Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Economic Evaluation

Clinical Outcomes and Direct Medical Expenditures Associated With Intensive Care Unit Admission for Inpatients With COVID-19 in Jordan: A Retrospective Cohort Study

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Objectives: This study aimed to describe clinical outcomes and medical expenditures associated with COVID-19 admissions. In addition, this study aimed to investigate the impact of patients' characteristics and baseline comorbidities on intensive care unit (ICU) admission, mortality, and medical expenditures for hospitalized patients with COVID-19.

Methods: This retrospective cohort study included all hospitalized patients with confirmed COVID-19 in Prince Hamza Hospital and King Abdullah University Hospital, during the period from March 2020 to June 2021. Medical records and pharmacy data were followed and reviewed throughout their admissions. The ICU admission, inpatient mortality, hospital length of stay, and inpatient charges were described. Predictors of ICU admission and inpatient charges were evaluated.

Results: A total of 7694 COVID-19 hospital admissions were included. Approximately 1189 patients (15.5%) were admitted to ICU and 21.4% died in the hospital. The fatality rate among those admitted to ICU was 82.6% compared with 10.2% for non-ICU admitted patients. The average admission charge and charge per admission day were 1598.2 and 200.2 Jordanian dinar, respectively, and both charges were higher in ICU admitted patients than non-ICU admitted patients. Being older in age, smoker or ex-smoker, and having chronic diseases were all significantly associated with a higher likelihood of ICU admission and mortality among admitted patients.

Conclusions: ICU admission in patients with COVID-19 is associated with poor clinical outcomes and substantial medical expenditures and is more likely among older adults, smokers, and those with chronic diseases.

Keywords: charges, COVID-19, death, hospitalized patients, intensive care unit, Jordan.

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Introduction

The ongoing outbreak of the novel COVID-19 has turned into a serious international public health crisis. The World Health Organization has declared COVID-19 as a global pandemic in March 2020.[1] As of November 1, the total number of worldwide cases and deaths reported by the World Health Organization was 246 594 191 and 4 998 784, respectively.[2]

The COVID-19 outbreak is a viral pneumonia that is caused by the severe acute respiratory syndrome coronavirus 2.[3] This infective disease contributes to the development of several detrimental clinical outcomes and increased mortality.[4,5] Indeed, COVID-19 pandemic has severely affected most healthcare sectors worldwide and increased the global economic burden.[6] Worldwide, the healthcare system is trying to adopt several strategies to manage COVID-19 cases, although it is trying to cope with the sudden surges of the overcrowded intensive care units (ICUs).

The first confirmed case of COVID-19 in Jordan was reported in Amman on March 2, 2020. As of November 1, 2021, Jordan had 864 661 confirmed cases and 11 052 deaths. Limited details that describe patients' characteristics and outcomes of Jordanian patients who required hospitalization due to COVID-19 are available. Nevertheless, these details were available for other countries.[3,4,7-9] In a case series study conducted in the United States, demographics, baseline comorbidities, presenting vital signs, and test results were described for patients requiring hospitalization for COVID-19. Hospitalized patients were predominantly men, the median age was 63 years, 14.2% required ICU care, 12.2% received invasive mechanical ventilation, and 21% died.[7] Higher rates of ICU admission (26%) and mortality (28%) were reported in a retrospective cohort study from China.[8] It has been shown that older age, higher Sequential Organ Failure Assessment score, and d-dimer > 1 μg/mL on admission were associated with higher odds of in-hospital death.[8]

Considering the significant differences across countries in population's demographics and comorbidities, it is essentially important to understand the clinical and economic outcomes at the national level in Jordan. Hence, this study examined the patients' characteristics, baseline comorbidities, and their impact on clinical outcomes and medical expenditures of hospitalized patients with COVID-19 in Jordan.

