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Effects of the COVID-19 pandemic in referrals of patients with cardiovascular, diabetes mellitus, neurological and neurosurgical diseases to hospital

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Abstract

Background: A novel virus from the coronavirus family, known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified in December 2019 in China. In addition to morbidity and mortality, the virus had many indirect effects on the referral and treatment of other diseases, including diabetes, cardiovascular, and neurological diseases. This study aimed to investigate the referrals trend and admissions of patients to medical centers; comparing the referrals trend with the same period in the previous year.

Methods: In this retrospective cohort study, we reviewed all referrals to the heart surgery, cardiology, diabetes mellitus, neurology and neurosurgery clinics of a great teaching hospital of Tehran University of Medical Sciences in Tehran, Iran. Anonymous data was extracted from the electronic health records and was listed in tables at intervals of one week. The descriptive analyses were reported as number of referrals to clinics.

Results: We found a noticeable reduction in total clinic referrals in 2020 compared with 2019 (4258 vs 12081; decreased by -65%). Heart surgery clinic displayed the highest decline (477 vs 1463, -67%) and diabetes clinic experienced the lowest decline (403 vs 840, -52%). Declining trend was also observed in other three clinics (-64-66%).

Conclusion: The number of referrals during the COVID-19 pandemic has decreased compared to the same period in 2019. The number of referrals to clinics was inversely related to the official statistics of COVID-19. During an infectious epidemic, steps must be taken to ensure that the care and treatment of other diseases is not compromised.

Keywords: COVID-19; cardiovascular diseases; cardiac surgery; diabetes mellitus; neurological diseases.

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Introduction

A novel human virus from the coronavirus family, known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified in December 2019 in Wuhan, China, and has spread rapidly all around the world. On March 11, 2020, the World Health Organization (WHO) announced the coronavirus disease 2019 (COVID-19) a pandemic. Since the identification of COVID-19 in December 2019 to September 15, 2020, 213 countries have been affected by the pandemic, with more than 29 million infected cases and more than 933,000 deaths [1]. SARS-CoV-2 is a single-stranded enveloped RNA virus which has been known to be originated in bats and spread from bats to an intermediate host such as Malayan pangolin and then to humans [2]. Transmission of SARS-CoV-2 is mainly through respiratory droplets from both symptomatic and asymptomatic patients. The most common symptoms of infection include mild fever, dry cough, sore throat, malaise, headache, and muscle pain [3]. COVID-19 causes severe respiratory infections and critical conditions in patients with underlying health conditions, the elderly, and people with suppressed immune systems. Among risk factors of COVID-19, cardiovascular disorders and diabetes mellitus can double the risk of mortality [4]. This novel coronavirus has imposed globally unprecedented challenges for health-care system specifically in developing countries. Poor basic health facilities, lack of sufficient health policies and governance, as well as weak protective measurement of public against the spread of virus also play a critical role in the aforementioned scenario [5]. Until January 11, 2021, Iran by performing more than 8.2 million COVID-19 identification tests have reported 1,292,614 confirmed cases and 56,262 deaths due to COVID-19 [1].

Patients with severe conditions need to be intubated and cared in the intensive care unit (ICU). Therefore, at the beginning of the COVID-19 pandemic, developing capacity and beds in the ICU wards had become one of the major challenges for health-care organizations. Also, due to the fact that COVID-19 is highly contagious, the contamination of medical centers and hospitals, and the fear of pandemic has reduced the number of hospital admissions compared to the same period last year [6]. Due to the importance of caring of patients with COVID-19, many non-emergency and elective cardiovascular surgeries have been discontinued, and surgical services appear to require planning to maintain surgical care during and after the pandemic [7,8]. Due to the high risk of COVID-19 for patients with cardiovascular problems and the need of ICU beds for post-operative cares, there is a need for a change in heart surgery services. In some health care systems, such as the United Kingdom National Health Service (NHS), specialized centers are declared as heart surgery centers during the pandemic, and all emergency surgeries are performed at these centers, and no patients suspected of having COVID-19 are admitted to these centers [9]. A study in China showed that emergency room visits with acute coronary syndrome (ACS) have been reduced by more than 50% in order to prevent COVID-19 transmission and reduce social contacting [10]. A survey of 15 hospitals in northern Italy showed that during the COVID-19 pandemic, especially after the announcement of national quarantine, the admissions of patients with ACS significantly decreased compared to the same period in 2019, while mortality increased [11]. In the United States, stroke im-

