Interrupted time series analysis of the impact of COVID-19 on emergency and elective surgeries in Iranian hospitals

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Abstract

Background: Emergency and elective surgeries are vital for saving lives and enhancing patient wellbeing. However, COVID-19 pandemic disrupted the provision of surgical services in Iranian hospitals and globally.

Aim: To investigate the impact of COVID-19 pandemic on emergency and elective surgical care in Iranian hospitals.

Methods: Using an interrupted time series analysis, we evaluated the impact of the COVID-19 pandemic on emergency and elective surgeries in western Islamic Republic of Iran between January 2017 and December 2023, using February 2020 as the intervention point. We analysed the data with R software Version 4.3.2 and used a segmented regression model to analyse the pre- and post-COVID-19 trends, ensuring the reliability of results by using Durbin-Watson statistic and auto-correction techniques. $P < 0.05$ was considered statistically significant.

Results: Pre-pandemic, the mean monthly number of emergency surgeries was 258.9. Due to the pandemic there was a significant decrease by 359.6; however, we observed a gradual recovery in surgical activity with an average increase of 15.8 surgeries above the pre-pandemic levels. The mean monthly number of elective surgeries before the pandemic was 199.5. After the onset of the pandemic, we found a significant decrease of 85.37, although there was a gradual recovery over time.

Conclusion: The COVID-19 pandemic significantly impacted surgical services in Iranian hospitals, causing a reallocation of resources to COVID-19 care and postponement of non-urgent surgeries. There is a need for strategic planning and policy interventions to ensure continuity of surgical care during health emergencies.

Keywords: COVID-19, interrupted time series, emergency surgery, elective surgery, health emergency, health policy, Iran

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Background

Surgical services are a fundamental component of global healthcare systems. They are used to address a broad spectrum of medical conditions, from life-saving emergency interventions to elective procedures designed to enhance the quality-of-life of patients *(1)*. However, the COVID-19 pandemic caused unparalleled disruptions in healthcare systems worldwide *(2)*. As healthcare facilities struggled to manage the influx of COVID-19 cases, there was a significant reallocation of resources and priorities, with profound implications for surgical services *(3)*.

The impact of the COVID-19 pandemic on surgical care has been complex and multifaceted. Hospitals encountered challenges in maintaining sufficient staffing, resources and infrastructure to continue providing surgical care amidst the crisis *(4)*. Public health measures such as lockdowns, travel restrictions and the redeployment of healthcare personnel to COVID-19 response led to the postponement or cancellation of elective surgeries *(5)*, and concerns about viral transmission in healthcare settings made patients to delay seeking surgical care unless necessary, further intensifying the pressure on surgical services *(6)*.

Like many other countries, Islamic Republic of Iran faced unique challenges and healthcare system dynamics during the pandemic *(7)*. Gaining insights into how hospitals managed the disruptions caused by COVID-19 and evaluating the implications for surgical care will provide vital information for healthcare policy, resource allocation and preparedness *(8)*. Investigating the impact of COVID-19 on surgeries in Iranian hospitals can provide insights into the effectiveness of pandemic response measures implemented within the Iranian healthcare system *(9,10)*. It can reveal the vulnerabilities in surgical care delivery and highlight areas for improvement to enhance resilience against future healthcare crises.

Lorestan Province, located in western Islamic Republic of Iran, has 12 cities and a population of approximately

1 680 000 people. The Lorestan University of Medical Sciences (LUMS) is responsible for delivering primary health care (PHC) and medical care in public hospitals across the province *(11)*. PHC services are provided free, while hospital and specialized treatments are billed according to government tariffs. Lorestan Province has 21 public hospitals and one private hospital *(7)*. During the COVID-19 pandemic, the province had 2440 hospital beds, with 2279 of these allocated for COVID-19 patients. Since the onset of the pandemic, around 850 000 people have been infected in Lorestan Province and approximately 2982 have died. This study investigated the impact of COVID-19 on elective and emergency surgeries in public hospitals in the province.

Methods

Ethics approval and data protection

Data for this study were collected in collaboration with Lorestan University of Medical Sciences, with strict adherence to ethics guidelines, data protection standards and patient privacy considerations. Access to the data was granted only to authorized researchers following approval from the Ethics Committee of Lorestan University of Medical Sciences (approval code: IR.LUMS. REC.1399.083). All patient data were anonymized and confidentiality was maintained throughout the study, ensuring compliance with institutional and national guidelines.