Methods

Study Design and Study Population

In this retrospective cohort study, all hospitalized patients with confirmed COVID-19 in Prince Hamza Hospital (PHH) and King Abdullah University Hospital (KAUH), the 2 major hospitals that were recognized for treating patients with COVID-19 in Jordan, during the period from March 2020 to June 2021 were included. KAUH is considered as the largest medical structure in the north of Jordan whereas PHH is a government hospital with a decentralization system that is located in the middle of Jordan. Medical records and pharmacy data were followed and reviewed throughout their admissions. Confirmed COVID-19 diagnosis was performed using real-time polymerase chain reaction of nasopharyngeal swab samples. The study protocol was approved by the Institutional Review Board Committees at KAUH (ref number: 202/132/2020) and PHH (ref number: 3309).

Assessment of Clinical Outcomes of COVID-19 Admissions

For each hospitalization included in the study analysis, the following outcomes were described and evaluated: ICU admission, inpatient mortality, hospital length of stay (LOS), invasive mechanical ventilation, ICU LOS, and time to ICU admission. Data about using invasive mechanical ventilation, ICU LOS, and time to ICU admission were available for KAUH hospital only.

Assessment of the Direct Medical Charges Associated With COVID-19 Hospitalization in Admissions With and Without ICU Stay

Using the billing systems at KAUH and PHH, inpatient charges in total and by charge components (by services provided) were retrieved for admissions included in the study. These charge components include pharmacy, laboratory, residency, medical supervision, procedures, radiology, consumables, and others. Total admission charges and charge components were compared between admissions with and without ICU stay. Even though costs are more pertinent from the provider perspective, charges were used in the current study to approach actual costs incurred from the healthcare system perspective. In fact, charges are readily available for researchers through the billing system whereas costs are proprietary to hospitals. Nevertheless, charge data are typically calculated based on actual costs and are used extensively in the literature to describe healthcare expenditures. The charge per day was calculated for each inpatient admission by dividing the total billing amount by the length of hospital stay in days.

Assessment of Risk Factors Associated With Clinical and Economic Outcomes

Patient' demographics and clinical data were extracted from the patient's medical records including age, gender, weight, and height (if available), smoking status (smoker/ex-smoker, or nonsmoker), and baseline chronic diseases. Chronic diseases that were evaluated included cardiovascular comorbidities (ischemic heart disease, hypertension, heart failure, and arrhythmia), asthma, chronic obstructive pulmonary disease, diabetes mellitus (DM), cancers, chronic kidney disease (CKD), and others.

Statistical Analysis

Simple descriptive statistics such as percentages, arithmetic means with standard deviation, and median with interquartile range were calculated to describe patient characteristics for the study patients. Patient outcomes by ICU admission status were compared using unadjusted bivariable tests (chi-square for categorical variables and *t* test or Wilcoxon rank-sum test for continuous variables). Multivariable logistic regression models were performed to identify risk factors associated with ICU admission and inpatient mortality.

Inpatient charges were summarized in total and by charge components using descriptive statistics. Total admission charges and charge components were compared between admissions with and without ICU stay using Mann-Whitney *U* test. Generalized linear models with Gamma family and log link function were conducted to evaluate predictors of inpatient charges in total and per admission day. All data analyses were conducted using Stata version 14 (Release 17; StataCorp LLC, College Station, TX).

Results

A total of 7694 patients with COVID-19 were included in the current study during the period from March 2, 2020, to June 7, 2021 (2540 were admitted in KAUH and 5154 were admitted in PHH). The average age for the patients included in the study was 53 years (SD = 19.2), and 58.7% were males. Only 10% of patients were either smokers or ex-smokers whereas the majority were nonsmokers. The most prevalent chronic diseases were cardiovascular disease (CVD) and DM (40.1% and 31.1%, respectively). Weight and height data were missing for approximately 89% of patients. Detailed demographics are presented in Table 1.

Table 1. Demographics and clinical characteristics of hospitalized patients with COVID-19.

Variable	Total (N = 7694)	
	n	Percentage
Age, years		
< 18	427	5.6
18-39	1430	18.6
40-65	3417	44.5
≥ 65	2409	31.4
Gender		
Female	3174	41.3
Male	4505	58.7
Smoking status		
Nonsmokers	6000	90.0
Ex-smokers	231	3.5
Smokers	433	6.5
BMI, kg/m^2		
< 18.5	39	4.7
18.5-25	157	18.8
25-30	285	34.1
≥ 30	354	42.4
Asthma	192	2.9
COPD	46	0.7
CVD	2677	40.1
DM	2066	31.1
Cancer	297	4.5
CKD	362	5.43

BMI indicates body mass index; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; DM, diabetes mellitus.

