Bayati *et al. Cost Effectiveness and Resource Allocation* (2025) 23:2
https://doi.org/10.1186/s12962-025-00606-y

Cost Effectiveness and Resource Allocation

RESEARCH Open Access

The effect of Covid-19 pandemic on the primary health care utilization and cost: an interrupted time series analysis

Mohsen Bayati[1], Farhad Lotfi[1], Mehdi Bayati[2] and Zahra Goudarzi[1*]

Abstract

Background Changes in the demand behavior for primary care during the covid-19 pandemic may translate into changes in the overall public health situation in Iran with the increase in the prevalence of non-communicable diseases.

Objective The present study aimed to investigate the impact of the Covid-19 pandemic on the primary health care utilization and cost in Fars province of Iran.

Methods Monthly utilization and cost of primary health care was extracted from the data base of Fars province branch of Iran Health Insurance Organization (IHIO) in Iran. The interrupted time series analysis (ITSA) was used to investigate the short-term and long-term effects of Covid-19 on the utilization and cost of primary health care.

Results The mean difference test showed that the monthly utilization and cost of primary health care after Covid-19 has decreased significantly (64307 for utilization and 11581 US dollars for cost). The ITSA estimates showed that the number of monthly primary health care visits after Covid-19 has decreased significantly by 53,003 in the short term and 2,330 in the long term. Moreover, the cost of primary health care shows a significant decrease of $24,722 and $3,822 per month in the short term and in the long term, respectively.

Conclusion It found a significant reduction in the utilization of primary health care. Considering the role of primary care in controlling the burden of chronic diseases, planning for active follow-up of patients with chronic conditions should be on the agenda.

Keywords Covid-19, Primary health care, Family physician, Utilization, Cost

*Correspondence:
Zahra Goudarzi
jinusgoudarzi93@gmail.com
[1]Health Human Resources Research Center, Department of Health Economics, School of Health Management and Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Student Research Committee, Department of Pediatrics, Jahrom University of Medical Sciences, Jahrom, Iran

Introduction

The Covid-19 pandemic was not only the most challenging and frightening outbreak in the world, but also caused unprecedented stress and pressure on the health systems of countries [1].

What cannot be ignored in the face of the pandemic is the vital role of primary health care services, which can meet over 80% of the health needs of people at any age [2]. Although primary care has formed a key defense line in the face of the Covid-19 crisis, the pandemic has confronted the practice of family physicians with various challenges in prescribing and providing services to patients [3]. At the beginning of the Covid-19 pandemic, the number of patients with chronic diseases who referred to family physicians for periodic checkups decreased [4]. Various factors affected patients' referrals to receive medical services during Covid-19, among these factors were public quarantine, fear of infection, hopelessness, and insufficient and incorrect information received from the mass media [5]. In this regard, some studies indicated that along with the spread of Covid-19, patients' visits to doctors decreased by 30–60% compared to previous years due to the fear of contracting the disease and the restrictions of quarantine [6]. Also, in Japan, 20–25% of outpatients to primary healthcare centers decreased in April 2020 compared to the same month in the previous year [7].

In this situation, most people desired to receive distant medical services or to postpone visiting a doctor. In the meantime, people with chronic diseases such as diabetes, blood pressure, etc. had fewer visits due to the fear of getting infected, which would lead to more severe physical and economic consequences for them in the long term [8]. Baum et al. concluded that a temporary reduction in access to health care for patients with hypertension would be associated with an increase in the incidence of cardiovascular events and mortality [9]. While Osawa et al. showed that only in the first month of the pandemic, referrals decreased and then increased, no significant difference was found in the number of patient referrals to general practitioners (GPs) and the prescribed medicinal items [10].

However, during the Covid-19 pandemic, there were more changes in visits to family physicians for some diseases than others. According to the study by Stephenson et al., visits for chronic diseases and preventive care decreased while they increased for mental disorders [11].

Changes in demand behavior for primary care during a pandemic may translate into changes in the overall public health status of the country. In this regard, some studies confirmed the increase in the number of stroke cases and cardiovascular events during the Covid-19 pandemic [12]. The burden of chronic diseases can increase in all countries, especially the countries with a long history and serious efforts to control the progress of these diseases by using screening programs and early diagnosis [13].