Study design

This study used an interrupted time series analysis (ITSA) design to evaluate the impact of the COVID-19 pandemic on emergency and elective surgeries in Iranian hospitals located in western Islamic Republic of Iran. ITSA enables researchers to assess the effects of an intervention or external event on a specific outcome of interest over time *(12)*. In public health and healthcare studies, researchers frequently need to evaluate the impact of policy change, intervention or natural event (such as the COVID-19 pandemic) on health outcomes *(11)*. ITSA is a versatile design that can accommodate various types of interventions, including abrupt changes (e.g. policy implementation, natural disaster) and gradual changes (e.g. implementation of public health campaigns, gradual policy rollouts) *(13,14)*.

Data collection

LUMS, the primary authority and provider of health care services in Lorestan Province, western region of Islamic Republic of Iran, provided the data for this study. The data were extracted from the health information system managed by the university's treatment vice-chancellor. We collected monthly records detailing the number of emergency and elective surgeries performed in hospitals across the province from January 2017 to December 2023. The intervention point, signifying the onset of the COVID-19 pandemic, was defined as February 2020, aligning with the first confirmed cases of COVID-19 in Islamic Republic of Iran. We had access to data from public hospitals only, we were unable to obtain data from the sole private hospital in the province due to restrictions on sharing patient information.

Statistical analysis

We used a segmented regression model to estimate the pre-COVID-19 trend of surgical volumes and to identify any immediate and sustained changes in the trend following the intervention point, which was the onset of the COVID-19 pandemic *(15)*. We used ordinary least squares regression to delineate the pre-COVID-19 trends of surgical volumes, thus facilitating estimation of the baseline trend before the emergence of the pandemic *(16)*. We assessed the effect of COVID-19, denoting the immediate change in surgical volumes after the onset of the pandemic, by incorporating an indicator variable for the post-COVID-19 period (February 2020 onwards) into the regression model. This allowed quantification of the immediate impact of COVID-19 on surgical volumes. We examined the sustained effect of the pandemic on surgical volumes by integrating a time trend variable for the post-COVID-19 period into the model. This adjustment enabled the estimation of any continuous changes in surgical volumes beyond the immediate impact of the pandemic, capturing the longer-term implications on surgical practices *(17)*. To ensure validity of the results and mitigate potential biases, we used the Durbin-Watson statistic, along with auto-correction techniques, to enhance the reliability of the estimated parameters and reduce the likelihood of spurious correlations *(16,18)*. We used R software version 4.3.2 to analyse the data. $P < 0.05$ was considered statistically significant.

Results

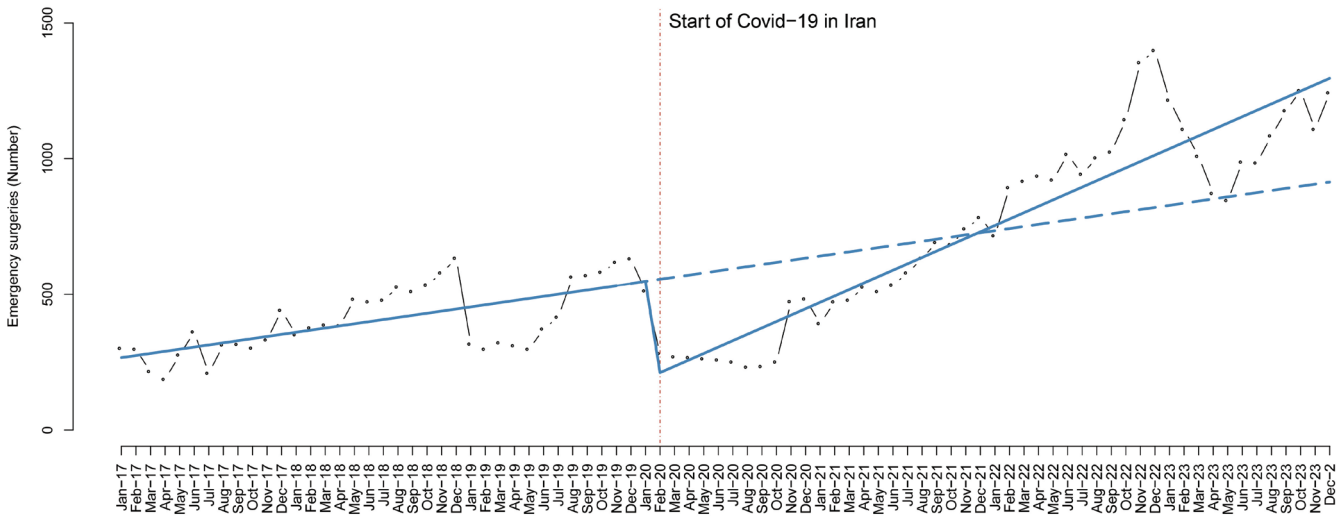
Emergency surgeries

Before the pandemic, the mean number of emergency surgeries was 258.88, representing the baseline for surgical activity. The baseline trend indicated a mean rate of change of 7.79 surgeries over time. However, following the onset of the pandemic, there was a significant decrease in emergency surgeries, with a level change of -359.64. The post-intervention trend change was positive at 15.78, suggesting a gradual recovery in surgical activity that exceeded pre-pandemic levels. Figure 1 and Table 1 show these findings.