Table 2. Clinical and economic outcomes of hospitalized patients with COVID-19.

Outcome	Total (7694)	ICU admitted patients (1189)	Non-ICU admitted patients (6504)	*P* value*
	n (%)	n (%)	n (%)	
Death	1645 (21.4)	982 (82.6)	663 (10.2)	< .001
	Mean (SD), median (IQR)	Mean (SD), median (IQR)	Mean (SD), median (IQR)	
LOS	9.9 (7.7), 9 (5-12)	11 (8.8), 8.9 (4.6-14.8)	9.6 (7.4), 9 (5-12)	< .001
Admission charge	1598.2 (1969.4), 943.0 (571.9-1774.9)	3594.7 (3211.9), 2627.8 (1236.5-4867.5)	1222.5 (1333.1), 872.9 (519.4-1374.2)	< .001
Per day admission charge	200.2 (236.1), 124.5 (84.2-230.8)	387.2 (372.3), 307.7 (206.3- 482.7)	161.7 (173.5), 106.1 (80.7-175.3)	< .001

IQR indicates interquartile range; LOS, length of stay.
**P* values were calculated using chi-square test for the death outcome and Mann-Whitney *U* test (Wilcoxon rank-sum test) for all others.

Clinical Outcomes of Patients With COVID-19 Admitted to ICU Versus Non-ICU

Among COVID-19 admissions included in the current study, approximately 1189 patients (15.5%) were admitted to ICU and 21.4% died in the hospital. The fatality rate among those admitted to ICU was 82.6% compared with 10.2% non-ICU admitted patients. Average inpatient LOS was 9.9 days and was also higher for ICU admitted patients. ICU LOS, using ventilators, and time to ICU admission data were only available for patient admitted in KAUH. For patients admitted to KAUH, the average ICU LOS and average time to ICU admission were 4.3 days (SD = 4) and 5.4 days (SD = 6), respectively. For these patients, 73.5% of ICU admitted patients used ventilators. Detailed outcome statistics are presented in Table 2.

Direct Medical Charges Associated With COVID-19 Hospitalization in Admissions With and Without ICU Stay

The average admission charge and charge per admission day were 1598.2 and 200.2 Jordanian dinar, respectively, and both charges were higher in ICU admitted patients than non-ICU admitted patients. Detailed descriptive charges are presented in Table 2.

The average billing amount was significantly different across age groups and was the highest for those aged 65 years or older. Average charge per admission day was also significantly different across age groups. Average admission charge per day was the highest for those aged 65 years or older with a clear trend of increasing per day charges with higher ages. Average admission charges per admission and per inpatient day by age groups are displayed in Figure 1.

At the patient level, laboratory tests, followed by medications, and residency were the top charged components of COVID-19 admissions with ICU stay. All charge components were significantly higher for admissions with ICU stay than those without ICU stay (*P* values were < .001 for all comparisons). Residency charges were the highest for non-ICU patients, whereas laboratory tests and medications were the top charged components for admissions with ICU stay. Detailed average charge components per admission are depicted in Figure 2. Similar results were found considering the contribution of charge components to the total direct medical charges from the hospital perspective. Residency contributed to the highest portion of total charges for admissions without ICU stay (36%), whereas laboratory tests and medications contributed to the highest portions of total charges for admissions with ICU stay (25% and 24%, respectively). Detailed contributions of charge components out of total direct medical charges are depicted in Appendix Figure 1 in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2022.09.002.

Risk Factors Associated With Clinical and Economic Outcomes of COVID-19 Admissions

Being in the older age categories of 40 to 65 and ≥ 65 years was significantly associated with ICU admission. In comparison with the 18 to 39 age group, odds ratios (ORs) were 1.72 and 4.02, respectively. Being smoker or ex-smoker was a significant predictor for of ICU admission with an OR of 1.63 ($P < .001$). Comorbid conditions including CVD, DM, cancers, and CKD were all significantly associated with the likelihood of ICU admission with $P <$ .001 and ORs of 1.46, 1.74, 2.22, and 1.88, respectively. Consistently, similar predictors were found for death among COVID-19 admitted patients. Detailed findings are listed in Table 3.

