ORIGINAL RESEARCH

DOI: 10.17944/interdiscip.1444084
Interdiscip Med J 2024;15(52):60-66

Comparison of effectiveness indicators before and during the COVID-19 pandemic in a university hospital

Mehmet Erdem[1], Bircan Kara[2], Sibel Armağan Karadeniz[1]

[1] Hatay Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine, Department of Public Health, Hatay, Türkiye
[2] Hatay Mustafa Kemal University Hospital, Hatay, Türkiye

Abstract

Comparison of effectiveness indicators before and during the COVID-19 pandemic in a university hospital

Objective: Our aim in this study is to reveal to what extent hospital efficiency indicators changed in a University Hospital between the period before the Covid 19 pandemic (2018-2019) and the period when the pandemic started and continued (2020-2021).
Method: The study planned as a retrospective and descriptive type, data belongs to a 4-year period (2018-2021). The number of personnel for the years examined in the study, the number of applications to the outpatient clinic and emergency department calculated monthly and the number of deceased patients. Bed occupancy rate, inpatient rate, average patient stay days, bed turnover rate and bed turnover interval were used as hospital bed utilization efficiency indicators.
Result: Among all years, April 2020 had the lowest number of emergency applications (n=1287) and total number of outpatient clinic applications (n=7530). The year with the highest bed occupancy rate was 2020 with 77.2±6.7. The highest inpatient rate was in 2020 with 6.7±2.1, the highest average day of stay was in 2021 with 10.8±2.2, the highest bed turnover rate was in 2018 and 2019 with 4.7±0.3 and the highest bed turnover interval was observed in 2021 with 5.2±2.2. April 2020 was the month with the highest inpatient rate at 11.8% and the highest bed turnover interval at 16.8.
Conclusion: The number of patients applying to emergency departments and outpatient clinics decreased, the inpatient rate increased, the bed turnover rate decreased, the bed turnover interval extended and the average day of stay increased during the pandemic period.
Keywords: Pandemic, COVID-19, Bed Occupancy Rate, Bed Turnover Rate

INTRODUCTION

In December 2019, cases of pneumonia of unknown cause were first reported in Wuhan, China. The pathogen called severe acute respiratory syndrome coronavirus 2 was isolated from the lower respiratory tract of infected patients, and the resulting disease was named COVID-19 (1). Restrictions began to be imposed in Turkey as of March 16, 2020, to prevent the spread of the virus. A full-time curfew started from Thursday, April 29, 2021 until Monday, May 17, 2021. First, schools and all public places were closed. Flexible working hours were introduced for public service employees, flexible working hours were introduced in hospital outpatient clinics, and the number of outpatient clinics was reduced (2). In the letter of the Ministry of Health dated 16.03.2020 on 'Postponement of Elective Procedures and Other Measures to be Taken'; Planning non-urgent elective surgical procedures to a more convenient date as much as possible, encouraging patients who do not have an emergency to receive service primarily from family physicians, ensuring that the current reports of patients with a temporary disability report whose report period has expired will be considered valid until the end of May 2020 and that they will not apply to hospitals to renew their report. It was also announced that medicines, medical supplies and diapers that require regular use due to chronic diseases and disabilities can be obtained from pharmacies and medical doctors without the need to write a prescription without going to a health institution (3). On March 20, 2020, a circular was published by the Ministry of Health stating that all hospitals with sufficient specialists and third-level adult intensive care beds are considered pandemic hospitals. This

Cite this article: Erdem M, Kara B, Armağan Karadeniz S. Comparison of effectiveness indicators before and during the COVID-19 pandemic in a university hospital. Interdiscip Med J. 2024;15(52):60-66. https://doi.org/10.17944/interdiscip.1444084

Corresponding Author: Mehmet Erdem: Hatay Mustafa Kemal University Tayfur Ata Sökmen Faculty of Medicine, Department of Public Health, Hatay, Türkiye
Email: dr.m_erdem@hotmail.com
ORCID iD: 0000-0001-5671-1213

Received: Feb 28, 2024
Accepted: May 25, 2024

situation caused an increase in workload, especially in the emergency departments and intensive care units of hospitals with intensive care beds (4). On March 21, a circular was published stating that those aged 65 and over and those with chronic diseases were prohibited from leaving their residences (5). All these situations have caused the number of non-emergency outpatient clinic patients to decrease.