Elective surgeries

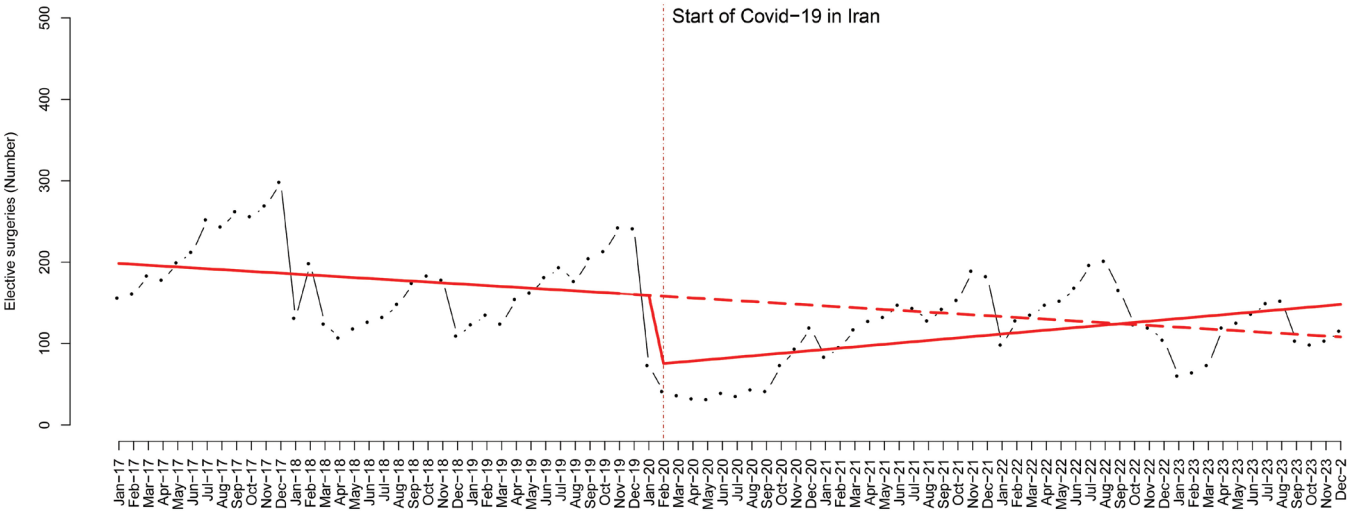
Before the pandemic, the mean monthly number of elective surgeries was 199.52. The baseline trend value of -1.08 suggests a declining trend in elective surgeries before the pandemic. After the onset of the pandemic, there was an immediate decrease in elective surgeries, with a level change of -85.37, indicating a significant reduction. However, there are indications of gradual recovery or adaptation over time, as shown by the

Figure 1. Change-points and interrupted time series analysis of emergency surgeries



The blue line represents the segmented regression models

Figure 2. Change-points and interrupted time series analysis of elective surgeries



The red line represents the segmented regression models

Table 1. Interrupted time series analysis of the impact of COVID-19 on emergency surgeries

Parameter	Coefficient	95% CI		Standard error	*P* value
Intercept	258.88	180.42	337.33	39.42	0.27
Baseline trend	7.79	4.19	11.39	1.80	0.31
Level change after the intervention	-359.64	-462.00	-257.27	51.43	0.05
Trend change after the intervention	15.78	11.39	20.17	2.20	0.10

Lag = 1; Auto correction = 0.73; D-W Statistic = 0.53

Table 2. Interrupted time series analysis of the impact of COVID-19 on elective surgeries

Parameter	Coefficient	95% CI		Standard error	*P* value
Intercept	199.52	168.21	230.84	15.73	0.36
Baseline trend	-1.08	-2.52	0.34	0.72	0.19
Level change after the intervention	-85.37	-126.24	-44.51	20.53	0.02
Trend change after the intervention	2.66	0.91	4.41	0.88	0.71