aging and evaluation in hospitals has decreased compared to before the pandemic [12]. In Barcelona, Spain, the number of stroke admissions has decreased, especially in the elderly [13]. A study in 73 centers in Spain showed a significant reduction in diagnostic procedures (56%) such as angioplasty or percutaneous coronary intervention (PCI) (48%), structural interventions (81%), and PCI with ST-elevation myocardial infarction (STEMI) (40%) [14]. Due to the current situation caused by the pandemic, face-to-face visits to heart centers are decreased and more telephone and virtual services are provided to patients [9]. New patients with cardiovascular diseases are first triaged virtually or by telephone and are cared and monitored physically or virtually, depending on the severity of the symptoms and clinical conditions [9].

Patients with diabetes mellitus need intensive cares and continuous blood glucose control. Due to the risk of serious complications of chronic diabetes mellitus, it is important to seek medical attention if the patient has any clinical symptoms. One of the most important and common complications of diabetes mellitus is diabetic foot ulcer (DFU), which is caused by neuropathy and peripheral angiopathy [15]. DFU causes irreversible and dangerous complications such as amputation and thrombosis. In quarantine conditions, DFU can be one of the leading causes of disability and mortality in diabetic patients [16]. In general, 20% of hospital admissions of diabetics and 40% of non-traumatic lower extremity amputations are related to DFU [15]. Due to the fear of going to medical centers and decreasing the number of visits to control diabetes mellitus, the risk of complications of uncontrolled diabetes mellitus has increased [17]. The number of patients with diabetes mellitus referred to medical centers decreased during the COVID-19 pandemic, but the rate of amputation arising from DFU increased [17].

Neurological diseases mostly include chronic diseases that need to be followed up. Neurological diseases are known as the leading cause of debilitating diseases. Therefore, controlling the course of the disease and reducing disability arising from the disease has an important role in terms of health, economic and social [18]. Eventually, evaluation and follow-up of these patients is very important. Due to general quarantine and social distancing in the United Kingdom, deterioration of disability was seen in people with chronic neurological diseases such as motor neuron disease [19]. According to studies conducted during the COVID-19 pandemic, the rate of referrals to the neurology and neurosurgery departments has decreased [20]. During the COVID-19 pandemic, due to the risk of disease, the use of telemedicine in the form of video, telephone, etc. has become very important [18]. Due to the persistence of the pandemic, planning to change the referrals process and evaluation of patients with neurological diseases seems necessary.

Failure to following-up the people with cardiovascular diseases, diabetes mellitus and neurological diseases can lead to more severe conditions and a worse prognosis. Studies following the Ebola virus disease (EVD) outbreak from 2014 to 2015 showed that the death rate from non-Ebola diseases was higher than the EVD mortality rate, and this finding indicates the inability of the health system to respond to other diseases [21]. As a result, health systems, in addition to managing epidemic

conditions, must also pay attention to cardiovascular diseases, diabetes mellitus, neurological and neurosurgical diseases and plan for the treatment and caring of these patients in accordance with the epidemic conditions. As far as our knowledge, no study has been conducted in Iran on the referral process of other diseases.

The aim of this study was to investigate the referrals trend and admissions of patients with cardiovascular diseases, candidates for heart surgery, diabetics and patients suffering from neurological diseases to medical centers; comparing the referrals trend with the same period in the previous year and determining the causes of possible changes in the referrals trend.