Hospitals play an important role in meeting the health needs of the society. In addition to providing health services to the society, they are important in

that they constitute the largest share of total health expenditures (6). Today, increased access to health services and the understanding of providing more qualified health services have necessitated the effective use of resources. One of the most important performance indicators used to evaluate hospital services is to reveal how effectively hospital beds are used. The concept of activity, human, financial, technological, etc. It is an evaluation criterion that shows to what extent input elements are used effectively or adequately in line with the determined purposes (7).

In this regard, integrating existing or created resources into the best use to meet the needs will ensure efficiency in service delivery. Effective use of hospital beds is defined by different criteria in various sources. Philip et al. (8) and Ağırbaş (9) studies, "capacity utilization" in the report published by the Ministry of Health in 2011, "productivity indicators (10), Avcı et al. "operational performance indicators" (11), Lotfi et al. "performance measures" (12), Vashishth et al. They preferred to use expressions such as "hospital bed use" (13).

Our aim in this study is to analyze the hospital efficiency indicators in a University Hospital; bed occupancy rate, average patient stay, inpatient rate, bed turnover rate, bed turnover interval, total number of patients applying to outpatient clinics and emergency departments, number of deaths, etc. It is to reveal to what extent the data changed between (2018-2019) before the pandemic and (2020-2021) during the period when the pandemic started and continued.

METHOD

The research is a retrospective and descriptive research. The data belongs to the years 2018-2021 and was taken from the statistics unit of Hatay Mustafa Kemal University Hospital, and the data are in the form of monthly results covering the 4 years of in this study. The study includes data on the number of working personnel, the number of applications to outpatient clinics and emergency departments, and the number of deceased patients between 2018-2019 (before the pandemic) and 2020-2021. As bed use efficiency indicators; Bed occupancy rate, inpatient rate, average patient stay day, bed turnover rate and bed turnover interval were used. Ethics committee permission for the study was obtained from Hatay Mustafa Kemal University Nonclinical Research Ethics committee (Date: 17.03.2022, decision no: 25).

Bed occupancy rate; It shows the rate at which patient beds are used by patients within a certain period of time (one month, three months, one year, etc.). It reflects the popularity of hospitals in terms of inpatients [14].It is considered positive that the bed occupancy rate is 80-85% in general hospitals and 90-95% in hospitals treating chronic diseases. It is calculated with the formula (Number of Days Stayed x 100) \ (Number of Beds x 30).

Inpatient rate; It is an efficiency ratio that shows how many patients who applied to hospital outpatient clinics were hospitalized and treated within a certain period of time. The rate varies by hospital type. In a health system where the referral system functions well, the rate of inpatients is expected to be high. The inpatient rate, which shows how many patients applying to hospital outpatient clinics are treated as inpatients, has been observed to be low in places where the health infrastructure is inadequate. It is calculated with the formula (Number of Inpatients) \ (Number of Polyclinics).

Average patient stay day; It is the measure obtained by dividing the total number of days spent (on a clinic basis) by the total number of discharged (discharged and deceased) patients within a certain period (month, three months or a year). This criterion is an indicator used to evaluate the use of health services and the quality of service provided in the hospital. In addition to reflecting the change in service provided in the hospital, the average length of stay is also important in that it provides data on seasonal change. Situations such as the presence of epidemic diseases and tourism activities also provide data about seasonal changes in hospital services. It is calculated with the formula (Total Patient Days) \ (Number of Discharged Patients).