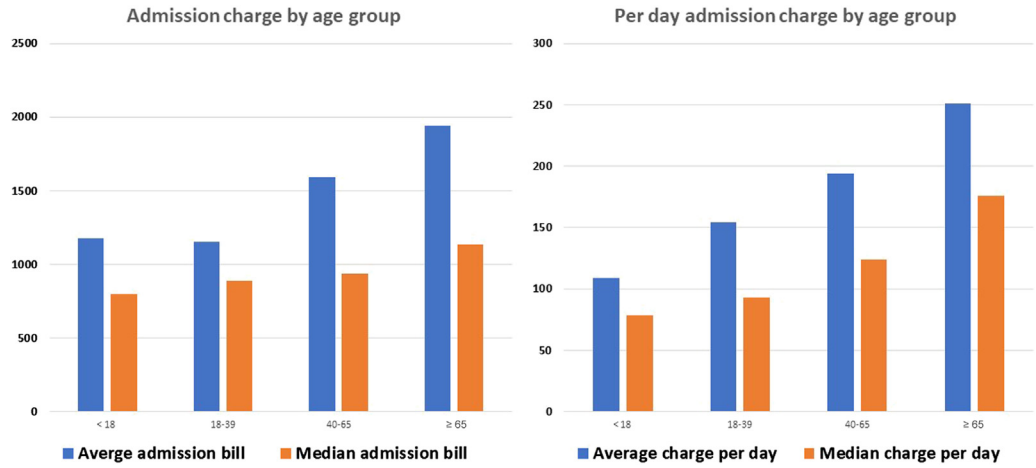
The average of admission charges was significantly higher for age categories of 40 to 65 and ≥ 65 years compared with 18 to 39 age group, males compared with females, and smokers/ex-smoker patients compared with nonsmokers (ratios of 1.22, 1.54, 1.07, and 1.09, respectively). CVD, DM, cancers, and CKD were significantly associated with higher billing amounts (ratios of 1.16, 1.09, 1.48, and 1.19, respectively) (Table 4).

The difference in expenditures was clearer considering charges adjusted for admission days. Per day charges were significantly higher for age categories of 40 to 65 and ≥ 65 years and lower for younger than or 18-year-old patients (compared with those aged 18-39, ratios were 1.09, 1.45, and 0.75, respectively). Being smoker or ex-smoker patient was also associated with higher per day charges (ratio = 1.23). CVD, DM, cancers, and CKD were prominently associated with higher per day charges (ratios of 1.21, 1.19, 1.45, and 1.14, respectively) (Table 4).

Discussion

To the best of our knowledge, this is the first national study that describes the hospital and ICU mortality and medical expenditures associated with hospitalization from COVID-19 in Jordan. Overall, the results reveal that most of admitted patients were older than 40 years with a little higher percentage of males. Age, smoking, and the presence of comorbidities were significant predictors of ICU admission and in-hospital mortality. A relatively high mortality rate among ICU admitted patients was reported. Billing data showed that residency, medications, and laboratory testing contributed to the highest percentages of total economic

Figure 1. Average admission charges based on age group (JOD). 1 JOD = 1.410 USD.



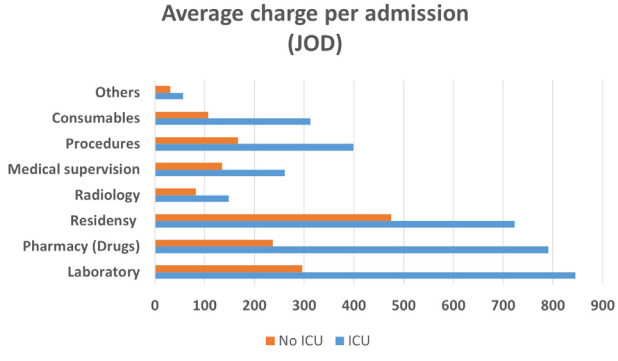
JOD indicates Jordanian dinar; USD, US dollars.

expenditures during COVID-19 admission. Laboratory tests and medications contributed to the highest portions of total expenditures for admissions with ICU stay.