Lag = 1; Auto correction = 0.68; D-W Statistic = 0.61

Figure 3. Trends in the impact of COVID-19 on the number of trauma and non-trauma surgeries

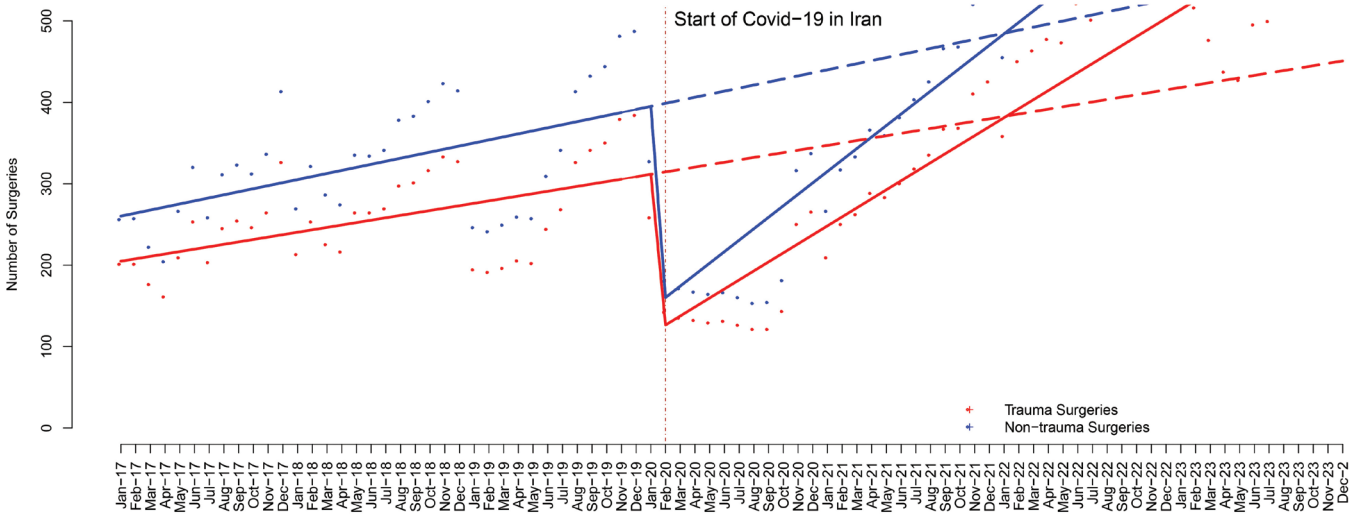


Figure 4. Trends in the impact of COVID-19 on elective surgeries, categorized by minor, moderate and major procedures

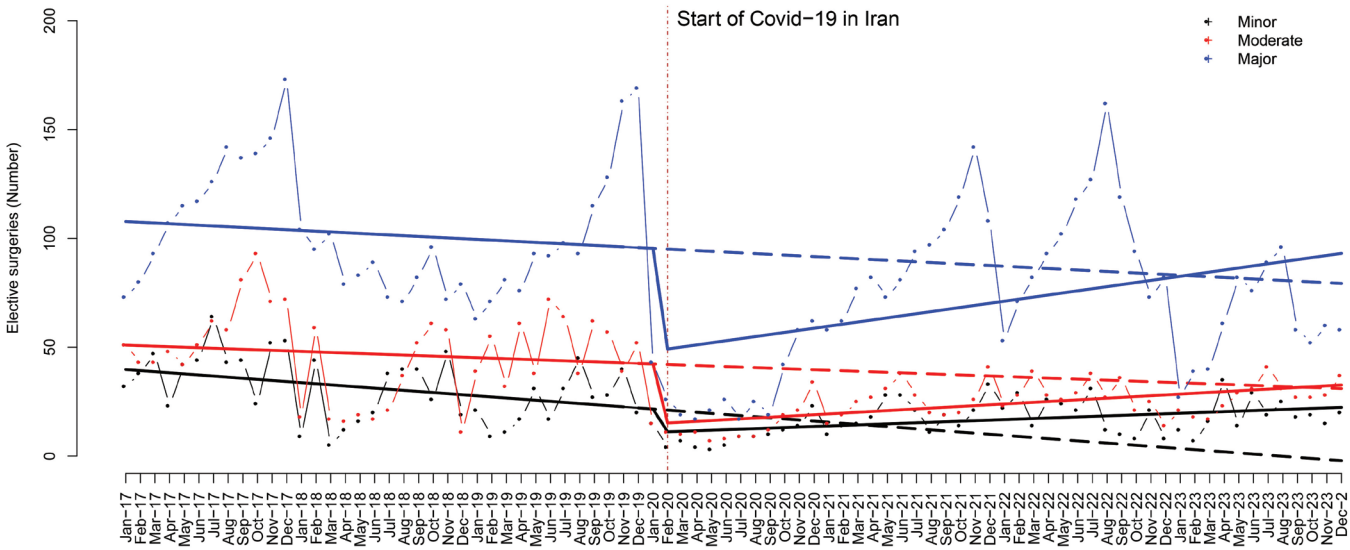


Table 3. Interrupted time series analysis of the impact of COVID-19 on elective surgeries, categorized by minor, moderate and major procedures