Bed turnover rate; It shows the patient bed efficiency level by how many patients use the bed in a certain period of time. There is a relationship between bed turnover rate and hospital size. For example, university hospitals with high bed capacity generally operate at higher capacity. A low bed turnover rate may not only indicate that the hospital is preferred by fewer patients or that patients are kept in the hospital unnecessarily, but it may also indicate that difficult and complicated diseases are treated in these hospitals. A high bed turnover rate may indicate that simple first aid treatments are provided by the hospital.It is calculated by the formula: Number of Inpatients (excluding Intensive Care) / Actual Number of Beds (excluding Intensive Care Bed Numbers)

Bed turnover interval; It is the measure that shows

the average number of days a patient bed remains empty between two patient admissions. Leaving a patient bed empty is considered inefficiency. Therefore, what is desired is that the time between two patient admissions is short. Although it is desirable to keep the bed turnover interval short, keeping it too short or constantly giving negative feedback about the quality of the service provided. Because low utilization level of hospital facilities indicates low turnover interval. It is calculated by the formula Bed Turnover İnterval= ((Hospital bed x number of days in the relevant period) - Number of days hospitalized) / (Number of discharged patients + Number of patients who died), (14).

In statistical analyses, numbers by month and the monthly average and standard deviation of hospital indicators by year were calculated as descriptive statistics. Spearman correlation analysis was performed between the monthly case numbers reported by Turkey to the World Health Organization (15) and the effectiveness indicators of the hospital under investigation.

RESULTS

Distribution of healthcare personnel in the hospital where the study was conducted is shown in **Table 1.** The total number of beds in the hospital in 2018, 2019 and 2020 is 503. While the total number of beds was 503 in January 2021, it later increased to 608. The number of adult intensive care beds in 2018, 2019 and 2020 is 52. The number of adult intensive care beds, which was 52 in January 2021, later increased to 72.

Table 1. Number of personnel by years

Year	Lecturer	Assistant Doctor	Nurse
2018	119	136	295
2019	111	137	350
2020	156	249	391
2021	157	254	463

In all years examined, the minimum number of emergency applications was in April 2020 (n = 1287) and the maximum in January 2020 (n = 8288). While the number of outpatient clinic admissions to the hospital was lowest in April 2020 (n=7530), the highest was seen in January 2020 (n=59642), **(Figure 1).**

The 12-month averages of hospital indicators for the four years examined were calculated. The highest bed occupancy rate by year was observed in 2020 with 77.2±6.7. The highest inpatient rate was in 2020 with 6.7±2.1, the highest average day of stay was in 2021 with 10.8±2.2, the highest bed turnover rate was in 2020 with 3.9±0.9, and the highest average day of stay was in 2021 with 3.9±0.9. The bed-to-bed turnover interval was found to be 5.2±2.2 in 2021 **(Table 2).**

During the years examined, the highest bed occupancy rate was in October 2019 with 92.9%, the highest inpatient rate was in April 2020 with 11.8%, the highest average day of stay was in October 2021 with 13.8, the highest bed turnover rate was in October 2021 with 11.8%. The turnover rate was 5.3 in January 2020, and the highest bed turnover interval was 16.8 in April 2020.

Mean±SD (Mean±Standard Deviation),* The average of 12 months was calculated

Table 2. Bed occupancy rate, inpatient rate, average day of stay, bed turnover rate and bed turnover interval by years

	Bed occupancy Rate	Inpatient Rate	Average Day of Stay	Bed Turnover Rate	Bed Turnover Interval
	Mean±SD*	Mean±SD*	Mean±SD*	Mean±SD*	Mean±SD*
2018	43,7±9,1	5,6±0,5	5,8±1,5	4,7±0,3	7,9±1,7
2019	77,2±6,7	4,4±0,3	5,2±1,9	4,7±0,3	1,4±0,3
2020	70,6±12,5	6,7±2,1	9,3±2,2	3,9±0,9	4,7±4,5
2021	68,3±7,5	6,4±0,5	10,8±2,2	3,9±0,6	5,2±2,2

*SD: Standart deviation

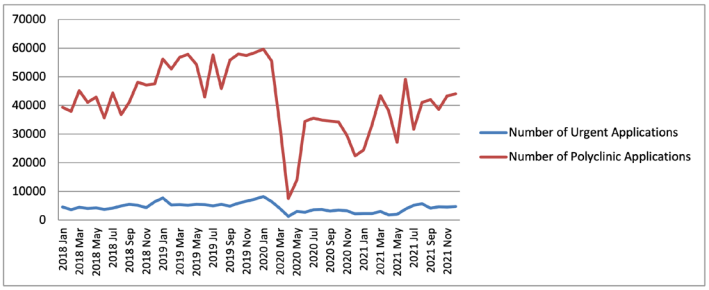

Figure 1. Monthly Numbers of Emergency and Polyclinic Applications to the Hospital Between 2018-2021

