Original Article

Effect of the COVID-19 Pandemic on the Performance Indicators of Academic and Non-academic Hospitals in West Azerbaijan Province in 2020

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Abstract

Background: Hospitals are the most important pillar of the country›s health system, especially when faced with a crisis. One of the most important indicators in evaluating hospitals is performance indicators. This research was done to investigate the effect of the COVID-19 pandemic on the performance indicators of academic and non-academic hospitals in West Azerbaijan province in 2020.

Methods: The present cross-sectional descriptive-analytical study was done on all academic and non-academic hospitals of West Azerbaijan province, which examined their performance indicators in 2019 and 2020. The data were analyzed using SPSS 16 software by repeated-measures analysis of variance (ANOVA).

Results: The results of repeated-measures ANOVA demonstrated that the effect of time (coronavirus) on the index of bed occupancy ratio was significant ($\eta^2 = 0.24$, $P = 0.006$) so that it decreased this index in academic hospitals and had the opposite result in non-academic hospitals. The COVID-19 had a significant effect on the index of average patient stay ($\eta^2 = 0.47$, $P < 0.001$) and this index in both types of hospitals increased. Also, the COVID-19 had a significant effect on bed turnover rate ($\eta^2 = 0.32$, $P = 0.001$) and it decreased in both types of hospitals.

Conclusion: Since academic hospitals are more responsible in dealing with epidemics, it is suggested to pay more attention to their infrastructures. Considering the financial burden of some non-communicable diseases, academic hospitals should be prepared to accept and support them, especially in the early period of the epidemic.

Keywords: COVID-19 pandemic, Performance indicators of the hospital, Analysis of variance, West Azerbaijan province

Introduction

On December 30, 2019, the World Health Organization (WHO) received an epidemic report related to a pneumonia-like disease in Wuhan, China, and on January 7, it was recognized as the COVID-19 by the Chinese authorities. The Director General of the WHO announced the emergence of a new disease on January 30, 2020. In Iran, the Ministry of Health on February 19, 2020 announced that the preliminary test results of 2 suspected cases of COVID-19 infection in Qom city were positive, which confirmed of the spread of the COVID-19 in Iran (1,2). The spread of COVID-19 was an emergency and dangerous situation for public health worldwide (3). The new coronavirus belonged to a large family of viruses that caused symptoms similar to colds to severe respiratory diseases (pneumonia) and had not been detected in humans before. After the epidemic, almost all countries planned to prevent and control this disease (4).

Hospitals are the most important pillars of the country's health system in providing services to people, especially when facing crises and infectious outbreaks. Providing the necessary infrastructure in medical centers to deal with epidemics and life-threatening crises is one of the most important goals of the country's health system. In the meantime, provision of specialist and support human resource to provide health and medical services which facing crisis is one of the most important tasks of the hospital (5). Providing necessary and effective resources, facilities, medical and non-medical equipment, protective equipment and medications, especially during an epidemic caused by newly emerging diseases, is one of the important elements of facing and preparing for a crisis (6). The optimal use of these resources and the preparation of hospitals in crisis, including epidemics is of great importance (3,7). Hospitals as the largest and most expensive parts of the health and treatment system are of special importance in critical situations and are highly responsible in providing health and treatment services (8).

Efficiency is considered the most important and

common mechanism for evaluating and measuring the performance of an economic enterprise, including a hospital; therefore, the optimal management of hospitals as the most important centers for providing healthcare services has always been considered by relevant decision makers and policymakers (9). Hospital performance is one of the criteria for determining their efficiency and effectiveness regarding using hospital resources (10). Therefore, it is crucial to evaluate the performance indicators of hospitals, especially during the COVID-19 pandemic. Following the COVID-19 pandemic, changes were made in the use of healthcare in hospitals, including no selective admissions and procedures and giving priority to hospital resources for the treatment of COVID-19 patients (11-13), leading to disruption in the care of non-COVID-19 patients (11). So far, few studies have been conducted on the effect of COVID-19 on the use of healthcare and the performance of hospitals in Iran (14,15).