Categories of elective surgeries	Coefficient	95% CI		Standard error	*P* value
Minor					
Intercept	40.26	33.04	47.47	3.62	0.00
Baseline trend	-0.50	-0.83	-0.17	0.16	0.00
Level change after the intervention	-10.70	-20.11	-1.29	4.72	0.02
Trend change after the intervention	0.74	0.34	1.15	0.20	0.00
Moderate					
Intercept	51.18	41.33	61.03	4.95	0.00
Baseline trend	-0.24	-0.69	0.21	0.22	0.29
Level change after the intervention	-27.48	-40.34	-14.63	6.45	0.41
Trend change after the intervention	0.61	0.06	1.17	0.27	0.02
Major					
Intercept	108.08	86.53	129.63	10.82	0.00
Baseline trend	-0.34	-1.33	0.64	0.49	0.49
Level change after the intervention	-47.18	-75.30	-19.07	14.12	0.00
Trend change after the intervention	1.29	0.09	2.50	0.60	0.03

positive trend change value of 2.66. Figure 2 and Table 2 show these findings.

We assessed the impact of COVID-19 on the number of surgeries for trauma and non-trauma patients (Figure 3). Before the onset of COVID-19, the monthly mean number of surgeries for trauma patients was 327.64. After the onset of COVID-19, the mean decreased significantly to 247.13. For non-trauma patients, the monthly average number of surgeries was 258.24 before the pandemic, and this decreased significantly to 127.18 after onset of the pandemic. Over time, the number of surgeries for trauma and non-trauma patients increased.

We categorized the impact of COVID-19 on elective surgeries into 3: minor, moderate and major or highly specialized (Table 3 and Figure 4). This analysis revealed that before the pandemic, the average number of minor elective surgeries was approximately 40 per time unit, with a significant decreasing trend over time, indicating a gradual reduction in these procedures before the pandemic. The onset of COVID-19 was associated with an immediate decrease of about 10.7 surgeries, reflecting the sudden impact of the pandemic on surgical activities. The post-pandemic trends showed a significant increase of 0.75 surgeries per time unit, suggesting a partial recovery in the number of minor elective surgeries as the healthcare system adapted to the new conditions.

Before the pandemic, the average number of moderate surgeries was approximately 51 per time unit. The trend over time was not statistically significant, indicating that the number of moderate surgeries was relatively stable before the pandemic. However, the onset of COVID-19 led to a significant and immediate reduction of approximately 27.5 surgeries, highlighting the substantial impact of the pandemic on these procedures. Post-pandemic, there was a small but significant recovery trend, with an increase of about 0.62 surgeries per time unit, suggesting a gradual rebound in moderate surgical volumes as the healthcare system adapted.

Before the pandemic, the mean number of major surgeries was around 108 per time unit, with no significant pre-pandemic trend, indicating stability in the number of these surgeries over time. The onset of the pandemic, however, caused an immediate substantial and statistically significant reduction of approximately 47.2 surgeries, reflecting the severe impact on the availability and scheduling of major surgeries. Following this initial decline, there was a modest but significant recovery trend, with an increase of about 1.3 surgeries per time unit, suggesting that some level of normalcy was gradually restored as the healthcare system adapted to pandemic conditions.

With a lag of 1 observed across both emergency and elective surgeries, indicating a one-time period delay between COVID-19-related factors and subsequent surgical trends, it became evident that the pandemic had caused changes in surgical patterns with a consistent temporal pattern. The autocorrelation values of 0.73 for emergency surgeries and 0.68 for elective surgeries indicate significant relationships between consecutive observations within each category, suggesting a degree of predictability in surgical trends over time. However, the Durbin-Watson statistics of 0.53 for emergency surgeries and 0.61 for elective surgeries highlighted the persistence of positive autocorrelation in the residuals, indicating potential unaccounted factors or trends influencing surgical data not captured by the current model.