According to years, the highest intensive care bed occupancy rate was observed in 2020 with 92.8±12.7, and the highest intensive care average patient stay was observed in 2021 with 2343.3±234.0. When we look at the surgical service bed occupancy rates by year, the year with the highest rate was 2019 with 81.9±9.2, and when we look at the internal service bed occupancy rate, the year with the highest rate was 2019 with 70.1±8.2 **(Table 3)**. When all years are analyzed by month, the lowest total intensive care bed occupancy rate is 35.9% in June 2018, and the highest total intensive care bed occupancy rate is 100% in May, June, July, September, October and November 2020.

Mean±SD (Mean±Standard Deviation),* The average of 12 months was calculated

Table 3. Intensive care, surgical Service, internal service bed occupancy rate and intensive care average patient stay day by years

	Intensive Care Bed Occupancy Rate	Intensive Care Average Patient Stay Days	Surgical Service Bed Occupancy Rate	Internal Service Bed Occupancy Rate
	Mean±SD*	Mean±SD*	Mean±SD*	Mean±SD*
2018	52,1±12,7	1025,3±203,4	46,2±6,9	36,1±11,9
2019	82,8±5,9	1742,2±124,5	81,9±9,2	70,1±8,2
2020	92,8±9,2	1951,0±276,0	68,3±15,5	65,2±12,6
2021	90,1±6,1	2343,3±234,0	67,8±8,9	61,2±9,9

*SD: Standart deviation

Number of patients who died from January 2018 to December 2021 **in Figure 2** can be seen. The average number of deceased patients in 2018, 2019, 2020 and 2021 is respectively 45±13, 52±12, 36±10 and 32±7.Spearman correlation analysis was performed for 2020 and 2021 between the monthly number of cases reported by Turkey to the World Health Organization since the beginning of the pandemic and the monthly indicators of the hospital under investigation. Moderate positive correlation between the number of cases and the inpatient rate (R = 0.446**, p=0,029**) and a strong positive correlation was detected between the monthly number of cases and the day of intensive care stay (R = 0.661, p<0,001).

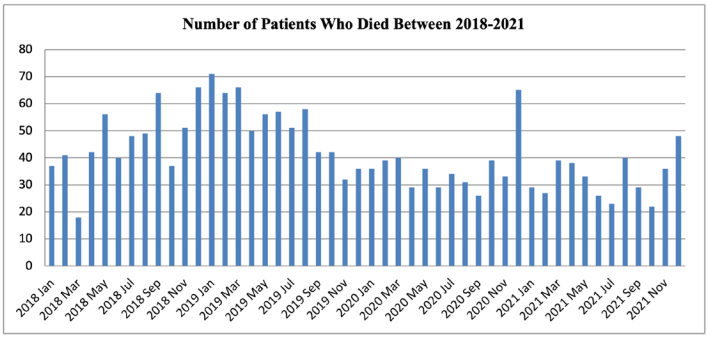

Figure 2. Number of Deaths of Patients by Month Between 2018 and 2021

DISCUSSION

A rapid increase in emergency applications was detected in October, November and December in 2018 and 2019, the pre-pandemic period. It can be thought that the important reason for the increase detected in these months is the increase in the frequency of upper respiratory tract infections. A similarity was found between our findings and the research conducted by Kuşkucu et al. at Istanbul University Cerrahpaşa Faculty of Medicine in 2020 (16). In this study, serious decreases have been observed in the number of emergency applications since January 2020, when Covid-19 started to spread rapidly around the world, and March 2020, when it was first seen in Turkey. In the study conducted by Alataş et al. in 2021 at Muğla Sıtkı Koçman University Training and Research Hospital during the pandemic period, it was found that the number of patients applying to the emergency department decreased (1). At the same time, the fact that the number of patients applying to the emergency department in the pre-pandemic years was higher than the number of patients applying to the emergency department during the pandemic period can explain why the Covid-19 pandemic caused a decrease in the number of patients applying to the emergency room.