Health care costs of non-communicable diseases are significant and are expected to increase in the coming years, imposing huge costs on individuals, families, businesses, governments, and health systems [14].

Primary healthcare in Iran is a fundamental component of the country's health system, offering essential and accessible health services to its citizens. In this regard, the family physician plays a central role in the healthcare team, overseeing the delivery of services that include training and counseling for disease prevention, as well as helping patients achieve a good level of mental and physical health [15]. The importance of interventions to prevent COVID-19 in primary care lies in their ability to reduce the burden on hospitals, decrease the costs associated with hospitalization, and provide healthcare services. This helps optimize the use of financial resources within the social health system. A recent study revealed that patients with a primary care provider incurred an average annual total cost that was 27.4% lower than those without one [16]. Additionally, another study found that, on average, each extra in-person primary care visit corresponded to a total cost savings of $721 per patient per year [17].

Since there is no sign of complete eradication of Covid-19 yet, and considering the role of primary level healthcare in preventing and reducing the burden of chronic diseases, the present study aimed to investigate the impact of the Covid-19 pandemic on the utilization and cost of primary services provided by family physicians in Iran.

Methods

Data

According to the latest census of the Statistical Center of Iran, Fars province is the fourth province of Iran in terms of population with more than 5 million people and about 1500 family physicians are engaged in providing primary health care services in this province. The research population consisted of all individuals insured by the Iran Health Insurance Organization (IHIO) in Fars Province (The approximate number of people, $n \approx 2{,}700{,}000$, represents 55% of the total population) in 2022 [18]. In this research, the data was extracted at the ecological level and were analyzed in aggregate, so sampling was not performed. The study's perspective was the insurance organization.

Using a researcher developed tool, the required data was extracted from the database of the Fars Province branch of IHIO. The data included the variables related to the cost and utilization of primary health services (visits) by family physicians in health centers, specifically family physicians in Fars province who were General

Practitioners (GPs) that provide primary care services in private and public-sector.

The mentioned variables were collected monthly from the insurance information system of the Fars Health Insurance Organization in two time periods, 23 months before the outbreak of the Covid-19 (April 2018 to February 2020) and 21 months after the outbreak of the Covid-19 in Iran (March 2020 to November 2021). Visit costs were adjusted to 2022 for analysis.

Analysis

After collecting the data, descriptive statistics and the mean difference of cost and utilization before and after the pandemic were used. Then the interrupted time series analysis (ITSA) was used to investigate the short-term and long-term effects of Covid-19 on the visit and cost of primary health care. February 2020, when the pandemic began in Iran, was regarded as a period of interruption. This model is widely used to examine the effects of policies/programs/events in the health sector. Various studies have used ITSA to assess the outcomes of different policies or events in health systems, such as health sector reforms, lockdown, soft drinks industry levy, vaccinations, encouraging natural childbirth program, malaria control program, the COVID-19 pandemic and so on [18–23]. Based on this model, changes in primary health care visits or costs in the first month of the Covid-19 outbreak (changes in models' intercept after Covid-19 compared to before it) are considered short-term effects, and Changes in their monthly trend (specifically, changes in the slope of the regression after COVID-19 compared to before it) are considered long-term effects [24].

In an ITSA, data are collected at several time points before and after an event to determine whether this event had an impact on the level and trend of the data or not. In ITSA, there are two variables that show the effect of a policy or event, one is the level variable that determines the immediate effect of the event, and the other is the trend variable that shows the long-term effects of the event.

In the present study, the following segmental regression model was estimated for to perform ITSA:

Primary care utilization/cost$_t = \beta_0 + \beta_1 T_t + \beta_2 Cov19_t + \beta_3 T_t\ Cov19_t + e_t$

Where the dependent variable is primary care utilization or cost in each month. T shows the time variable since the beginning of the study and Cov19t is a dummy variable that takes the value of zero before and 1 after the pandemic. Tt Cov19t is the interaction term of time and the pandemic, and e_t represent the error term of the model. Moreover, β_0 represents the constant term and β1 represents the primary care utilization or cost trend without considering the Covid-19. Also, β_2 shows the immediate effect (change in level), and β_3 shows the long-term effect (change in trend) of the pandemic on the utilization or cost of primary health care. To convert Iranian Rials to US dollars, the free market dollar rate (1 dollar = 310,000 Rials) was used. Stata15 software was used for data analysis.