Accordingly, we investigated the impact of the COVID-19 pandemic on the performance indicators of hospitals in West Azerbaijan province in 2019, including bed occupancy rate (the ratio of occupied daily beds to active daily beds, in a certain period), average patient stay (average length of hospitalization or stay of patients discharged from the hospital, in a certain period), and the bed turnover rate (the number of times a hospital bed is used by hospitalized patients in a certain period) in all selected hospitals in in 2019 (before COVID-19) and 2020 (during COVID-19). The obtained results can be used for future studies and upgrading the infrastructures and beds to prepare as many hospitals as possible during epidemics can be considered to minimize the damage and casualties of the disease.

Methods

The present descriptive-analytical study was conducted in 2019 (before COVID-19) and 2020 (during COVID-19) on 30 hospitals of West Azerbaijan province (22 academic hospitals and 8 non-academic hospitals), including all government (educational and non-educational), private, military, social security and charity hospitals selected by census. A standard checklist of the Ministry of Health (form No. 201 of the new statistical system) was used, whose content validity was confirmed by the Ministry of Health and the experts. This checklist is based on the performance indicators of the hospital, including the bed occupancy rate, the average patient stay, and the bed turnover rate. First, the data related to before and after the COVID-19 were collected from the statistics and information department of the relevant hospitals and the vice president of medical affairs of the university. Then, the value and trend of the mentioned indicators were calculated based the extracted data from the hospitals of West Azarbaijan province during the considered period.

Finally, the repeated-measures analysis of variance (ANOVA) was used to assess the difference between the mean scores and the effect of the COVID-19 pandemic on the performance indicators of the hospitals of West Azarbaijan province.

Statistical analysis was done using SPSS16 software. Then, the presuppositions of repeated-measures ANOVA were checked. The normal distribution of data was assessed by the Shapiro-Wilk test, which confirmed the normal distribution of data regarding the performance indicators of the hospitals before and during the COVID-19 pandemic ($P < 0.05$). Before repeated-measures ANOVA, in order to comply with the presuppositions, the results of the Mauchly's sphericity and Levene's tests were conducted. The Levene's test showed non-significance of the indices, thereby indicating the assumption of equality of variances between groups ($P < 0.05$). The results of the Box's M test also indicated the equality of the observed covariance matrix among the hospitals ($P < 0.05$). The Mauchly's sphericity test showed significant results for the research variables; therefore, the assumption of sphericity was not met ($P < 0.05$). Therefore, according to the epsilon value, Greenhouse-Geisser correction indices were used in order to check the between- and within-group results. By rejecting the null hypothesis, it was concluded that the bed occupancy rate, the average patient stay, and the bed turnover rate had significant changes over time in both groups regardless of the type of hospitals ($P < 0.05$).

All ethical considerations were observed regarding research design, conducting the research, and publishing the results and the study protocol was approved by the Ethics Committee of Urmia University of Medical Sciences (IR.UMSU.REC.1401.202). Also, all the information remained anonymous.

Results

Based on the descriptive findings, the average bed occupancy rate in academic hospitals decreased from 59.27 (15.16) in 2019 to 44.45 (16.97) in 2020, whereas this parameter showed the opposite result in non-academic hospitals and increased from 56.56 (17.59) in 2019 to 46.59 (15.17) in 2020. The average patient stay in academic hospitals increased from 3.54 (3.47) in 2019 to 3.81 (3.55) in 2020 and in non-academic hospitals from 2.30 (0.81) in 2019 to 2.37 (0.94) in 2020. Also, during the COVID-19 pandemic, the average bed turnover rate decreased from 66.54 (12.95) to 59.30 (10.79) in academic hospitals and from 82.77 (14.82) to 73.23 (15.45) in non-academic hospitals (Table 1).