Previous descriptive studies among patients with COVID-19 in Jordan were limited to characterizing the epidemiologic and clinical features and radiological and laboratory findings of patients.[10-12] One of these initial investigations conducted among 81 COVID-19 admitted cases in North Jordan between March 15 and April 2, 2020, showed that the mean age of cases was 40 years, with 54% being females.[12] Most of the cases were mild in nature.[12] Another retrospective study of 145 patients admitted to a hospital in South Jordan between December 2020 and February 2021 showed that the mean age of the sample was 62 years and 59% were males.[11] Approximately 18% were admitted with severe symptoms.[11] The current study analyzed data of Jordanian population from the initial diagnosed cases with COVID-19 in March 2020 until June 2021. The current study revealed that approximately two-thirds of the admitted cases were more than 40 years old with a bit more representation of males than females. This is consistent with previous international observations that older age and males are more susceptible to COVID-19.[13,14]

Age, smoking, and the presence of comorbidities were significant predictors of ICU admission in the current study. These findings emphasized what was reported in countries with close sociodemographic characteristics.[15-18] For instance, in addition to age, diabetes was associated with admission to the ICU in patients with COVID-19 in Kuwait (OR 1.78 [95% confidence interval 1.17-2.70]).[15] Several studies examined the factors associated with ICU admission and poor outcomes among patients hospitalized with COVID-19 overall the world.[19,20] Ahlstrom and colleagues[21] showed that various comorbid conditions such as hypertension, DM, CKD, asthma, and obesity were associated with ICU admission in a case-control study conducted in Sweden. Another nationwide retrospective study of 116 539 patients with COVID-19 in Poland found that age > 60 years, male sex, and the presence of at least 1 endocrine, cardiovascular, nutritional, or metabolic disorders were independent determinants of ICU admission.[13] In the present study, the percentage of patients admitted to the ICU was relatively high (15.5%) compared with that observed in Poland (4.9%),[13] which might be attributed in part to the different characteristics of the study population. Consistent with previous investigations,[13] the current study found that older age of > 40 years and the presence of comorbid conditions including CVD, DM, cancer, and CKD were associated with increased risk of ICU admission. This also supports the results of a prospective multicenter cohort study conducted among 2215 patients in the United States where the mean age of patients admitted to the ICU was 60.5 years and 64.8% were males.[22] Nevertheless, the current study is different from previous studies with respect to ICU mortality given that the proportion of patients who died in the ICU was high (82.6%) compared with that reported in US cohorts (35.4%[22] and 32.8%[20]) or in Brazil (59%).[14] Nevertheless, another analysis of 330 critical cases in the United States who were primarily elderly showed a 74% mortality.[19] Overall, a recent meta-analysis of 24 983 patients with COVID-19 distributed globally reported a 32% rate of ICU admission with a 39% prevalence of ICU mortality.[23] The mortality rate in ICU admitted patients in the current study is still high compared with data reported in other countries with shared geographic and demographic characteristics. In a retrospective observational study conducted at a university-affiliated hospital in Kuwait, 59% mortality rate was reported among 133 patients who were admitted to COVID-19 ICU.[24] In a cross-sectional retrospective study that was conducted in Iran, 64.5% mortality rate (147 of 228) in ICU wards was reported.[17] In a larger sample of patients with COVID-19 admitted to ICUs in public hospitals of Abu Dhabi, 12.7% of 1542 ICU

Figure 2. Average charge components for ICU vs non-ICU patients (JOD). 1 JOD = 1.410 USD.



ICU indicates intensive care unit; JOD, Jordanian dinar; USD, US dollars.

Table 3. Predictors of clinical outcomes associated with COVID-19 admissions.