Results

The mean difference test indicated that the monthly cost and utilization of primary health care significantly decreased after COVID-19. Specifically, the monthly difference in visits and costs of primary health care before and after the pandemic was approximately $64,307 and $11,581, respectively (Table 1). In Supplementary Table 1, we present the components of our ITSA model, which includes the study months (from April 2018 to November 2021), two main independent variables (primary health care costs and visits each month), a dummy variable for COVID-19 occurrence (0 for before and 1 for after COVID-19), time points from the beginning of the study, and time points after the onset of COVID-19.

The findings from the ITSA showed that although the initial monthly level and trend of primary health care visits were 161,151 and 545, respectively, the number of monthly primary health care visits after COVID-19 significantly decreased by 53,003 in the short term and by 2,330 in the long term. Moreover, the cost of primary health care experienced a significant decrease of $24,722 and $3,822 per month in the short term and long term, respectively (Table 2; Fig. 1). The F-test indicates that the estimated models are significant.

Discussion

The findings showed that the spread of the coronavirus had a significant impact on patients' primary health care visits and the resulting costs in both the short and long term. Specifically, the number of monthly visits provided by family physicians decreased by 53,003 and 2,330 in the short and long term, respectively. Additionally, the

Table 1 Mean difference of monthly primary health care visit and cost before and after Covid-19 pandemic

	Before Covid-19	After Covid-19	*P*-value
Primary care visit	167152.4 (23990.69)	102845.3 (17419.93)	0.0000
Primary care cost	132662.9 (20023.2)	121,081 (15384)	0.0385

() shows standard deviation

Table 2 Effect of Covid-19 pandemic on the primary health care visit and cost using ITSA

	Visit		Cost	
	Coefficient	***P*-value**	**Coefficient**	***P*-value**
Pre covid-19 level	161151.5	0.000	106978.3	0.000
Pre covid-19 trend	545.5326	0.431	2334.963	0.000
Changes in Pre covid-19 level (short term effect)	-53003.71	0.000	-24722.3	0.008
Changes in Pre covid-19 trend (long term effect)	-2330.507	0.018	-3822.871	0.000
Model significance	F = 66.19	0.000	F = 23.74	0.000

costs of patient visits, primarily incurred by health insurance organizations, decreased by $24,722 and $3,822 per month in the short and long term, respectively.

Primary health care is usually the first point of care for people in many countries. Traditional face-to-face consultations enable early assessment and further management of health problems [25]. An important aspect of optimizing any country's pandemic management, such as for COVID-19, is the primary care response. Primary care has been critical in identifying, managing, and monitoring cases of COVID-19 and other non-communicable diseases [26].

With the onset of COVID-19 and the increase in the spread of this disease, the Iranian government took strict actions in March 2020 to protect and support vulnerable populations against the new epidemic. These actions included general quarantine and changes in the activities of medical centers, such as the cancellation of screening programs and the closure of some outpatient clinics. Furthermore, health centers in Iran were ordered to postpone unnecessary medical interventions, including elective surgeries, to preserve medical resources for COVID-19 patients. However, it should be noted that patients with other health problems, especially chronic diseases, needed access to medical care during the COVID-19 pandemic and quarantine period [27]. Additionally, many people refused to visit health centers and family physicians due to fear of infection, resulting in a significant decrease in outpatient visits. Although special departments and hospital units were allocated to COVID-19 patients in Iran for better management, fear of the disease prevailed in society [28].