Discussion

The findings of our study show that the COVID-19 pandemic significantly influenced the frequency of

emergency and elective surgeries, with a resulting decrease in procedures. With the emergence of COVID-19, the Iranian health system found itself in an exigent situation, which made it to reallocate all healthcare resources towards the prevention and control of COVID-19 *(19)*. Hospitals were obligated to reallocate resources, including staff, equipment and facilities to the management of COVID-19 patients *(11)*.

This immediate and substantial reduction in emergency and elective surgeries in Islamic Republic of Iran, following the onset of the pandemic, is consistent with findings from analogous studies conducted in other countries *(20-22)*. A study in Singapore reported that elective surgeries were significantly reduced after the onset of COVID-19, primarily due to the traffic restriction policies *(23)*. A study in Brazil found that COVID-19 pandemic disrupted the Brazilian healthcare system, leading to the postponement of many medical procedures *(24)*. This was due to various factors, including the reallocation of resources to COVID-19 care, fear of infection, economic uncertainties, and quarantine measures. These factors especially impacted individuals who had financial challenges, those who lost their jobs or those who had concerns about future income reductions, causing them to delay elective surgeries *(25)*. Another study conducted across 10 countries reported that approximately 28.4 million surgeries were cancelled due to the pressure on health services, based on demographic characteristics, or government actions *(24)*. Governments had recommended cancelling elective surgeries due to severe limitations in service delivery, aligning with our study's findings *(26-28)*. Burnout among health care providers, caused by long working hours, sleep deprivation, fatigue and the risk of infection, made them reluctant to perform elective surgeries *(29)*.

Regarding emergency surgeries, the findings of our study were consistent with those conducted in other countries *(27,29)*. In these studies, prioritization of more critical and more urgent surgeries, such as those for cancer patients or patients with severe trauma, led to a decrease in emergency surgeries *(25,30)*. The dangerous nature of COVID-19, the increased focus of health systems on providing services to COVID-19 patients, and efforts to reduce spread of the virus all contributed to this decrease *(28)*. A multitude of factors, such as resource reallocation, patient safety concerns, staff shortages, patient prioritization, government regulations, capacity constraints, and the implementation of public health measures such as quarantine and physical distancing in Islamic Republic of Iran, as in many other countries, contributed to a decrease in certain health care services, including emergency or elective surgeries *(3,21,31)*. Our findings corroborate existing literature documenting the disruptive impact of COVID-19 on surgical services globally *(31,32)*. However, unique contextual factors, such as healthcare infrastructure, pandemic response strategies and patient demographics, may have influenced the magnitude and duration of these effects *(33,34)*.

In Islamic Republic of Iran, hospitals reallocated resources to managing COVID-19 cases, leading to a reduction in surgical capacities. The fear of contracting COVID-19 in hospitals was also one of the primary reasons for this reduction, as well as the use of hospital resources and healthcare staff in emergency departments. The prioritization of COVID-19 patients and those with urgent medical needs over less urgent emergency surgeries resulted in significant reduction of hospital revenues, further limiting available resources for surgeries. Some non-urgent emergency surgeries were also restricted by government policies, laws and regulations that aimed to conserve available resources and reduce the risk of COVID-19 transmission *(35)*.

The increasing prevalence and number of COVID-19 patients caused capacity constraints in hospitals, leading to a reduction of activities in some operating rooms (36). On the other hand, quarantine and physical distancing caused a decrease in accidents and traumatic injuries, reducing the need for emergency trauma surgeries *(37)*.

Our categorization of elective surgeries as minor, moderate and major revealed distinct patterns that highlight the pandemic's varying impact on health care services. Other studies have shown similar decreasing patterns in minor, moderate and major surgeries and the importance of continuing to provide surgical services during a pandemic *(38-40)*. The significant decrease in minor elective surgeries pre-pandemic may be a reflection of the changes in health care practices, such as the adoption of non-surgical treatment, changes in patient preferences and the use of less invasive procedures *(41)*. The increase in emergency and elective surgeries post-pandemic suggests a relative recovery as healthcare systems adapted. The pre-pandemic stability in the number of major surgeries highlights their essential nature and the healthcare infrastructure required to support them *(29)*. However, the sharp decrease in both minor and major surgeries at the onset of the pandemic shows the severe strain on hospital resources, with priorities shifting toward critical care and life-saving treatments *(20)*. These findings highlight the need for healthcare systems to develop more robust strategies for managing elective surgeries during future public health crises *(42)*.

The differential impact on minor, moderate and major surgeries suggests that a one-size-fits-all approach may not be effective. Instead, tailored strategies that consider the urgency, resource requirements and patient outcomes associated with each category of surgery are necessary *(43)*. The slow recovery trends observed in all categories suggest that healthcare systems need to focus on optimizing resources, reducing surgical backlogs and addressing patient concerns to fully restore elective surgical services *(38)*.