It was determined that the lowest number of outpatient clinic applications in the last four years was in April 2020, and it is seen that the Covid-19 pandemic caused a decrease not only in the number of emergency applications but also in the number of all outpatient clinic applications. In the study titled 'Evaluation of Health Services Use during the Covid-19 Pandemic Period', conducted by Yıldız et al. at Batman University in 2021,a decrease was observed in the number of outpatient clinic applications during the Covid-19 period (17). It can be said that the decrease in the number of outpatient clinic applications in April 2020 was caused by some restrictions imposed during the pandemic period. As an example, a curfew was imposed on individuals over the age of sixty five on March 21, 2020, and on individuals under the age of twenty on April 3, 2020, and it is possible to give these restrictions to continue throughout April. At the same time, the reduction in public transportation capacities by half on March 24, 2020, and the continuation of this situation throughout April may have caused difficulties in transportation to the hospital, which may have caused the decrease in the number of applications to polyclinics (18).

Bed occupancy rate is considered a basic efficiency indicator as it determines the hospital's utilization level and productivity. This rate is a measure of the efficient use of hospital beds. It would be useful to evaluate this efficiency criterion together with criteria such as average patient stay and bed turnover rate. The Ministry of Health has accepted the bed occupancy rate as 72% and the average day of stay as 4.5 days as an efficiency indicator in training and research hospitals. A low average day of stay is a good indicator, but a large decrease is interpreted negatively (19). Bed turnover interval also affects bed occupancy rates, and it has been seen in the literature that there may be decreases in bed occupancy rates if there is idle capacity in hospitals (20). When we examined the years before the pandemic, the bed occupancy rate in 2018 was found to be 43.4% and remained below the Ministry of Health's productivity indicator. We can explain this situation in this study with the shortage of healthcare personnel and nurses in 2018. In the study titled Examination of human resources in the health sector in Turkey, conducted by Özkan et al. at Marmara University in 2015, the need for nurses and auxiliary health personnel was mentioned and the importance of studies to meet this need was emphasized

(21). At the same time, the high value in the bed turnover range is another factor in the low bed occupancy rate. In this study, the bed occupancy rate in 2019 was found to be 77.3% and exceeded the value determined by the Ministry of Health. This situation may be related to the increase in the number of staff and nurses working in our hospital, but it may also be due to the effect of the bed turnover interval, which has decreased significantly compared to the previous year.

With the pandemic, an increase in the rate of inpatients and an extension in the average day of stay were detected. A decrease in the bed turnover rate may be observed as the average day of stay becomes longer. The increase in the average day of stay above the accepted value and the decrease in the bed turnover rate negatively affected the bed occupancy rate during the pandemic period of 2020. In 2021, when the pandemic continues, the increase in the average day of stay and bed capacity compared to the previous year can be explained as the reason for the decrease in bed occupancy rate.

Surgical service bed occupancy rates increased significantly in 2019 compared to 2018. It is thought that the increase in the number of nurses and healthcare personnel and the increase in the number of surgeries performed played an important role in this large increase. During the pandemic period, the surgical service bed occupancy rate decreased compared to the previous period. This situation can be explained by the postponement of elective surgeries and the infection control measures notification announced by the Ministry of Health in our country (22). In case of emergency and oncological surgery, early discharge is important in order to reduce the exposure of patients and healthcare personnel to the virus and to use beds, ventilators and other hospital resources appropriately. This situation brought the "Accelerated Recovery After Surgery" protocols to the agenda. With why these protocols, a significant decrease was recorded in the number of days spent in the hospital in April 2020. On March 9, 2021, the guide titled 'Study Guide and Infection Control Measures in Health Institutions during the COVID-19 Pandemic' was published. With the update, postponed elective surgeries started to be performed gradually. In this way, the number of surgeries performed in March 2021 and later, and accordingly the surgical service bed occupancy rate, remained at normal levels (60-80%).