Considering the limitations, as well as the fear and stress of contracting or transmitting COVID-19, concerns about breaking quarantine measures and the resulting fines, and uncertainty regarding the implementation of social distancing in medical centers, significant changes occurred in the practice of family physicians during the pandemic compared to the same period in 2019. These changes dramatically hindered access to and use of health care services for people with various medical conditions. Similar findings related to the practice of family physicians were reported in a study conducted in Jordan, where more than half of family physicians reported a 50% decrease in patient visits during the quarantine, with most consultations conducted remotely. Furthermore, 69.4% of doctors admitted that at least one patient's condition had worsened during the quarantine due to a lack of or delay in medical care [29]. Such findings are likely to be observed worldwide in areas where full government quarantines were implemented.

A qualitative study conducted on 132 physicians in Finland revealed that patients were less likely to consult their GPs for reasons other than COVID-19 compared to the pre-pandemic period. The GPs acknowledged that care for chronic diseases was largely deferred, and the consequences would become apparent after the pandemic [30]. A retrospective cohort study based on routine primary care data in the UK showed a 50% reduction in first diagnoses of common mental health problems, a 49% reduction in type 2 diabetes diagnoses, and a 43.3% reduction in circulatory system diagnoses. During the same period, the prescription rate for related medications was also significantly lower than expected [31]. In Spain, a study on quality indicators in primary care highlighted the negative impacts of COVID-19, particularly in following up patients treated with anticoagulants and those suffering from diabetes, hypertension, chronic ischemic heart disease, and cerebrovascular events. The pandemic also led to a substantial reduction in screenings, especially for diabetic foot and retinopathy, as well as some vaccination indicators, such as measles, mumps, and rubella [32].

The present study showed extensive changes in the utilization of primary care services provided by family physicians during the first two years of the COVID-19 pandemic. Despite the adoption of special policies by the government, such as allocating specific centers for COVID-19 patients, canceling quarantine requirements, implementing social distancing measures in public centers, and increasing public awareness about virus transmission and prevention, there has been a significant reduction in the provision and utilization of primary health care services. It can be stated that the gap in service utilization due to delays in treatment or prevention will likely result in long-term negative consequences for the health of society.

During the COVID-19 pandemic, the reduction in visits to family physicians at primary levels of medical care led to decreased costs for the health system and insurance organizations, but this cost reduction occurred only

