Impact of COVID-19 Waves and Lockdowns on Emergency Department Visits and Intensive Care Unit Admissions in Türkiye: A Retrospective Analysis

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Abstract

Aim: This study aimed to evaluate the impact of the COVID-19 pandemic on emergency department (ED) utilization and intensive care unit (ICU) admissions in Türkiye, while also examining healthcare policies by focusing on changes in non-COVID-19-related visits during lockdown periods.

Methods: A retrospective analysis was conducted on ED and ICU admission data from a tertiary care hospital in Türkiye during the COVID-19 pandemic. Data were categorized into COVID-19 and non-COVID-19 cases and stratified based on curfew periods. The causal inference method, particularly Bayesian Structural Time Series modeling, was employed to evaluate trends in healthcare utilization and to question the reliability of the findings.

Results: Non-COVID-19 emergency department (ED) visits significantly decreased during the pandemic (p=0.00075), with the most notable reductions during lockdowns (p=0.00084). In the first lockdown, ICU admissions increased significantly (p=0.00029), while COVID-19 ED visits remained unchanged (p=0.09358). During the second lockdown, COVID-19 ED visits rose (p=0.000001), non-COVID-19 visits decreased (p=0.00019), and ICU admissions showed a non-significant numerical decline (p=0.10771). These findings indicate shifts in healthcare utilization and critical care demands during the pandemic.

Conclusion: The COVID-19 pandemic significantly altered healthcare utilization patterns, reducing non-COVID-19 ED visits without affecting ICU admission rates. These findings underscore the need for robust public health strategies, including improved triage systems and public education, to optimize healthcare delivery during crises. Further research is warranted to assess the long-term implications of delayed care for non-COVID-19 conditions.

***Keywords**: Emergency Department Utilization, COVID-19 Pandemic, Intensive Care Units*

1. Introduction

Emergency services are a critical part of hospitals where patients can access healthcare services 24 hours a day, 7 days a week. According to the circular numbered 31952 dated 13.09.2022 of the General Directorate of Treatment Services of the Ministry of Health of the Republic of Türkiye, 'It is essential that all patients applying to emergency services are evaluated as emergency patients upon their first application and admitted to emergency services and that procedures are carried out accordingly', the complaints that the patient states they have are accepted as emergencies until the physician examines and diagnoses them. Every patient who applies to the Emergency Service and states that they have urgent complaints is an emergency. They are definitely examined, treated, directed, admitted or referred according to their condition.[1] According to this circular, since the patient determines whether the patient is an emergency patient, a very serious workload has occurred in emergency services. This situation has reached such proportions that it can sometimes cause delays in the care of patients who really need it in emergency services.[2-4]

The COVID-19 pandemic has profoundly disrupted healthcare systems worldwide, leading to significant changes in patient behaviors, healthcare delivery, and resource allocation.[5,6] Emergency departments (EDs) and intensive care units (ICUs) have borne the brunt of these changes, serving as critical points of care during surges in COVID-19 cases.[7] Lockdown measures, implemented globally to curb the spread of the virus, have further influenced healthcare utilization patterns, including a marked reduction in

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non-COVID-related ED visits and shifts in ICU admission rate.[6,8]

In Türkiye, the effects of the COVID-19 pandemic on healthcare usage remain underexplored, particularly in the context of ED and ICU utilization during different pandemic waves and lockdown periods. Understanding these trends is essential for optimizing resource allocation, planning for future healthcare crises, and ensuring patient safety during public health emergencies.

This retrospective study aims to analyze ED visit volumes and ICU admission rates in Türkiye from 2019 to 2022, focusing on COVID-19 and non-COVID-related patterns during pandemic waves and lockdown periods. By leveraging Bayesian Structural Time Series (BSTS) methodology, we aim to provide robust causal inferences on the impact of these interventions on healthcare utilization.

2. Materials and Methods

This study was approved by the Eskişehir Education and Training Hospital of Medicine Non-Interventional Clinical Research Ethics Committee (Date: 15.02.2023; Decision No: ESH/GOEK 2023/5). All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

After obtaining ethics committee approval, the monthly number of non-COVID-19 and COVID-19 emergency department visits and intensive care admissions were retrospectively recorded between October 2019 and January 2022. The peak periods of the COVID-19 waves, as identified by the Ministry of Health of the Republic of Türkiye, were specifically noted and analyzed. According to the ministry's official data, the first wave occurred during March–May 2020, the second wave during September–November 2020, and the third wave during March–May 2021.[9]

The lockdown periods enforced by the Ministry of Internal Affairs of the Republic of Türkiye were determined based on official announcements.[10] The first major lockdown was implemented in May 2020, and the second in December 2020. The effects of these periods on emergency department visits and intensive care admissions were analyzed.