Methods

In this cohort study, we retrospectively reviewed referral of patients to the cardiology, heart surgery, diabetes mellitus, neurology and neurosurgery clinics of a great teaching hospital of Tehran University of Medical Sciences, between Feb 20, and May 15, 2020, compared with those belonging to the same period in 2019. We evaluated the number of referrals to clinics daily and reported them weekly. No inclusion and exclusion criteria were defined and all patients referred to mentioned clinics were included in this study. Anonymous data was extracted from the electronic health records and was listed in tables at intervals of one week. The descriptive analyses were reported as number of referrals to clinics. Chi-square test was used to compare categorical variables. All statistical analyzes were carried out using SPSS (Statistical Package of Social Science, Chicago, IL, USA) version 22.

This study was performed according to Declaration of Helsinki and was approved by the research ethics commission of Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1399.075).

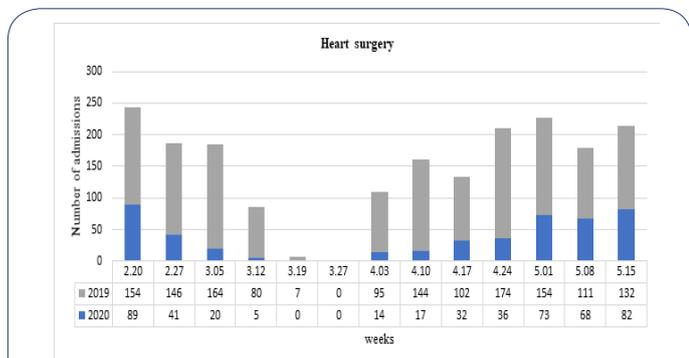


Figure 1: Number of weekly visits to the heart surgery clinic between February and May in 2019 and 2020.

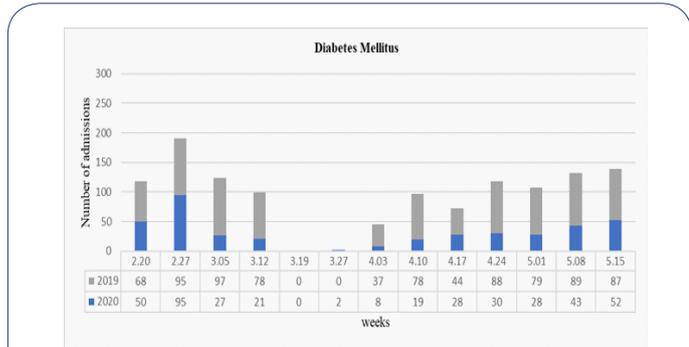


Figure 2: Number of weekly visits to the diabetes mellitus clinic between February and May in 2019 and 2020.

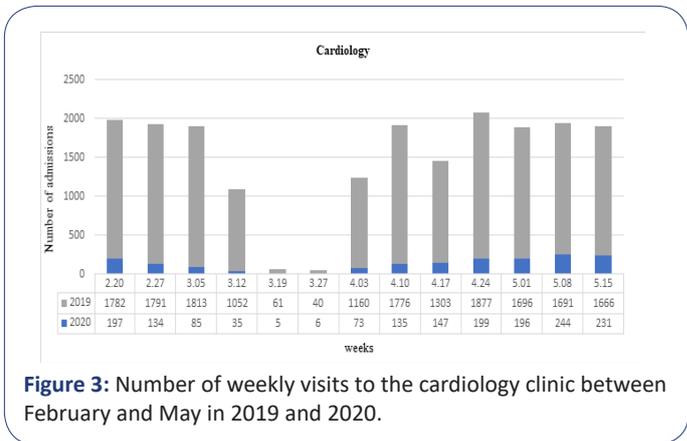


Figure 3: Number of weekly visits to the cardiology clinic between February and May in 2019 and 2020.