Variable	OR	*P* value	95% confidence interval
ICU admission			
Age group			
18-39	Ref		
40-65	1.72	.001	1.26-2.34
≥ 65	4.02	< .001	2.93-5.52
< 18	0.98	.937	0.55-1.75
Male gender	1.13	.146	0.96-1.32
Smoker or ex-smoker	1.63	< .001	1.29-2.05
Chronic respiratory disease	0.83	.353	0.56-1.23
CVD	1.46	< .001	1.20-1.77
DM	1.74	< .001	1.46-2.08
Cancer	2.22	< .001	1.66-2.96
CKD	1.88	< .001	1.46-2.43
Overall death			
Age group			
18-39	Ref		
40-65	2.55	< .001	1.74-3.74
≥ 65	8.03	< .001	5.45-11.83
< 18	0.33	.069	0.10-1.09
Male gender	1.13	.165	0.95-1.34
Smoker or ex-smoker	1.72	< .001	1.35-2.19
Chronic respiratory disease	0.74	.172	0.48-1.14
CVD	1.34	.004	1.10-1.64
DM	1.57	< .001	1.31-1.88
Cancer	2.24	< .001	1.65-3.02
CKD	1.76	< .001	1.34-2.30

CKD indicates chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; DM, diabetes mellitus; ICU, intensive care unit; OR, odds ratio.

Table 4. Predictors of direct medical charges associated with COVID-19 admissions.

Variable	Coefficient	Exp (coefficient)	*P* value
Admission bill			
Age group			
18-39	Ref		
40-65	0.20	1.22	< .001
≥ 65	0.43	1.54	< .001
< 18	0.02	1.02	.742
Male gender	0.07	1.07	.017
Smoker or ex-smoker	0.09	1.09	.043
Respiratory disease	−0.04	0.96	.591
CVD	0.15	1.16	< .001
DM	0.09	1.09	.010
Cancer	0.39	1.48	< .001
CKD	0.17	1.19	.011
Per day charge			
Age group			
18-39	Ref		
40-65	0.09	1.09	.015
≥ 65	0.37	1.45	< .001
< 18	−0.29	0.75	< .001
Male gender	0.02	1.02	.412
Smoker or ex-smoker	0.21	1.23	< .001
Respiratory disease	−0.002	0.99	.978
CVD	0.19	1.21	< .001
DM	0.17	1.19	< .001
Cancer	0.37	1.45	< .001
CKD	0.13	1.14	.033

CKD indicates chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; DM, diabetes mellitus; Exp, exponent of a number.

admitted patients died.[16] The reasons for the observed variability in ICU admission and ICU mortality between the studies are multifactorial and may reflect the variations in the number of patients included in the analysis, disease severity and clinical characteristics of patients such as those who received invasive mechanical ventilation, critical care capacity and setting, or treatment procedures.[22] The relative high rate of ICU admission and death among patients with COVID-19 raises a concern and presents a challenge to the optimum management in pandemic situations.

The current analysis also showed that inpatient mortality was much more prevalent among ICU admitted patients than non-ICU patients. In fact, 60% of total deaths were for ICU admitted patients. This indicates the high severity of ICU cases as the majority were under mechanical ventilation. In addition, older ages (> 40 years old), smoking, CVD, DM, CKD, and cancers were significant predictors of inpatient death from COVID-19. Increased mortality among older age may be explained in part by the higher frequency of comorbid conditions and the known decrease in physiological functions with aging. Comorbid conditions may be linked to increased levels of inflammatory markers and thus death among patients with COVID-19.[25,26] The current findings are in line with other studies that examined determinants of COVID-19 mortality. In India, age, dyspnea, and the presence of comorbid diseases such as malignancy and DM were significantly associated with increased mortality.[27] In the nearby regions, age and some biochemical and vital measures were associated with mortality in United Arab Emirates.[16] End-stage renal disease was also observed as a significant predictor of mortality among patients with COVID-19 in Saudi Arabia.[28] A recent meta-analysis showed that patients with COVID-19 with chronic obstructive pulmonary disease and current smoking status were at high risk of death, attributed in part to decreased lung function.[29] Other chronic diseases associated with death in Middle East countries were type 2 diabetes, cancer, and CVD.[15-18] Finally, age was repeatedly recognized as one of the parameters in the proposed risk scores for mortality prediction in patients with COVID-19.[30-32] Understanding factors that can predict adverse outcomes among patients with COVID-19 would be very crucial in stratifying critical cases and prioritizing and optimizing the treatment practice and supportive care in this life-threatening pandemic. Revaluation of ICU care and treatment strategies for patients with different comorbidities are needed to improve outcomes in the current pandemic. Continuous assessment is crucial step in the quality assurance process.