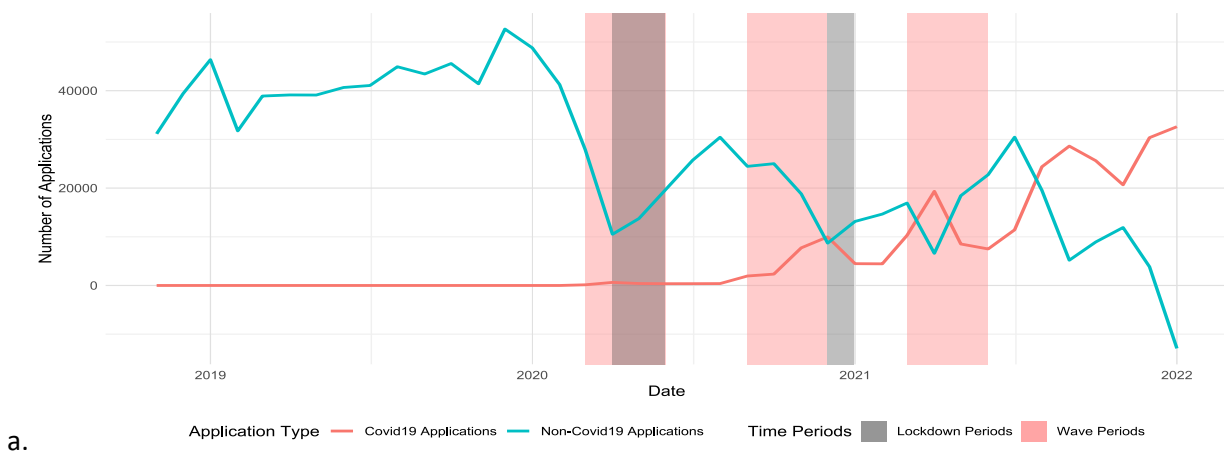
The number of non-COVID-19 emergency department visits in 2019, prior to the pandemic, was compared with the corresponding months in 2020 and 2021. During the pandemic, total emergency department visits were categorized into COVID-19 and non-COVID-19 groups for analysis.

2.1. Statistical Analysis:

The Bayesian Structural Time Series (BSTS) methodology was employed for causal inference, particularly in the absence of randomized controlled trials. This method constructs counterfactuals using state-space time series models to estimate the causal impact of interventions. Pre-intervention data of the target metric were integrated with control series unaffected by the intervention, leveraging their predictive value.

Figure 1

Monthly time series graphics between 2019-2022
a) COVID 19 and NON-COVID 19 emergency department applications b) Intensive care admission rate



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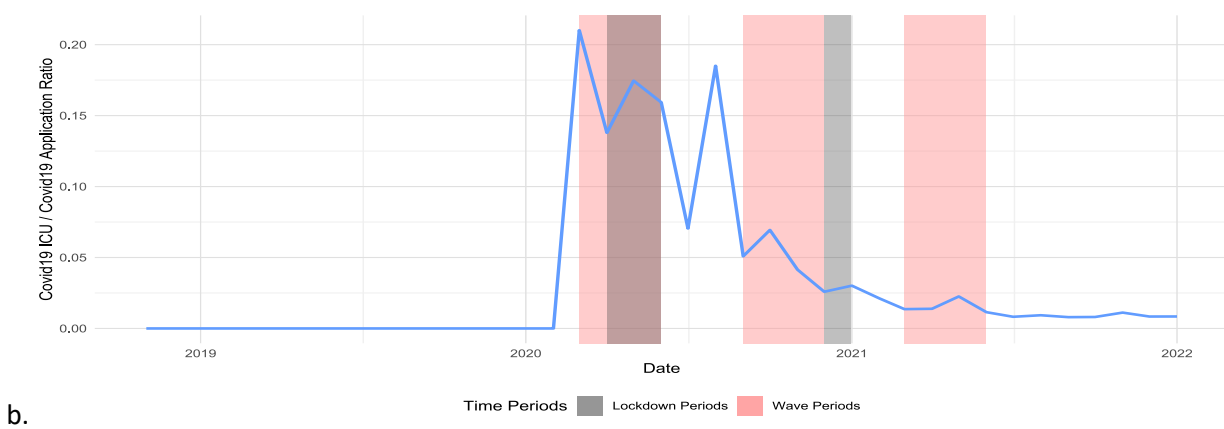

b.

