardiography if myocarditis suspected
	Chest X-ray
	Spiral chest CT scan
	Cardiac enzymes + ECG
	Renal function test (BUN, Cr, Na, K)
	Serum albumin
	Blood culture*2 if sepsis
	Throat swab culture test
	AFB Test
	ABG, if intubated
	PT, PTT, D-Dimer
Antibiotics and antiviral	Hydroxychloroquine
	Ribavirin
	Lopinavir–Ritonavir
	Interferon-α2
	Oseltamivir
	Atazanavir
	NSAID
	Corticosteroid
	Vancomycin
	Meropenem
	Tazocin
	Azithromycin
	Clindamycin
	Ceftriaxone
Other medications	Paracetamol
	Ascorbic acid
Cost in other centers	Hospital costs
	Diagnostic and laboratory tests
	Medications
Productivity losses of patient and family members	

LOS: length of stay; ISO-Room: isolation room; ICU: intensive care unit; ECG: electrocardiogram; LFT: Liver function tests; ALT: alanine aminotransferase; AST: aspartate aminotransferase; PT: prothrombin time; PTT: partial thrombin time; ABG: arterial blood gas; AFB: acid-fast bacillus; BNP: brain natriuretic peptide; BUN: blood urea nitrogen; Cr: serum creatinine; CPK: creatine phosphokinase; LDH: lactate dehydrogenase; NSAID: nonsteroidal anti-inflammatory drug; CRP: C-reactive protein