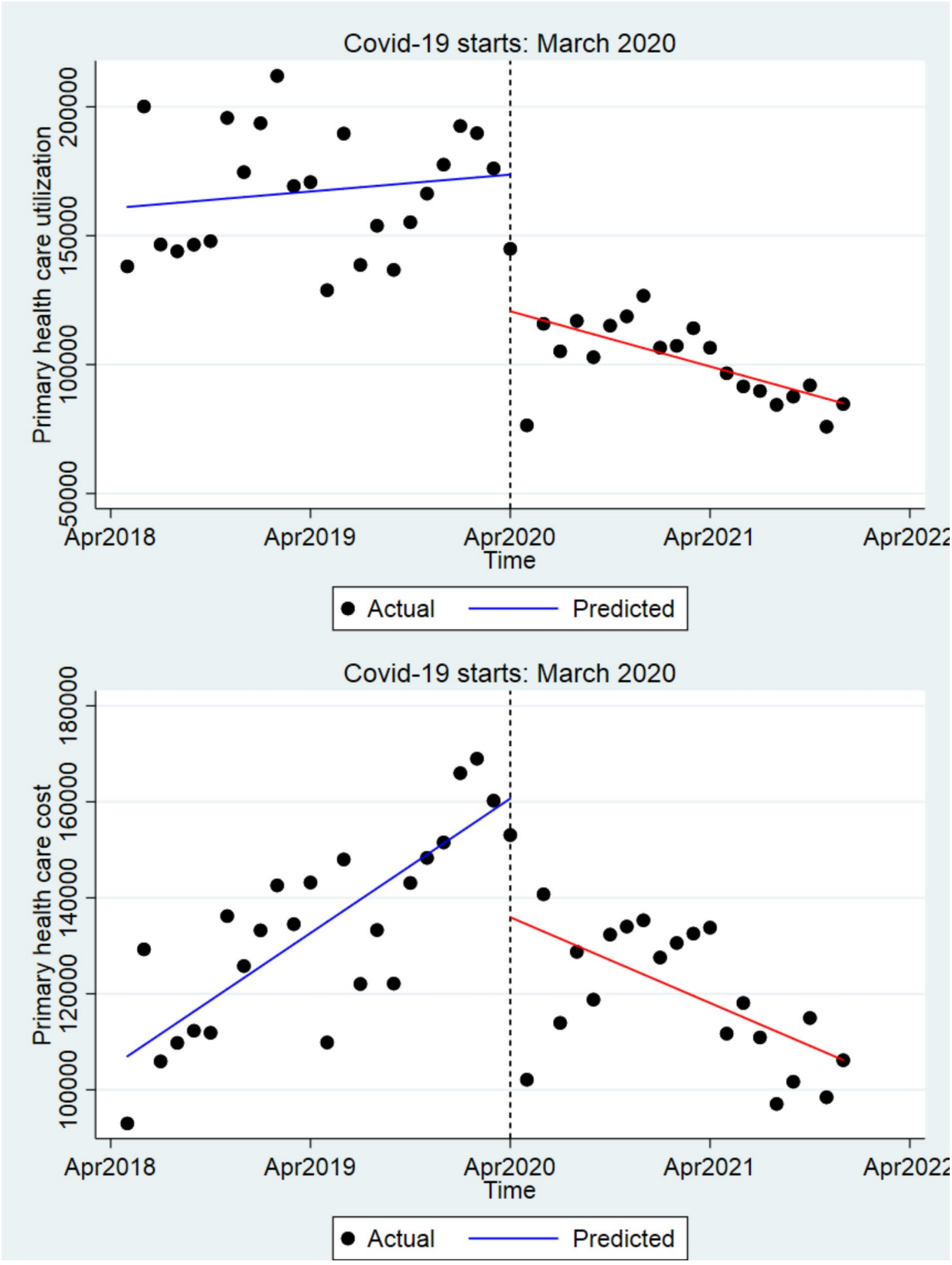

Fig. 1 Trend of primary health care utilization and cost before and after of Covid-19, ITSA estimates

within the time frame of the current study. As patients' health conditions, particularly those with chronic diseases, become more complicated due to delays in identification and diagnosis, a significant increase in health costs and the economic burden of diseases is expected in the future.

Furthermore, reduced consultations with family physicians will affect patients' adherence to treatment, as inadequate counseling can lead to irrational drug use and potential drug interactions. Non-adherence to medication is a significant public health challenge; in Europe, it is estimated that 9% of cardiovascular events can be attributed to non-adherence to treatment [33].

In general, the outbreak of COVID-19 has had comprehensive effects on all aspects of people's and patients' lives. Nevertheless, the true extent of the effects of the quarantine period on patient care, as well as morbidity and mortality, remains unclear. More prospective studies should be conducted to evaluate the long-term effects of the pandemic and quarantines on patients. After the quarantine and safety measures, such as vaccination requirements, mask usage, and social distancing, family physicians should follow up on unmet medical needs, especially for individuals with chronic diseases, the elderly, and vulnerable populations, to address health problems and other chronic conditions that may have been neglected during the quarantine.

Like any other study, this research faced some limitations. Due to a lack of access to comprehensive data on family physicians' visits and costs, the researchers had to rely on data from the health insurance organization. Additionally, classifying patient visit information based on the type of services to accurately examine changes in visits for each disease group was another limitation of this study. Finally, this study is limited to Fars province, and thus, the results may not necessarily reflect the situation in other provinces of Iran.

Conclusion

Family physicians faced tough challenges during the Covid-19 pandemic, and the quarantine period and the resulting restrictions caused a fundamental change in the levels of patient care across the country. To avoid such challenges and their impacts on patient care dynamics, clear strategies and policies should be included in planning for future epidemics in order to deal with the known long-term and short-term effects of quarantines and the stress caused by epidemics on the health and well-being of people.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12962-025-00606-y.

Supplementary Material 1

Acknowledgements
The authors are grateful to the Fars province Health Insurance Organization for their valuable contributions in data collection.

Author contributions
M.B., Z.G. and F.L. designed the study Z.G., M.B., M.B. and F.L. collected data and analysed Z.G. and M.B. prepared the first draft of the report. All authors approved the final version and took responsibility for its content.