Table 1

Posterior inference on the impact of the COVID 19 ICU admission

	May 2020		December 2020	
	Average	Cumulative	Average	Cumulative
Actual	0.13	0.64	0.013	0.174
Prediction (s.d.)	0.0096 (0.031)	0.0482 (0.155)	0.043 (0.024)	0.556 (0.312)
95% CI	[-0.051, 0.071]	[-0.253, 0.357]	[-0.0045, 0.09]	[-0.0583, 1.18]
Absolute effect (s.d.)	0.12 (0.031)	0.59 (0.155)	-0.029 (0.024)	-0.381 (0.312)
95% CI	[0.057, 0.18]	[0.284, 0.89]	[-0.077, 0.018]	[-1.001, 0.233]
Relative effect (s.d.)	568% (347410%)	568% (347410%)	-75% (4175%)	-75% (4175%)
95% CI	[-6541%, 6235%]	[-6541%, 6235%]	[-214%, 115%]	[-214%, 115%]
Posterior tail-area probability p	0.00029		0.10771	
Posterior prob. of a casual effect	99.9712%		89%	

The BSTS framework incorporates a local-level random walk model and a regression component with static or dynamic coefficients, facilitating robust predictions. Predictor selection was optimized using a spike-and-slab prior, enabling efficient identification of relevant variables from large datasets. Causal effects were estimated using Markov Chain Monte Carlo (MCMC) sampling, which provided probabilistic estimates of intervention impacts.

Compared to traditional methods, BSTS excels in accounting for uncertainty, trends, seasonality, and automated covariate selection. It is a robust and flexible tool for causal inference in complex medical scenarios.[11]

According to this method, a statistically significant decrease in a post-lockdown series, or no significant difference between pre- and post-lockdown periods, indicates the effectiveness of the lockdown. A p-value < 0.05 was considered statistically significant.

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3. Results

A significant decrease in non-COVID-19 emergency department visits was observed during the pandemic compared to pre-pandemic years (p=0.00075). In contrast, intensive care admissions were significantly higher during the first wave of the pandemic but gradually declined in subsequent months. The monthly time series analysis of emergency department visits and intensive care admissions is presented in **Figure 1**.

The findings for the first and second lockdown periods are detailed in **Table 1**.

During the first major lockdown, no statistically significant change was observed in COVID-19 emergency department visits (p=0.09358), while a significant decrease was noted in non-COVID-19 emergency department visits (p=0.00084). Intensive care unit (ICU) admissions, on the other hand, increased significantly (p=0.00029). The average COVID-19 ICU admission ratio during the post-lockdown period was approximately 0.13, compared to an expected response of 0.0096 in the absence of intervention (95% interval: [-0.051, 0.071]). The estimated causal effect was 0.12 (95% interval: [0.057, 0.18]), with a p-value of 0.00029, indicating that the first lockdown did not reduce COVID-19 ICU admissions. These results are detailed in **Figure 2**.

During the second major lockdown, a statistically significant increase was observed in the rate of COVID-19 emergency department visits (p=0.000001), whereas non-COVID-19 emergency department visits showed a significant decrease (p=0.00019). ICU admissions exhibited a numerical decrease, but this change was not statistically significant (p=0.10771). The average COVID-19 ICU admission ratio during the post-lockdown period was approximately 0.013, while the expected response without intervention was 0.043 (95% interval: [-0.0045, 0.090]). The estimated causal effect was -0.029 (95% interval: [-0.077, 0.018]), with a non-significant p-value of 0.10771. These results suggest that the second lockdown had a positive effect on reducing COVID-19 ICU admissions, as the increase observed prior to the lockdown did not continue. Detailed results for this period are shown in **Figure 3**.