It is very important to what extent the intensive care bed potential is used in hospitals. Low bed occupancy rate causes personnel costs to remain high compared to the service provided and existing potential cannot be used efficiently. In Turkey, acceptable intensive care ICU was determined as 85% in the efficiency scorecard indicator cards of the Ministry of Health (23). The average intensive care bed occupancy rate in our hospital in 2018 is below the acceptable value with 52.1. In 2019, this rate increased to the normal level of 82.8. In the next two years, the intensive care bed occupancy rate continued at acceptable levels. With the onset of Covid-19 cases in Turkey, the intensive care bed occupancy rate remained at 100% from April 2020 to November 2020.

When the data on the number of patients who died between January 2018 and December 2021 is examined, the post-pandemic months of December 2020 and 2021 are the months with the highest number of deaths in both years. However, the number of emergency applications and outpatient clinic applications in December 2020 and 2021 are below the number of applications in the same months of previous years. Although the number of applications is low, the number of deceased patients is high, which may suggest that people with Covid-19 infection and comorbid chronic diseases apply for emergency and outpatient clinic examinations. Similarly, the fact that the number of days spent on the same dates was higher than in other periods may have been effective in the increase in the number of deaths. Various studies emphasize that mortality increases as the duration of hospitalization increases. In the study conducted by Ceylan et al. in 2001, no difference was found between prolonged hospital stay and mortality, but complications were found to increase in patients hospitalized for more than 14 days (24). In the study conducted by Craven et al., it was reported that the relative risk of mortality was 3.2 times higher in patients with a hospital stay of more than 10 days (25). In a study conducted by Kölgelier et al. at Adıyaman University in 2012, it was stated that as the length of stay in the ICU increased, the effect of infections on mortality was mentioned, but no direct relationship was found between mortality and length of stay (26).

CONCLUSION

A number of indicators are used to measure the performance and efficiency of hospital services. These indicators include bed utilization activities related to the hospital's capacity utilization. With this in mind, the bed utilization efficiency of the relevant hospital was evaluated within the scope of the study. Accurate analysis of the hospital's capacity utilization and the efficiency indicators evaluated in the study should be considered as a whole. As a result of the analysis; While there was a decrease in the bed occupancy rate compared to the previous year during the pandemic period, there was an increase in the rate of inpatients and the number of days spent. During the pandemic period, the intensive care bed occupancy rate remained high and 100% occupancy was detected during the peak period throughout the country. During the pandemic period, a decrease was detected in the number of emergency room applications, polyclinic applications, and surgical service bed occupancy rates due to only emergency surgeries

being allowed. During the pandemic, there was an increase in the number of days spent in intensive care compared to the previous period. While the number of applications to the outpatient clinic decreased during the pandemic, an increase in the hospitalization rate of patients was detected. While the bed turnover rate decreased, an increase in the death rate was observed.

As a result, efficient use of hospital beds is of great importance for hospitals and patients, especially in situations such as unexpected pandemics. In this regard, in hospitals; Taking precautions and decisions as quickly as possible, considering that they will be negatively affected by the pandemic, increasing the number of intensive care beds, increasing the Emergency Department service capacity, increasing the number of doctors, nurses and staff working in intensive care and emergency, constantly evaluating hospital efficiency indicators by hospital managers and making rapid plans. We consider being prepared for the rapid supply of necessary equipment, taking the necessary precautions to prevent emergency surgeries from being interrupted, arranging operating procedures and keeping all hospital committees, especially the infection committee, in communication with each other and all similar practices as recommendations that should be taken in terms of pandemic management.

ACKNOWLEDGEMENT

Peer-Review

Both externally and internally peer reviewed.

Conflict of Interest

The authors declare that they have no conflict of interests regarding content of this article.

Financial Support

The Authors report no financial support regarding content of this article.

Ethical Declaration

Ethical permission was obtained from the Ethics committee permission for the study was obtained from Hatay Mustafa Kemal University Non-Interventional Clinical Researches Ethics Committee (Date: 17.03.2022, decision no: 25) and Comparison of effectiveness indicators in Covid 19. Helsinki Declaration rules were followed to conduct this study.