Funding
This study supported by Shiraz University of Medical Sciences (grant number: 23630).

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Ethical approval for this study was obtained from Ethics Committee of the Shiraz University of Medical Sciences (Code of Ethics: IR.SUMS.NUMIMG.REC.1400.035). Also, patient consent is not required.

Consent for publication
Consent for publication is not applicable as this study did not include names, images, or videos relating to individual participants.

Competing interests
The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript.

Received: 23 July 2024 / Accepted: 3 February 2025
Published online: 12 February 2025

References

1. Zoumpourlis V, Rizos GM, Baliou E, Spandidos S. [Comment] the COVID–19 pandemic as a scientific and social challenge in the 21st century. Mol Med Rep. 2020;22(4):3035–48.
2. Tumusiime P, Titi-Ofei KH, Amri R, Seydi M, Kipruto ABW H, et al. editors. Building health system resilience in the context of primary health care revitalization for attainment of UHC: proceedings from the Fifth Health Sector Directors' Policy and Planning Meeting for the WHO African Region. BMC proceedings; 2020: BioMed Central.
3. Breton M, Deville-Stoetzel SE, McKinstry N, DePuccio D, Sriharan M, Deslauriers A, Dong V, McAlearney A. Telehealth challenges during COVID-19 as reported by primary healthcare physicians in Quebec and Massachusetts. BMC Fam Pract. 2021;22(1):1–3.
4. Stephenson E, Gronsbell BD, Ji J, O'Neill C, Crampton B, Tu N. Changes in the top 25 reasons for primary care visits during the COVID-19 pandemic in a high-COVID region of Canada. PLoS ONE. 2021;16(8):e0255992.
5. Rezapour R, et al. The impact of the Covid-19 pandemic on primary health care utilization: an experience from Iran. BMC Health Serv Res. 2022;22(1):1–8.
6. Jamili S, Adel EH, Badiee Aval A, Hoseini S, Vejdani SJ, Ebnehoseini M. Experience of patients hospitalized with COVID-19: a qualitative study of a pandemic disease in Iran. Health Expect. 2022;25(2):513–21.
7. Brenes GA. Anxiety, depression, and quality of life in primary care patients. Prim care Companion J Clin Psychiatry. 2007;9(6):437.
8. Fekadu G, Tolossa BF, Fetensa T, Turi G, Getachew E, Abdisa M, Assefa E, Afeta L, Demisew M, Dugassa W. Impact of COVID-19 pandemic on chronic diseases care follow-up and current perspectives in low resource settings: a narrative review. Int J Physiol Pathophysiology Pharmacol. 2021;13(3):86.
9. Gold K, Kinney LA, Harmes D, Serlin K. Video visits: family physician experiences with uptake during the COVID-19 pandemic. Fam Med. 2021;53(3):207–10.