Figure 2

Causal impact analysis for COVID-19 ICU admissions: model results for the effects of the first major lockdown (May 2020)

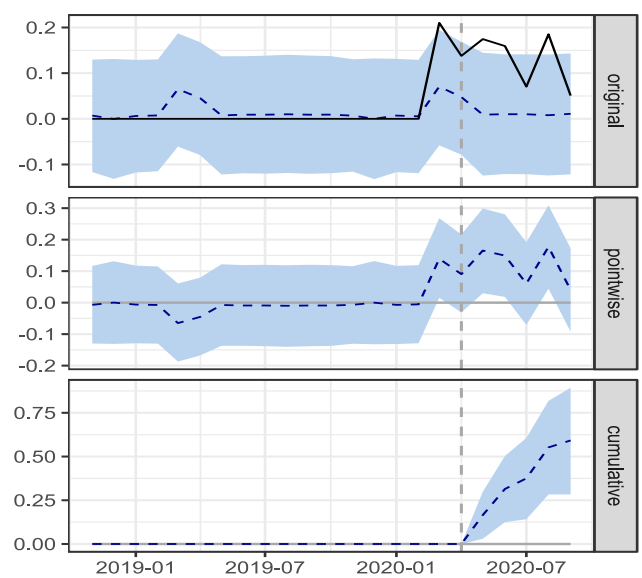
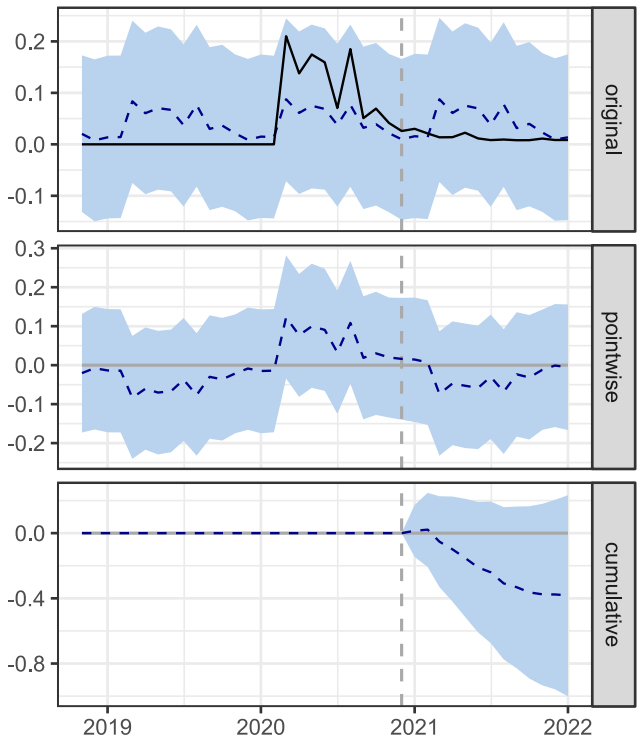


Figure 3

Causal impact analysis for COVID19 ICU admissions: model results for the effects of the second major lockdown



4. Discussion

Our study provides valuable insights into the impact of the COVID-19 pandemic on emergency department (ED) utilization and intensive care unit (ICU) admissions in Turkey. We observed a significant reduction in non-COVID-19 ED visits during curfew periods, which aligns with findings from other studies conducted globally. However, despite this decrease, ICU admission rates did not show a statistically significant decline during these periods, emphasizing the critical care demands imposed by the pandemic.

The reduction in non-COVID-19 ED visits can likely be attributed to factors such as fear of infection, government-imposed curfews, and public health policies encouraging individuals to delay or avoid seeking care unless absolutely necessary. This finding aligns with international reports, including studies from Canada (Rennert-May E), the Netherlands (Djik R), and Thailand (Yorsaeng R), which observed comparable reductions in ED utilization during lockdowns, attributed to patient hesitancy and alterations in healthcare-seeking behaviors.[12-14] A study conducted in Alberta, Canada, parallel to our study, examined changes in hospitalizations and ED visits before and after the implementation of public health measures during the COVID-19 pandemic, highlighting significant reductions in non-COVID ED visits and shifts in healthcare utilization patterns, likely due to delayed care or changes in patient behavior during lockdowns.[12] A large-scale observational study from three hospitals in the Netherlands focused on ED use during the first and second COVID-19 waves of the pandemic. They examined changes and rates in patient volumes, urgency classifications, and hospitalizations. The study attributed the reductions in ED visits in part to public health messaging and quarantine measures.[13] In our study, there were also significant decreases in non-COVID emergency room visits. We believe that the reasons for this are fear of infection, curfews and health policies.

A study from Thailand, while discussing the decrease in emergency room visits during quarantines, noted increases in ICU admissions and suggested that there were delays in presentation or care seeking behaviors for serious conditions during the restrictions. This study is consistent with our data.[14] In our study, although emergency room visits decreased, especially during quarantine periods, there was no actual decrease in seriously ill patients. ICU admissions did not change significantly. These decreases, while reducing ED crowding, may have delayed care for patients with critical non-COVID-19 conditions, leading to potential long-term health consequences.