Hospitals prioritized resources for COVID-19 care, leading to the postponement or cancellation of elective surgeries. Since the costs of elective surgeries in public hospitals are minimal, many physicians and patients postponed these surgeries due to fear of contracting

COVID-19 and to minimize the risk of transmission within hospitals *(44)*. The Ministry of Health instructed hospitals to delay elective surgeries and prioritize COVID-19 treatment and urgent need for medical care over elective surgeries. Shortages in the supply chain of equipment and medical supplies in the early months of the COVID-19 onset affected the ability of hospitals to perform elective surgeries, with priority given to securing personal protective equipment for emergency surgeries *(11,45)*.

Key lessons and recommendations

To mitigate the impact of future pandemics on surgical services, healthcare infrastructure should be strengthened to ensure that essential services, such as surgeries, can continue uninterrupted during crises. This includes investing in hospital surge capacity and developing protocols for reallocating resources during emergencies. Healthcare systems should develop flexible resource allocation frameworks that can balance pandemic response with the continuity of critical services. Telemedicine can play a crucial role in managing pre-operative consultations and post-operative follow-ups. It reduces the need for in-person visits and can help alleviate hospital congestion during future pandemics or crises. Expanding telemedicine platforms will enable health care providers to maintain surgical services while reducing the risk of infection transmission. Healthcare systems should develop clear priority-setting frameworks to guide decision-making during pandemics or other large-scale emergencies. Triage protocols should prioritize emergency and life-saving surgeries while deferring non-urgent cases in a systematic and transparent manner. These protocols will help ensure that resources are used efficiently, even in times of crisis. We recommend continuous training and education for surgical teams to enhance their adaptability during emergencies. Such training should include infection control and management of remote consultations and triage. Investment in surgical education will prepare healthcare workers for future pandemics, ensuring that they can deliver high-quality care in a rapidly changing environment.

Key strengths and limitations of the study

The main strength of our study lies in its comprehensive analysis of surgical trends across multiple hospitals in Lorestan Province during the pandemic. The use of retrospective hospital data allows for an accurate depiction of the impact of the pandemic on surgical services, and the categorization of surgeries into emergency, elective, major, and minor provides an understanding of how different types of surgeries were affected. The use of time-series analysis, controlling for factors such as seasonality and hospital capacity, adds to the rigour of the study.

Although this study provides valuable insights into the impact of the pandemic on surgical services in Islamic Republic of Iran, it is not without limitations. The data is limited to hospitals in Lorestan Province, which may not fully represent the broader national context. Although we controlled for seasonality and hospital capacity, other factors such as the availability of healthcare workers and specific regional policies may have influenced the surgical volumes. Future research could expand this analysis to include a broader range of hospitals and explore the long-term effects of the pandemic on surgical outcomes.

To address the limitations of our study, we implemented several strategies to improve data accuracy and analysis rigour. These included using robust statistical techniques such as segmented regression with correction mechanisms to account for autocorrelation and validation through Durbin-Watson tests. The use of R software for data analysis ensured precision and reproducibility, and the collaboration with Lorestan University of Medical Sciences facilitated comprehensive data collection despite certain constraints.

Conclusion

The COVID-19 pandemic has significantly impacted surgical services in Iranian hospitals, causing notable reductions in emergency and elective surgeries. The immediate response to the pandemic, including reallocation of resources and prioritization of COVID-19 care necessitated the postponement or cancellation of non-urgent surgeries. Iranian hospitals demonstrated adaptability in reallocating resources and reprioritizing surgical procedures to address the crisis effectively, however, the sustained decrease in surgical volumes highlight the continuous challenges faced by healthcare systems in maintaining regular surgical services during health emergencies. Our study highlights the importance of maintaining essential surgical care during public health emergencies. Further research and strategic measures are needed to ensure continuity of services and enhance resilience of healthcare systems during such crises.

Funding: None.

Competing interests: None declared.

Évaluation de l'impact de la COVID-19 sur les interventions chirurgicales d'urgence et programmées dans les hôpitaux iraniens à l'aide de l'analyse des séries chronologiques interrompues

Résumé

Contexte : Les interventions chirurgicales d'urgence et programmées sont essentielles pour sauver des vies et améliorer le bien-être des patients. Cependant, la pandémie de COVID-19 a perturbé la prestation de services chirurgicaux dans les hôpitaux iraniens et au niveau mondial.