According to Table 2, the effect of time (coronavirus) on bed occupancy rate was significant ($\eta^2 = 0.24$, $P = 0.006$ and $F = (1,28) = 8.77$). Therefore, regardless of the type of hospitals, there was a significant difference between the average bed occupancy rate before and after the COVID-19. Also, the interaction between time and

group (hospitals) indicated that the bed occupancy rate decreased in academic hospitals and increased in non-academic hospitals. The bed occupancy rate was different before and after the COVID-19 pandemic in academic and non-academic hospitals so that after COVID-19, the mean bed occupancy rate in academic hospitals was lower than in non-academic hospitals, while before COVID-19, this rate in academic hospitals was about 3% higher than in non-academic hospitals ($\eta^2 = 0.40$, $P < 0.001$ and $F = (1,28) = 18.404$). However, the effect of type of hospitals on bed occupancy rate was not significant.

Figure 1 shows the effect of the COVID-19 pandemic on bed occupancy in academic and non-academic hospitals. After the COVID-19 pandemic, the bed occupancy rate decreased in academic hospitals and increased in non-academic hospitals.

Also, the effect of COVID-19 on the average patient stay was significant ($\eta^2 = 0.47$, $P < 0.001$ and $F = (1.28) = 24.673$). Therefore, regardless of the type of hospitals, there was a significant difference between the average patient stay before and after the COVID-19 pandemic. On the other hand, the interaction between the effect of COVID-19 pandemic and the type of hospitals, as well as the effect of the type of hospitals on the average patient stay, was not significant. Figure 2 also shows the effect of the COVID-19 pandemic on the average patient

stay in academic and non-academic hospitals. The average patient stay increased due to the effect of COVID-19 in both academic and non-academic hospitals.

Another result of the present study that the significant effect of COVID-19 on bed turnover rate ($\eta^2 = 0.32$, $P = 0.001$ and $F = (1.28) = 13.281$). Thus, regardless of the hospital type, there was a significant difference between the average bed turnover rate before and after the COVID-19 pandemic. Despite no significant interaction between the effect of COVID-19 and the hospital type, the effect of hospital type on the bed turnover rate was significant ($\eta^2 = 0.27$, $P < 0.001$ and $F = (1.28) = 10.328$). Therefore, regardless of the effect of COVID-19, there was a significant difference between the average bed turnover rate in academic and non-academic hospitals. Figure 3 shows the effect of the COVID-19 pandemic on bed turnover in academic and non-academic hospitals, which showed a decrease in both types of hospitals.

Discussion

The aim of the present study was to investigate the effect of the COVID-19 pandemic on the performance indicators of academic and non-academic hospitals in West Azarbaijan province in 2020. The results showed that the significant effect of COVID-19 pandemic on bed occupancy so that it decreased in academic hospitals, whereas opposite results were observed in non-academic hospitals. Also, the COVID-19 pandemic had a significant effect on the average patient stay in hospital and increased this parameter in academic and non-academic hospitals during the pandemic. Also, the results showed the significant effect of COVID-19 pandemic on the bed turnover rate, which decreased in both types of hospitals.

One of the most important results of this study was a decrease and an increase in bed occupancy rate in academic and non-academic hospitals, respectively, which is consistent with the results of other studies. In a study on the impact of the COVID-19 pandemic on the workload of orthopedic services in a general hospital in the United Kingdom, the average number of weekly visits

Table 1. Mean score of performance indicators of hospitals in West Azerbaijan province before (2019) and during (2020) the COVID-19 pandemic

Variable	Academic hospitals (n = 22)	Non-Academic hospitals (n = 8)
Bed occupancy rate		
Before COVID-19	59.27 ± 15.16	56.56 ± 17.59
During COVID-19	44.45 ± 16.97	59.46 ± 15.17
Average patient stay		
Before COVID-19	3.54 ± 3.47	2.30 ± 0.81
During COVID-19	3.81 ± 3.55	2.37 ± 0.94
Bed turnover ratio		
Before COVID-19	66.54 ± 12.95	82.77 ± 14.82
During COVID-19	59.30 ± 10.79	73.23 ± 15.45