Interestingly, while ED visits declined, ICU admissions during certain periods either remained stable or increased, as observed during the first major lockdown in our study. This trend highlights the challenges of managing healthcare resources during a pandemic, where balancing the care needs of COVID-19 and non-COVID-19 patients becomes increasingly complex. A detailed examination of the ICU admissions ratio using advanced causal inference methods, such as the Bayesian Structural Time Series (BSTS) model, has strengthened the reliability of our findings, providing a robust framework for evaluating intervention impacts.

Another important aspect of our findings is the shift in healthcare-seeking behavior, particularly in relation to inappropriate ED visits. In Turkey, ED overcrowding due to inappropriate visits is a well-documented issue, often driven by patients seeking faster service, quicker diagnostic results, or bypassing appointment delays in outpatient clinics. The COVID-19 pandemic significantly reduced these inappropriate visits, particularly among low-acuity (green area) cases, as supported by national and international studies.[4,6,8] This period underscores the potential for public health crises to reshape healthcare utilization patterns, offering insights into how effective patient education and streamlined triage systems can optimize ED use in the future.

Additionally, our study highlighted the crucial role of triage systems in managing ED workflow during the pandemic. In ideal conditions, triage systems direct patients to appropriate care levels based on urgency, yet variations in sociocultural factors, age, and regional differences can influence healthcare-seeking behavior. This discrepancy underscores the need for public awareness campaigns to educate individuals on appropriate ED usage and to promote primary care as a viable alternative for non-emergent issues. Studies from Turkey and other countries corroborate this need, highlighting the benefits of reducing inappropriate ED visits through targeted interventions.[15-18]

The COVID-19 pandemic also prompted significant shifts in healthcare policy and practice. The rapid adoption of telemedicine, enhanced community-based care, and increased reliance on primary care providers for managing stable COVID-19 cases demonstrate the healthcare system's adaptability during crises. These innovations, though born out of necessity, offer valuable lessons for addressing future public health emergencies, ensuring equitable access to care, and alleviating pressure on hospital-based services.[19]

Lastly, our findings suggest that the decreases in red and yellow area admissions during lockdown periods were partially influenced by external factors such as reduced traffic and decreased trauma cases due to limited mobility. However, the stable ICU admission rates indicate that critical care demands persisted, reinforcing the importance of maintaining robust ICU capacity during pandemics.

Future research should explore the long-term effects of delayed care for non-COVID-19 conditions and evaluate the effectiveness of policies aimed at optimizing healthcare delivery during crises. This includes refining triage systems, expanding public health education, and leveraging data-driven tools like BSTS models to guide

healthcare planning and decision-making.

4.1. Limitations of study

This study has several limitations that should be acknowledged. One of the primary limitations is the classification of emergency department visits into only two categories: COVID-19 and non-COVID-19 cases. While this approach provides a broad understanding of the pandemic's impact, it may overlook important nuances in patient presentations. A more detailed stratification of emergency department visits, such as categorizing patients based on triage levels (green, yellow, and red zones), could have provided a more granular understanding of the effects of the pandemic on emergency healthcare utilization. This would have allowed for a clearer assessment of the severity of conditions and better insights into how different acuity levels were affected during lockdown and non-lockdown periods.

Additionally, as this study relies on retrospective data, it is subject to inherent limitations such as the accuracy and completeness of medical records. Factors such as variations in triage protocols, changes in healthcare-seeking behavior, and potential underreporting during the pandemic could also influence the findings. Future studies incorporating real-time data collection and more detailed patient categorization could yield more robust and actionable insights.

5. Conclusion

This study highlights the significant impact of COVID-19 waves and lockdown measures on healthcare utilization in Turkey, with a marked reduction in non-COVID-19 emergency department visits and fluctuating ICU admissions. The findings underscore the need for adaptive healthcare strategies to address the dual burden of pandemic and non-pandemic care demands. Using Bayesian Structural Time Series methodology, this analysis provides a robust framework for evaluating interventions, offering valuable insights for optimizing resource allocation during future public health crises. Further research is warranted to explore the long-term consequences of these trends and improve resilience in healthcare systems.

Statement of ethics

This study was approved by the Eskişehir Education and Training Hospital of Medicine Non-Interventional Clinical Research Ethics Committee (Date: 15.02.2023 Decision No: ESH/GOEK 2023/5). All procedures were performed according to the ethical rules and principles of the Declaration of Helsinki.

Source of Finance

The authors declare that they have received no financial support for this study

Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

Author contributions

All authors reviewed the results and approved the final version of the manuscript.

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