Authorship Contributions

Concept: ME, BK Design: ME, BK, Supervising: SAK, Financing and equipment: ME, Data collection and entry: SAK, BK Analysis and interpretation: SAK, ME Literature search: ME, BK, SAK, Writing: ME, Critical review: ME

Thanks

We would like to thank Hatay Mustafa Kemal University Faculty of Medicine Intern Doctors for their contribution to the study; Saime Ezgi Yalçındag, Evin Sincaroglu, Kubra Kaya, Begum Unlutaskiran, Muhammet Yagız Ibiloglu, Gullu Akbas, Feyza Nur Bastik, Hande Tunc, Almira Aggul, Elif Yaltirik, Esra Toplan, Murat Baran Yasar, Aslihan Uygun, Betul Eronu, Zeynep Kara.

REFERENCES

1. Alataş ÖD, Gökçek K. Pandemi Döneminde ve Pandemi Öncesi Dönemde Acil Servise Başvuran Hastaların Karşılaştırılması. Muğla Sıtkı Koçman Üniversitesi Tıp Dergisi. 2021;8(3):195-8. https://doi.org/10.47572/muskutd.844037.
2. COVID-19 Pandemic In Turkey [Internet]. Wikipedia 2022 [cited 2022 Dec13]. Available from: https://en.wikipedia.org/wiki/COVID-19 pandemic_in_Turkey.
3. Elektif İşlemlerin Ertelenmesi ve Diğer Alınacak Tedbirler [Internet]. Sağlık Bakanlığı 2020 [cited 2022 Mar 13]. Available from: https://dosyamerkez.saglik.gov.tr/Eklenti/36865/0/elektif-islemlerin-ertelenmesi-ve-diger-tedbirlerpdf.pdf.
4. Pandemi Hastaneleri [Internet]. Sağlık Bakanlığı 2020. [cited 2022 Mar 7]. Available from: https://dosyamerkez.saglik.gov.tr/Eklenti/36907/0/pandemi-hastaneleripdf.pdf.
5. 65 Yaş ve Üstü ile Kronik Rahatsızlığı Olanlara Sokağa Çıkma Yasağı Genelgesi [Internet]. Sağlık Bakanlığı 2020. [cited 2022 Mar 7]. Available from: https://www.icisleri.gov.tr/65-yas-ve-ustu-ile-kronik-rahatsizligi-olanlara-sokaga-cikma-yasagi-genelgesi
6. Nwagbara VC, Rasiah R, Aslam MM. An Approach Toward Public Hospital Performance Assessment. Medicine (Baltimore). 2016;95(36):e4688. https://doi.org/ 10.1097/MD.0000000000004688.
7. Yükçü S, Atağan G. Etkinlik, Etkililik Ve Verimlilik Kavramlarının Yarattığı Karışıklık. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi 2009;23(4), 1-13.
8. Phillip PJ, Mullner R, Andes S, Toward A. Better Understanding Of Hospital Occupancy Rates. Health Care Financ Rev. 1984;5(4):53-61.
9. Ağırbaş, İ. Hastane yönetimi ve organizasyon. Siyasal Kitabevi 2016. p. 339-54
10. Kamu Hastanelerinin Genel Verimliliğinin Değerlendirilmesi Araştırma Raporu. Sağlık Bakanlığı 2011.
11. Avcı K. Bir Eğitim ve Araştırma Hastanesinin Finansal ve Operasyonel Performans Göstergeleri Arasındaki İlişki. Hacettepe Üniversitesi Sağlık İdaresi Dergisi 2014;17(1):1-20.
12. Lotfi F, Kalhor R, Bastani P, Shaarbafchi ZN, Eslamian M, Dehghani MR, Kiaee MZ. Various İndicators For The Assessment Of Hospitals Performance Status: Differences And Similarities. Iran Red Crescent Med J. 2014 ;16(4):e12950. https://doi.org/10.5812/ircmj.12950

13. Vashishth TK, Chaudhary S, Sharma V. Optimum Utilization of Bed Resources in Hospitals: A Stochastic Approach. In: Manju, Kumar, S, Islam SMN (eds). Artificial Intelligence-based Healthcare Systems. The Springer Series in Applied Machine Learning. Springer, Cham. (2023). https://doi.org/10.1007/978-3-031-41925-6_7

14. Dhungana HN, Siddiqui MU, Sahu KK. Role Of Hospital Utilization Constants As Past Performing And Future Planning Markers. Asian Journal of Management Sciences 2014;2(05): 01-04.