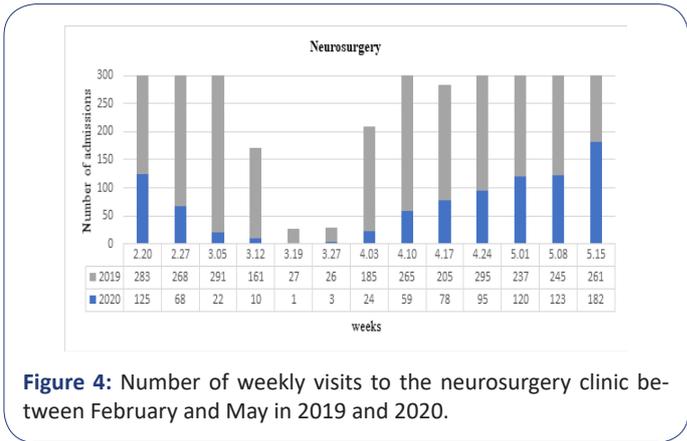


Figure 4: Number of weekly visits to the neurosurgery clinic between February and May in 2019 and 2020.

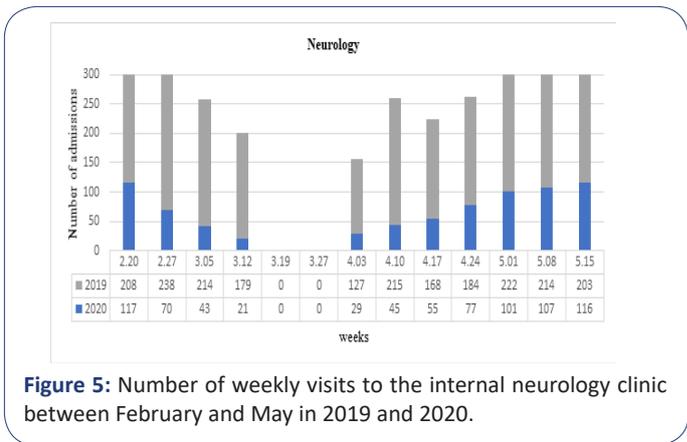


Figure 5: Number of weekly visits to the internal neurology clinic between February and May in 2019 and 2020.

Table 1: The frequency of referrals to clinics in 2019 and 2020.

Clinic	Admission Year		Total	Reduction
	2019	2020		
Neurology	2172 (73.6%)	781 (26.4%)	2953 (100%)	64%
Neurosurgery	2749 (75.1%)	910 (24.9%)	3659 (100%)	66%
Heart Surgery	1463 (75.4%)	477 (24.6%)	1940 (100%)	67%
Diabetes Mellitus	840 (67.6%)	403 (32.4%)	1243 (100%)	52%
Cardiology	4857 (74.2%)	1687 (25.8%)	6544 (100%)	65%
Total	12081 (73.9%)	4258 (26.1%)	16339 (100%)	65%
Chi-Square Test				p < 0.001

Results

We found a noticeable reduction in total clinic referrals in 2020 with respect to 2019 (4258 vs 12081; decreased by 65%). The decline in referral rate was not consistent in all clinics. Heart surgery clinic displayed the highest decline (477 vs 1463, -67%) and diabetes mellitus clinic experienced the lowest decline (403 vs 840, -52%). The relationship between the number of referrals to four clinics in two years was significant ($p < 0.001$) (Table 1, Figure 1-5).

Trends of weekly admissions to clinics in 2020 and 2019

The trend of referrals indicates that since February 20, the number of referrals in 2020 has decreased compared to 2019.

Discussion

This study aimed to describe the trend of patients' referral rate during the COVID-19 pandemic and compare it with the same period in 2019 in one of the greatest teaching hospitals in Iran. Based on the results, a significant decrease in referrals to the heart surgery, cardiology, diabetes mellitus and neurological diseases clinics compared to the same period in 2019 was observed. It is worth mentioning that the rate of referrals to clinics has been reduced noticeably between March 12th and March 27th in both 2020 and 2019, which was due to the Nowruz holiday in Iran. Before the beginning of the Nowruz holiday in 2020.