This study clearly demonstrated higher direct medical charges associated with ICU patients than other non-ICU admitted patients where both total charges and per day charges were significantly

higher for ICU admitted patients. Furthermore, predictors of ICU admission were consistent with those for higher medical charges, which in fact supports the harmonic relationship between ICU admission and the greater economic burden. In Saudi Arabia, the economic burden associated with COVID-19 admissions was almost twice in ICU admissions compared with general medical ward ($21 165.54 vs $11 381.05, respectively).[33] Di Fusco and colleagues[34] reported that 22% of hospitalized patients with COVID-19 were admitted to the ICU and that hospital charges were significantly higher for those requiring ICU or invasive mechanical ventilation. Furthermore, it has been shown that patients requiring mechanical ventilation had the highest hospital and ICU median costs and that older age, hypertension, and obesity were among major drivers of inpatient costs.[35] Residency contributed to more than one-third of total charges for admission without ICU stay, whereas medications and laboratory tests contributed to approximately half of total charges for admissions with ICU stay. Medications contributed to 24% of the overall admission charges with ICU stay during the 15 months of the pandemic in Jordan. Further research is needed to evaluate the cost-effectiveness of the used medications in patients with COVID-19 especially in the ICU setting because controversy was and still surrounding the use of many agents in the treatment of COVID-19.

Although studied in other countries, results from this study are particularly reflective to Jordan and other developing Middle East countries. In addition to providing data about risk factors, clinical outcomes, and economic burden for COVID-19 ICU admissions using data on a national level in Jordan for the first time, this study is also part of continuous efforts to characterize ICU practice in Jordan. This research specifically sheds light on ICU practice in pandemic situations. Learning from the COVID-19 experience about the huge clinical and economic burdens related to ICU admissions should be important for policy makers in taking decisions regarding preventative measures especially for those at risk of ICU admissions and poor outcomes. Such data are impotent for possible new waves and for any future pandemics. In Jordan and similar developing countries, lack of data is a very impotent weakness that hinders appropriate and rationale developments. The current study has few limitations. A major limitation was related to missing some important demographics and clinical parameters such as socioeconomic status, race, occupation, Sequential Organ Failure Assessment score, and d-dimers. Such data were incomplete, not documented, or not feasible to collect for the whole sample. For instance, there was a high percentage of missing height and weight information for the study subjects, and this was a documentation issue that might be related to the pandemic setting and priorities. Furthermore, the contribution of other factors to ICU admission and mortality such as laboratory findings and biomarker levels were not assessed in this study for the same reasons. Nevertheless, best efforts were made to collect most important factors and outcomes that are feasibly available for this national sample. In estimating the economic burden associated with COVID-19 admissions, only direct medical costs were assessed. This underestimates the total economic burden given that indirect costs were not measured due to feasibility issues because this was a retrospective study. Indirect costs, including income loss due to premature death, and economic production loss due to hospitalization were estimated to be $11 634 on average per person in a study conducted in Iran.[36] Further research is needed to estimate indirect costs attributed to COVID-19 admissions.

Conclusion

To the best of our knowledge, this is the first national study in Jordan that reveals information about ICU admission and mortality among hospitalized patients with COVID-19. The current findings demonstrate that increasing age, smoking status, and the presence of comorbid conditions contribute to higher ICU admission and mortality rate among patients with COVID-19. Earlier risk stratification of vulnerable patients would be vital to minimize adverse outcomes in COVID-19. Future investigations are needed for a better understanding of the reasons behind the observed differences in clinical outcomes among patients with COVID-19 and to explore the effect of other covariates on the pandemic outcomes.

Supplemental Material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.vhri.2022.09.002.

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