10. Aoki T, Matsushima M. The ecology of medical care during the COVID-19 pandemic in Japan: a nationwide survey. J Gen Intern Med. 2022;37(5):1211–7.
11. Khera A, et al. Continuity of care and outpatient management for patients with and at high risk for cardiovascular disease during the COVID-19 pandemic: a scientific statement from the American Society for Preventive Cardiology. Am J Prev Cardiol. 2020;1:100009.
12. Velek P, Ikram SM, Ikram MK, Leening MA, van der Lei MJ, Olde Hartman J, Peters T, Tange LL, Rutten H, van Weert FH. Changes in the diagnosis of stroke and cardiovascular conditions in primary care during the first 2 COVID-19 waves in the Netherlands. Neurology. 2022;98(6):e564–72.
13. Hajat C, S.E.T.g.b.o.m.c.c.a.n.r.P.m.r.D.-.
14. Osawa I, et al. Physician visits and medication prescriptions for major chronic diseases during the COVID-19 pandemic in Japan: retrospective cohort study. BMJ open. 2021;11(7):e050938.
15. Zahiri M et al. *Survey of General Practitioners Point of View about Family Physician and Referral System Policies in Urban Areas for 2013.* 2017.
16. Gao J et al. Primary Care's effects on costs in the US Veterans Health Administration, 2016–2019: an Observational Cohort Study. J Gen Intern Med, 2022: pp. 1–6.
17. Gao J, et al. The effect of primary care visits on total patient care cost: evidence from the veterans health administration. J Prim Care Community Health. 2022;13:21501319221141792.
18. Rezaei Z, et al. The effect of Covid-19 pandemic on healthcare utilization in public vs private centers in Iran: a multiple group interrupted time-series analysis. BMC Health Serv Res. 2023;23(1):822.
19. Bayati M, et al. Effect of two major health reforms on health care cost and utilization in Fars Province of Iran: family physician program and health transformation plan. BMC Health Serv Res. 2020;20:1–9.
20. Delavari S, Jamali Z, Bayati M. Lockdown effect on COVID-19 incidence and death: Iran experience. Disaster Med Pub Health Prep. 2022;16(6):2385–7.
21. Cobiac LJ, et al. Impact of the UK soft drinks industry levy on health and health inequalities in children and adolescents in England: an interrupted time series analysis and population health modelling study. PLoS Med. 2024;21(3):e1004371.
22. Lotfi F, et al. The impact of Health Transformation Plan on natural vaginal delivery and cesarean section frequency in Iran: an interrupted time series analysis. BMC Res Notes. 2021;14(1):257.
23. Janko MM, et al. The impact of sustained malaria control in the Loreto region of Peru: a retrospective, observational, spatially-varying interrupted time series analysis of the PAMAFRO program. The Lancet Regional Health–Americas; 2023. p. 20.
24. Bernal JL, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health interventions: a tutorial. Int J Epidemiol. 2017;46(1):348–55.
25. Prado NM, Chaves RT, Barros SC, Magno SG, Santos L, Santos HL. AM. The international response of primary health care to COVID-19: document analysis in selected countries. Cadernos De saúde pública. 2020;36.
26. Mughal F, Mallen KK. The impact of COVID-19 on primary care: insights from the National Health Service (NHS) and future recommendations. J Family Med Prim care. 2021;10(12):4345.
27. Pezeshki MZ, Arab-Zozani JA. Medical overuse in the Iranian healthcare system: a systematic scoping review and practical recommendations for decreasing medical overuse during unexpected COVID-19 pandemic opportunity. Risk Manage Healthc Policy. 2020;13:1103.
28. Behzadifar M, Kehsvari AA, Darvishi Teli M, Ghanbari B, Gorji MK, Sheikhi HA, Azari A, Heydarian S, Ehsanzadeh M, Kong SJ. The effect of COVID-19 on public hospital revenues in Iran: an interrupted time-series analysis. PLoS ONE. 2022;17(3):e0266343.
29. Allan H, Al Omary AQT. Family medicine practice challenges during Covid-19 outbreak, curfew and phased re-opening, lessons to be learned from Jordanian experience. Annals Med Surg. 2021;68:102580.
30. Verhoeven V, Philips TG, Van Royen H. Impact of the COVID-19 pandemic on the core functions of primary care: will the cure be worse than the disease? A qualitative interview study in flemish GPs. BMJ open. 2020;10(6):e039674.
31. Williams R, Ashcroft JD, Brown DM, Campbell B, Carr S, Cheraghi-Sohi MJ, Kapur S, Thomas N, Webb O, Peek RT. Diagnosis of physical and mental health conditions in primary care during the COVID-19 pandemic: a retrospective cohort study. Lancet Public Health. 2020;5(10):e543–50.
32. Coma E, Méndez MN, Benítez L, Hermosilla M, Fàbregas E, Fina M, Mercadé F, Flayeh A, Guiriguet S, Balló C. Primary care in the time of COVID-19: monitoring the effect of the pandemic and the lockdown measures on 34 quality of care indicators calculated for 288 primary care practices covering about 6 million people in Catalonia. BMC Fam Pract. 2020;21(1):1–9.
33. Caldeira D, Costa V-CA. The impact of dosing frequency on medication adherence in chronic cardiovascular disease: systematic review and meta-analysis. Revista Portuguesa De Cardiologia (English Edition). 2014;33(7–8):431–7.

Publisher's note