Being in special and emergency situations such as epidemics causes different changes in the physical, mental, social and spiritual health of people in society. During an epidemic of infectious and contagious diseases, the risk of transmitting diseases is very high due to the accumulation of patients in health centers. Various factors are involved in reducing patient referrals. Due to the sensitivities created in the community and the fear of infection, referrals to medical centers decreased. For example fear of transmission of COVID-19 has reduced hospitalization in acute and emergency situations myocardial infarction (MI) [11].

Sometimes, due to the increase in referrals of patients with COVID-19, other wards of the hospital were dedicated to these patients, which can increase the fear of referral. Reducing accidents, including driving accidents, due to less travel and less vehicle use can also be the reason for reduced visits to the neurosurgery clinic. Many elective surgeries have also been delayed, but there are limits to these delays.

In the case of other diseases, the incidence of some diseases, such as myocardial infarction and stroke, may have decreased due to the possible reduction of air pollution, or, conversely, due to the lack of referrals, their mortality may have increased. It is relevant to ensure this.

Under normal circumstances, some referrals to medical centers were unnecessary and there was no need to refer. According to some health care workers, unnecessary patient visits have also decreased.

However, the question is what happened to these patients who need long-term and timely care in this condition. One of the concerns in health-care systems is the excessive reduction of referrals to medical centers. Excessive reduction of patients visits indicates that patients with acute conditions do not visit the clinics, so the health of individuals will be endangered if treatment and care are delayed. According to the government

of the United Kingdom, the number of referrals to the non-COVID-19 emergency departments in April 2020 has decreased by 50% compared to April 2019, and this decrease in referrals despite suffering from acute illnesses and serious conditions can be worrying [22].

Investigating the changes in the referrals trend of patients with cardiovascular diseases

Based on the results, the rate of referrals to cardiology clinic and elective cardiovascular surgeries such as catheterization has been decreased compared to the same period last year, which is consistent with similar studies [10,14,23]. Due to the severity of the cardiovascular diseases and the increased mortality rate in patients with COVID-19 who have cardiovascular diseases, taking care of these patients and controlling the disease should be planned in order to reduce their attendance in hospitals [10]. Today, due to the importance of cardiovascular emergencies, there is a concern about the increment in mortality rate due to delays in visiting medical centers [24]. One of the reasons for the decrease in elective surgeries such as angioplasty is the increment in the use of alternative medications such as thrombolytic drugs instead of surgeries in order to manage the disease until the end of the epidemic [14,23]. In the present study, an inverse relationship was observed between the official daily reports of COVID-19 disease statistics and referrals to the mentioned clinics, which is consistent with a similar study in the United States [25]. According to a study in the United States, the rate of admissions to the cardiology department among patients referred to the cardiology clinic has decreased compared to the same period last year. This finding indicates a decrease in unnecessary referrals to medical centers [25]. A study showed that during the COVID-19 epidemic, the referrals to medical centers after heart attacks were delayed [26]. Another reason for the decrease in referrals to cardiology clinic might be visiting private offices, or even online or telephone evaluation of patients.

Investigating the changes in the referrals trend of patients with diabetes mellitus

According to the results, the number of referrals of people with diabetes mellitus has decreased compared to the same period last year. This finding is favorable due to the high risk of COVID-19 in these patients, but is worrying due to the need for constant care and blood glucose control. One of the most important complications of diabetes mellitus is DFU, which is caused by peripheral neuropathy and peripheral angiopathy and causes disability (high DALYs (disability-adjusted life years)) and imposes high costs on the health-care system and society [15]. A study showed that 20% of diabetics' referrals to the hospitals were due to DFU. The estimated risk of DFU in diabetic patients was about 20% [15]. Similar studies showed that during the COVID-19 pandemic, the number of patients with DFU decreased, but due to delays in referrals, diagnosis and treatment, the rate of amputations increased [16]. According to studies, for controlling DFU, it is recommended to use social networks and perform medical and surgical interventions, if necessary. Of note, at the beginning of hospital admissions, the patients should be evaluated for COVID-19 and should be separated from COVID-19 wards [15].