Objectif : Étudier l'impact de la pandémie de COVID-19 sur les soins chirurgicaux d'urgence et programmés dans les hôpitaux iraniens.

Méthodes : À l'aide d'une analyse de séries chronologiques interrompues, nous avons évalué l'impact de la pandémie de COVID-19 sur les interventions chirurgicales d'urgence et programmées dans l'ouest de la République islamique d'Iran entre janvier 2017 et décembre 2023, en prenant février 2020 comme point de rupture. Nous avons analysé les données à l'aide du logiciel R version 4.3.2 et utilisé un modèle de régression segmentée pour étudier les tendances avant et après la COVID-19, en garantissant la fiabilité des résultats au moyen de la statistique de Durbin-Watson et de techniques d'autocorrection. Une valeur *p* inférieure à 0,05 était considérée comme statistiquement significative.

Résultats : Avant la pandémie, le nombre moyen mensuel d'interventions chirurgicales d'urgence était de 258,9. Une baisse significative de 359,6 a été enregistrée du fait de la pandémie ; cependant, nous avons observé une reprise progressive de l'activité chirurgicale, avec une augmentation moyenne de 15,8 interventions par rapport aux niveaux prépandémiques. En ce qui concerne les interventions chirurgicales programmées, le nombre moyen mensuel était de 199,5 avant la pandémie. Après son début, une diminution marquée de 85,37 a été enregistrée, suivie d'une reprise progressive au fil du temps.

Conclusion : La pandémie de COVID-19 a eu un impact significatif sur les services chirurgicaux dans les hôpitaux iraniens, ce qui a entraîné une réaffectation des ressources aux soins liés à la COVID-19 et le report des interventions chirurgicales non urgentes. Une planification stratégique et des interventions politiques sont nécessaires pour assurer la continuité des soins chirurgicaux dans les situations d'urgence sanitaire.

تحليل السلاسل الزمنية المتقطعة لتأثير كوفيد-19 على الجراحات الطارئة والانتقائية في المستشفيات الإيرانية

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الخلاصة

الخلفية: للجراحات الطارئة والانتقائية أهمية حيوية في إنقاذ الأرواح وتحسين صحة المرضى. ولكن جائحة كوفيد-19 تسببت في تعطيل تقديم الخدمات الجراحية في المستشفيات الإيرانية وعلى مستوى العالم.

الأهداف: هدفت هذه الدراسة الى تقصي تأثير جائحة كوفيد-19 على الرعاية الجراحية الطارئة والانتقائية في المستشفيات الإيرانية.

طرق البحث: استعنَّا بتحليل سلاسل زمنية متقطعة في تقييم تأثير جائحة كوفيد-19 على الجراحات الطارئة والانتقائية في غرب جمهورية إيران الإسلامية في الفترة ما بين يناير/ كانون الثاني 2017 وديسمبر/ كانون الأول 2023، مع اعتبار شهر فبراير/ شباط 2020 نقطة التدخل. حللنا البيانات بالنسخة 4.3.2 من برنامج R، واستخدمنا نموذج انحدار مجزأ لتحليل اتجاهات ما قبل كوفيد-19 وما بعده، مع ضمان موثوقية النتائج باستخدام إحصائية ديربن–واتسون والتصحيح الذاتي. وقد عُدَّت قيمة الاحتمال < 0.05 ذات دلالة إحصائية.

النتائج: بلغ متوسط عدد الجراحات الطارئة قبل الجائحة 258.9، بزيادة قدرها 7.8 بمرور الوقت. وقد شهد هذا المتوسط انخفاضًا كبيرًا بمقدار 359.6 بعد الجائحة، ولكنه زاد لاحقًا بمقدار 15.8 ليتجاوز مستويات ما قبل الجائحة. وأما على صعيد الجراحات الانتقائية، فقد بلغ المتوسط قبل الجائحة 199.5، بانخفاض قدره 1.1. كما حدث انخفاض فوري في متوسط الجراحات الانتقائية بمقدار 85.4 بعد الجائحة، أعقبه انتعاش بوتيرة بطيئة بمقدار 2.66.

الاستنتاجات: أثَّرت جائحة كوفيد-19 تأثيرًا كبيرًا على الخدمات الجراحية في المستشفيات الإيرانية، إذ أدت إلى إعادة تخصيص الموارد وتوجيهها لرعاية مرضى كوفيد-19 وتأجيل الجراحات غير العاجلة. وهناك حاجة ماسة إلى التخطيط الاستراتيجي وتدخلات السياسات لضمان استمرارية الرعاية الجراحية في أثناء الطوارئ الصحية.

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