Table 2. Results of repeated-measures analysis of variance on the effect of COVID-19 pandemic on performance indicators among hospitals

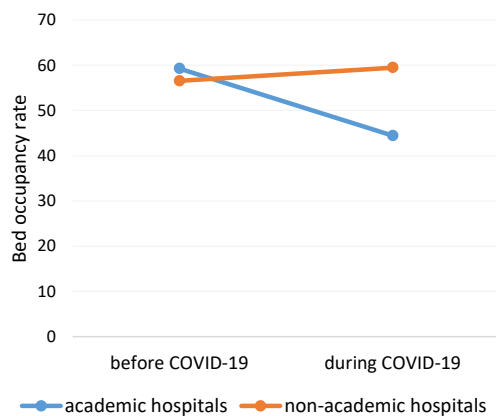| Index		Source	Sum of squares	Degree of freedom	Mean of squares	F	P value	Effect size	Test power
Bed occupancy rate	Within-group	Time	362.13	1	362.13	8.77	0.006	0.239	0.816
		Time × group	759.74	1	759.74	18.404	<0.001	0.397	0.985
	Between-group	Group	569.34	1	569.34	1.18	0.286	0.040	0.138
Average patient stay	Within-group	Time	0.050	1	266.567	24.673	<0.001	0.468	0.998
		Time × group	0.010	1	0.010	5.055	0.063	153/0	0.584
	Between-group	Group	0.035	1	0.035	0.678	0.417	0.024	0.125
Bed turnover ratio	Within-group	Time	924.181	1	924.181	1.2813	0.001	0.322	0.940
		Time × group	15.614	1	15.614	224/0	0.639	0.008	0.074
	Between-group	Group	2666.567	1	2666.567	10.328	<0.001	0.269	0.873

Figure 1. Effect of COVID-19 on bed occupancy rate by academic and non-academic hospitals

Figure 2. Effect of COVID-19 on the average patient stay by academic and non-academic hospitals

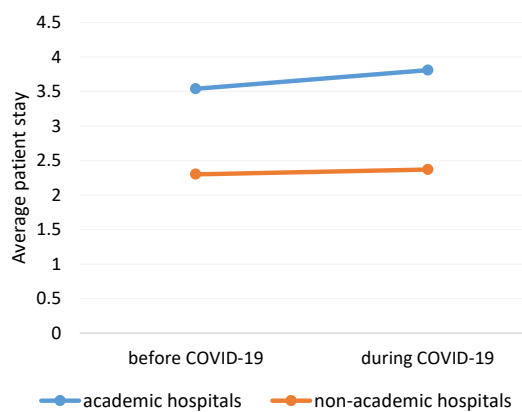**Figure 3.** Effect of COVID-19 on bed turnover rate by academic and non-academic hospitals