Investigating the changes in the referrals trend of patients with neurologic diseases

According to the results, referrals to the neurology and neurosurgery departments in 2020 decreased compared to the same period in 2019. The neurology department's admissions are mostly done in the two areas of following-up of chronic patients and strokes. During the COVID-19 pandemic in Iran and several other countries, referrals of patients with acute strokes decreased, mostly in mild and sometimes severe strokes [27]. Also, patients with chronic neurological diseases were followed-up mostly by video, telephone, using social networks, etc. [18]. Together, these two can be reasons for decreased referrals to the neurology department. The decrease in referrals to the neurosurgery department was consistent with a similar study [20, 28]. Also, to reduce the risk of COVID-19 and reduce the pressure on health-care system, the treatment guidelines for some brain tumors were changed and drug therapy was substituted for surgery. Also, tumor surgery appointments were delayed when possible [20]. According to a similar study, due to reduced accidents, especially occupational accidents, spinal surgeries also decreased during the COVID-19 pandemic [28].

What are the alternatives now?

Studies show that many underlying diseases, such as chronic pulmonary diseases, cardiovascular diseases, diabetes mellitus, acquired or congenital immunodeficiency diseases, and cancers are directly related to the severity and mortality of COVID-19 [29]. Due to the increased risk of COVID-19 in people with underlying disorders and the need for clinical and para-clinical care and control of these people, new alternative methods are proposed to evaluate patients with chronic diseases. Health-care systems manage patients according to the conditions of the community, the level of access to communication tools and the level of information organization. Telemedicine is now one of the new methods in evaluating and controlling patients and is an alternative to face-to-face visits to medical centers [30]. Telemedicine is defined as technologies and devices responsible for gaining health status information remotely. Therefore, it can provide both screening and diagnostic measures [31]. Initially, telemedicine emerged as medical assistance in places where have not access to health-care system or rural areas especially in urgent conditions. Over the past years, both epidemic and pandemic situations led to increased use of digital technologies such as telemedicine [32, 33]. Applications that engage patients through online booking, providing remote rehabilitation experience for both practitioner and patients, serving health-care providers across urgent cares, and providing online/virtual video visits are examples of telemedicine applications used in both developed and developing countries. There are 2 types of telemedicine, real-time (synchronous) type including telephone and video call and store-and-forward (asynchronous), such as email and smartphone applications [34]. Telemedicine covers two main clinical areas including cardiovascular diseases and diabetes [31]. In case of cardiovascular diseases, constant monitoring process can cause increased infection risk for both clinicians and patients. Hence, online and remote monitoring such as phone and video call are available in the case of need [35]. In this setting, electrophysiologists have converted clinical visits to online/remote visits [31]. In case of diabetic retinopathy, fundus cameras and other portable devices are able to take photos and deliver retinal photos to specialists for reading [31]. According to a study, telephone service in combined with mul-