15. WHO COVID-19 dashboard data [Internet]. World Health Organization [cited 2022 Mar 7]. Available from:https://data.who.int/dashboards/covid19/data?n=c.

16. Kuşkucu M, Mete B, Tabak F, Midilli K Yetişkinlerde Solunum Yolu Viral Etkenlerinin 2010-2018 Yılları Arasındaki Prevalansı ve Mevsimsel Dağılımı. Türk Mikrobiyoloji Cemiyeti Dergisi. 2020;50(1): 21-6. https://doi.org/10.5222/TMCD.2020.021

17. Yıldız A, Bulut S. COVID-19 Pandemi Döneminde Sağlık Hizmetleri Kullanımının Değerlendirilmesi. Türkiye Klinikleri Sağlık Bilimleri Dergisi. 2021;6(4):928-38. https://doi.org/10.5336/healthsci.2020-79427

18. İnce F, Evcil FY. Covid-19'un Türkiye'deki İlk Üç Haftası. Süleyman Demirel Üniversitesi Sağlık Bilimleri Dergisi. 2020;11(2):236-41. https://doi.org/10.22312/sdusbed.719168

19. Aydemir İ. Bir Kamu Hastanesinde Yatak Kullanım Etkinliğinin Değerlendirilmesi. Uluslararası Sağlık Yönetimi ve Stratejileri Araştırma Dergisi. 2019;5(2):230-42.

20. Yücel E. Kamu Hastanelerinde Yatak Doluluk Oranını Etkileyen Faktörler. Uluslararası Sağlık Yönetimi ve Stratejileri Araştırma Dergisi. 2019;5(1):1-11

21. Özkan Ş, Uydacı M. Türkiye'de Sağlık Sektöründe İnsan Kaynakları Sisteminin İncelemesi. Öneri Dergisi. 2015;11(44), 221-38. https://doi.org/10.14783/od.v11i44.5000080012

22. COVID-19 Pandemisinde Sağlık Kurumlarında Çalışma Rehberi ve Enfeksiyon Kontrol Önlemleri [Internet]. Sağlık Bakanlığı 2020 [cited 2022 Mar 8]. Available from: https://covid19.saglik.gov.tr/TR-66532/saglik-kurumlarinda-calisma-rehberi-ve-enfeksiyon-kontrol-onlemleri.html

23. Esen H, Yiğit V. Yoğun Bakım Yatak Kullanım Verimliliğinin Pabon Lasso Modeli İle Değerlendirilmesi. MANAS Sosyal Araştırmalar Dergisi. 2021;10(2),1138-50. https://doi.org/10.33206/mjss.661570.

24. Ceylan E, İtil O, Arı G, Ellidokuz H, Uçan ES, Akkoçlu, Aİç hastalıkları yoğun bakım ünitesinde izlenmiş hastalarda mortalite ve morbiditeyi etkileyen faktörler Toraks Dergisi. 2001;2(1), 6-12.

25. Craven DE, Kunches LM, Lichtenberg DA, Kollisch NR, Barry MA, Heeren TC, McCabe WR. Nosocomial infection and fatality in medical and surgical intensive care unit patients. Archives of internal medicine. 1988;148(5),1161-8. https://doi.org/10.1001/archinte.1988.00380050165024

26. Kölgelier S,Küçük A, Aktug DN,Özçimen S,Demir L. Yoğun bakımlardaki hastane enfeksiyonları: Etiyoloji ve predispozan faktörler. Kafkas Tıp Bilimleri Dergisi. 2012;2(1):1-5. https://doi.org/ 10.5505/kjms.2011.36036