to the hospital after the confirmation of the COVID-19 pandemic was decreased by 33%. Also, the number of surgeries performed per week decreased by 26%. There was also a significant decrease in the number of referrals for simple fractures, joint dislocations, wounds, and soft tissue injuries (16). Other studies showed that acute trauma referrals in the post-COVID-19 period, compared to 2019, decreased by almost half, the referrals of adult patients and children requiring admission decreased by 19%, and the total number of operations during the outbreak of COVID-19 reduced to one-third (16,17). academic hospitals almost refused to accept non-coronavirus patients in the first year of the COVID-19 pandemic, i.e. in 2019, due to the large number of these patients and especially during the peaks of this pandemic. It can be argued that during the first year of the COVID-19 outbreak (2020), academic hospitals were reluctant to admit non-coronavirus patients, particularly during the peaks of the pandemic. This was due to the high number of COVID-19 patients, and different hospital wards were designated for their treatment. Despite the large number of hospitalizations of COVID-19 patients, bed occupancy in academic hospitals decreased by 25%. However, according to the findings, this index increased
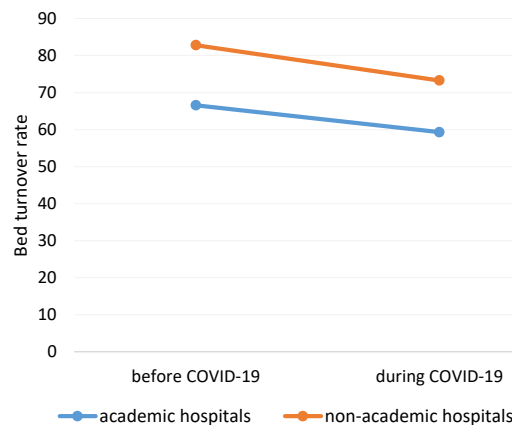
by 5% in non-academic hospitals. Because academic hospitals did not accept non- COVID-19 patients, they were all admitted to non-academic hospitals. In general and considering all disease types, due to the observance of health protocols, the fear of contracting COVID-19, staying at home and postponing unnecessary hospitalizations, especially in 2020, the number of hospitalized patients and consequently bed occupancy rate decreased in 2020.

Another result of the current research was that significant effect of the COVID-19 pandemic on average patient stay, which increased during COVID-19 pandemic in both types of hospitals. This parameter showed a 7% increase in academic hospitals; therefore, average patient stay moved away from the optimal status range and was at a moderate level. This parameter showed a 3% increase in non-academic hospitals and showed the optimal status. It should be noted that the average patient stay of less than 3.5 days is favorable, between 3.5 and 4 days is moderate, and more than 4 days is unfavorable (18). This increase in the average patient stay in academic hospitals that accepted most COVID-19 patients in 2020 was due to the acute conditions of these patients who needed long-term hospitalization. Also, the average patient stay increased slightly in non-academic hospitals, where most non-COVID-19 patients were admitted and most cases had special condition and could not be refused. Consistent with these results, other studies also showed that the average patient stay increased during the COVID-19 pandemic era (19-22).

Also, the findings showed that bed turnover decreased by 11% and 12% respectively in 2020 in academic and non-academic hospitals, which is consistent with the increase in the average patient stay results. Consistent with our results, a study entitled "The effects of COVID-19 on the quality of healthcare in tertiary medical centers (a retrospective study)" on clinical performance indicators in Taiwan showed that the unplanned return of emergency patients within 72 hours after discharge,

the unplanned return of hospitalized patients within 14 days after discharge, and the unplanned return of patients receiving surgery to the operating room during hospitalization, decreased during the prevalence of COVID-19 (23).

One of the most important limitations of this study was the exclusion of hospitals of Khoy city from the study because they are under the supervision of Khoy Medical Sciences Faculty. Thus, the results of this study should be cautiously generalized to the entire province and country.

Conclusion

The results showed that the high responsibility of academic hospitals in facing epidemics and crises, especially in the early period of epidemics when the government is facing a decrease in income, especially a decrease in tax revenues. Therefore, scientific and principled infrastructures and planning and policies should be more considered. However, in such situations, non-academic hospitals accepting most non-infectious patients should also be taken into consideration along with the necessary management measures. It should be noted that due to the financial burden of some diseases, even in epidemics, academic hospitals should be prepared to accept non-infectious patients and support them, and on the other hand, in order to reduce the number of patients visiting academic hospitals, non-academic hospitals should also be prepared. Because this study assessed the effects of COVID-19 pandemic during the epidemic, other effects of COVID-19 pandemic as well as its adverse effects after the end of the epidemic and on the indicators should be assessed in future studies; for example, the damages and losses that some patients will suffer due to postponing their treatment due to the epidemic, or its adverse effects on social and economic issues.

Authors' Contribution
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Validation: Majid Babaei.
Visualization: Shila Hasanzadeh.
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