tidisciplinary team and video consultation can manage >90% of patients with Parkinson disease [36]. Moreover, significant numbers of patients with amyotrophic lateral sclerosis prefer telephone telemedicine to traditional care [36]. A study from Mayo Clinic reported that implementing well-established telemedicine, increased its clinician user numbers by 2,000% and provided health care for neurological patients combined with reduced exposure of health-care staffs to coronavirus [36]. Depending on the infrastructures of each country and the extent of internet access, a special form of telemedicine is implemented. In developing countries such as Iran, due to the limited internet access, other communication tools such as telephones are used more. Due to the non-specificity of COVID-19 symptoms and the similarity of its symptoms with other diseases of the respiratory tract such as flu, colds and allergic hypersensitivities and the increased risk of COVID-19 in case of visiting medical centers, a telephone system named "4030" started to work in Iran. This system had a significant contribution in reducing the number of visits to hospitals and medical centers by responding to people suspected of having COVID-19 and providing the necessary guidance [37]. While some medical conditions can be managed by telemedicine and other alternative ways of care, certain medical conditions such as signs of heart attack, seizures and fainting, pregnancy issues as well as other life-threatening conditions require emergency referrals to hospitals and are not fully replaceable by alternative ways of care. There are some recommendations for hospitals and other health-care systems to reduce the spread of virus among non-COVID-19 patients including isolation of COVID-19 infected patients, social distancing, mandatory face masking, patient screening for COVID-19 symptoms before appointment, and extended appointment time. According to studies in patients with rare neurological diseases, telemedicine was not significantly different from face-to-face referrals, and patients showed better acceptance of telemedicine during the COVID-19 pandemic than face-to-face referrals [38].

limitations

The present study had some limitations. We only represented patterns of referrals to our hospital and not every hospital and the health-care system in Iran. Therefore, this retrospective cohort cannot extrapolate these present patterns to the rest of the Iran's health-care system.

Since during the COVID-19 pandemic, our hospital was announced as one of the biggest hospitals for admission of COVID-19 infected patients, it is assumable that in this period, patients avoid to refer to this health department and instead chose to be admitted in other hospitals and go to non-COVID-19 centers near their home. Thus, to better understand the exact patterns of referrals to health-care system in Iran, we should assess the trend of referrals in both hospitals responsible for admitting COVID-19 patients and non-COVID-19 patients.

Lastly, we could not evaluate the patterns of referrals to other types of outpatient departments, such as emergency departments. Decrease in patients' visits can probably be due to shift in different way of referrals to health-care system (including calling to emergency departments, face time/video call with doctors, or visits through applications such as Pezeshket and Snapp.doctor) rather than an absence of it. Hence, assessing the trend of patients' referrals through other available ways can help us determine whether this trend is owing to decrease pa-

tients' referrals to hospitals or altered way of it.

Conclusion

This study was designed to evaluate the rate of referrals to the heart surgery, cardiology, diabetes mellitus, and neurological diseases clinics of a great teaching hospital of Tehran University of Medical Sciences in Tehran, Iran during the COVID-19 pandemic and to compare it with last year. According to the results, in all four clinics, the number of referrals during the pandemic has decreased compared to the same period in 2019. referral rate was inversely related to the prevalence of COVID-19 and as the prevalence of the disease increased in the community, referral rate decreased. Given the continuing pandemic of COVID-19, the risk of COVID-19 for patients with chronic diseases, social distancing rules, planning for taking care of the patients and controlling the disease in these patients is essential and should be considered by health-care systems. As COVID-19 pandemic is becoming a universal crisis, the world requires quick measurements to deal with health delivery challenges, particularly for patients with cardiovascular diseases, diabetes mellitus and neurological diseases. Our empirical results provide concerns for health system leaders and public health authorities on how patients with medical conditions that require particular hospital care should be ensured to obtain medical care during pandemic. long-term studies are required to evaluate the exact impact of COVID-19 and pandemic on avoiding hospitalization and patients' morbidity, and mortality. According to the findings of this study, COVID-19 lockdown had a negative impact on health outcomes. This impact could affect patients who have no access to telemedicine and other alternative ways of care than others.

Declarations

Funding statement: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest: The authors declare having no conflict of interest related to this work.

Ethical approval: This study was ethically approved by the Ethic Committee of Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1399.075).

Consent to participate: We used electronic data and informed consent was not possible, but all ethical issues were considered.

Availability of data and material: Corresponding author had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Authors' contribution: Z.K: Conceptualization, study design, analysis of data, writing original draft, writing and editing the final manuscript, supervision, and project administration.

A.F, S.KK, and F.S: Analysis of data, Writing original draft, Writing final manuscript.

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mission of Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1399.075).

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