How would COVID-19 protocols have impacted on continuity of care of hypertension patients

Seo Yoon Lee

University of Illinois at Chicago

Sung Youn Chun

National Health Insurance Service Ilsan Hospital

Hyeki Park (✉ hyekipark@gmail.com)

Health Insurance Review and Assessment Service

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Abstract

Objective

To investigate the impact of the coronavirus disease 2019 (COVID-19) pandemic on the continuity of care (COC) in hypertension patients. Additionally, the factor of whether participants were treated by telemedicine or not was also considered.

Methods

National Health Insurance and Medical Aid claims This study used data from the Republic of Korea between 2019 and 2020. The multiple regression analysis was performed to identify the differences in visits and the Most Frequent Provider Continuity (MFPC) of hypertensive patients before and after the COVID-19. To confirm the effect of telemedicine, additional analysis was performed with data that deleted cases that received telemedicine.

Findings

A total of 5,791,812 hypertensive patients are included in this study. When the confounding variables were adjusted, the MFPC decreased by 0.0031 points after the COVID-19. It also showed the same results for MFPC when telemedicine cases were excluded. The number of outpatient clinic visit days decreased by 0.2930 days after the COVID-19. Without telemedicine cases, the number of outpatient clinic visit days decreased by 0.3330 days after the COVID-19.

Conclusion

The COVID-19 protocols did not affect hypertension patients' COC but impacted their outpatient frequency. Additionally, when telemedicine cases are considered, COC was the same, but the patient's outpatient frequency had decreased, but not as much as when telemedicine cases were considered.

Introduction

Hypertension is a chronic disease that requires healthcare provider routine management. The hypertension prevalence rate has increased due to the aging population, westernized eating habits, and high sodium consumption. Among the population aged over 20, the estimated hypertension prevalence is 29%, and among the patients diagnosed with hypertension, the controlling rate is only 47%¹. High blood pressure is the most important modifiable risk factor with the most significant influence on cardiovascular or cerebrovascular diseases^{2,3}. According to the National Health Insurance Service (NHIS) statistics in Korea, the estimated medical cost of treating hypertension was 3.83 trillion Korean Won (i.e., 3.4 billion U.S. dollars). This amount is equivalent to 4% of all medical expenses and 16% of medical expenses for chronic diseases^{1,3}. Thus, controlling the hypertension prevalence by continuous monitoring and management would reduce the tremendous financial burden caused by the disease and eventually improve the patient's quality of life.

According to Shortell⁴, the continuity of care (COC) is defined as "the extent to which services are received as part of a coordinated and uninterrupted succession of events consistent with the medical care needs of patients." It is well-recognized that patients receiving continuous care from regular healthcare providers have better health outcomes and higher patient satisfaction at a lower cost⁵. Among hypertension patients, the greater COC, the lesser risk of hospital admission was reported⁶. Additionally, COC is also associated with a decreased use of emergency room visits and better follow-up rates with appointments^{7,8}. This could be due to the fact that the rapport built with the patient allows the healthcare providers to have a better knowledge about the patient and instantly recognize the changes in their health status. This can eventually prevent the patients from suffering from complications or disease onsets. Thus, in order to control high blood pressure, COC is an important concept.

On March 11th, 2020, the World Health Organization declared coronavirus disease 2019 (COVID-19) a pandemic. A response to the pandemic declaration, social distancing and isolation were recommended and done to prevent the virus from spreading. Many researchers showed concerns of a negative impact of social isolation on outpatient and primary care^{9,10}. However, telemedicine was also enlighten as an effective method to treat patients in such situation¹¹. Korean government also temporarily approved to provide medical counseling and prescription in non-face-to-face method which is over the telephone call. Considering the fact that the unprecedented length of the social isolation period would significantly impact the patients' outcomes who require continuous care by healthcare providers; the study might be the first to provide information about the influence of a pandemic on COC of hypertension patients and how the telemedicine will reduce its impact in South Korea. Thus, this article aims to investigate the impact of the COVID-19 pandemic protocol on the COC to hypertension patients. Additionally, whether patients received telemedicine or not is considered.

Methods

Source of data

This study analyzed the medical use of patients with hypertension by using the outpatient statements of the National Health Insurance (NHI) and Medical Aid beneficiaries that were claimed by the Korea Health Insurance Review and Assessment Service (HIRA). Over 95% of all Koreans are compulsorily insured by NHI and Medical Aid. In order to evaluate the impact of the COVID-19 outbreak, the cases treated between January 20, at the

beginning of COVID-19 in Korea, and December 31, 2020 were considered in the study. For comparison, the cases between January 20 and December 31, 2019 were considered. In order to compare COC under the same conditions, the data was limited to cases reviewed by the March of the following year.

Among those receiving hospitalization or outpatient treatment for hypertension (I10, I11, I12, I13) as their major diagnosis or sub-diagnosis, patients who have been prescribed antihypertensive drugs twice or more on different days, and the total number of administration days is 7 days or more, between January and December 2019 were defined as hypertensive patients. Of these, the total number of the study population was 5,791,812, excluding the fatalities before December 31, 2020, and those who did not meet the study conditions. This study was exempt from institutional review board of HIRA review due to the data being used were deidentified which are available for public use by the HIRA.

Variables

Dependent variables

Number of visits

The frequency of visits to a medical institution is a representative variable that can measure the volume of medical use. It is suitable for measuring medical usage changes due to COVID-19 protocols due to its consistency compared to the expenses affected by the medical practices. In this study, the number of outpatient-visits due to hypertension as the major diagnosis or sub-diagnosis during each study period was defined as the number of visits.

Most Frequent Provider Continuity (MFPC)

In chronic disease management, the relationship continuity between doctor and patient, a type of the COC, is known to have a positive effect on the treatment process, outcome, and cost. MFPC is a representative tool that can measure COC when the measurement target is an individual patient in a situation where the attending physician is not determined. In this study, MFPC was calculated by counting the total number of visits to medical institutions due to hypertension as the denominator and the number of visits to the most visited institution as the numerator during each study period. It has a value between 0 and 1, and the closer it is to 1, the higher the MFPC. If the frequency of the visits is too low, there is a possibility that the MFPC will be measured too high. Therefore, those who visited medical institutions less than twice per year were excluded.

Variable of interests

In order to evaluate the impact of the COVID-19 outbreak on the patients' medical use behavior, the period between January 20, when the first COVID-19 case was confirmed in Korea, and December 31, 2020 was defined as the period after importation (After). The same period in the previous year, with no COVID-19, was defined as the period before importation (Before).

Confounding variables

The variables with an impact on medical use, such as the patient's gender, age, region of residence, insurance type, Charlson Comorbidity Index (CCI), diabetes status, duration of hypertension and type of medical institution most frequently used, were adjusted. Any change in the region of residence or insurance type during the study period, led to the exclusion of the patients from the study.

CCI is a representative tool that can measure the severity of patients' underlying condition in administrative data such as health insurance claim data that lacks clinical information. Nineteen of the comorbidities included in the CCI calculation were included in the hospitalization and outpatient statements for a year before each study period as major diagnoses or sub-diagnosis (weights of 1 to 6 points were given to each morbidity and calculated). The bigger score implies the more serious underlying condition. Diabetes mellitus was initially included in CCI but was excluded because it was measured separately in this study. Diabetes mellitus was defined if E10 to E14 were claimed as major diagnoses or sub-diagnosis in hospitalization and outpatient statements for 1 year prior to the study period.

Statistical analyses

In this study, Chi-square test and independent t-test were performed to identify the general characteristics of the study populations. The multiple regression analysis and independent t-test were performed to identify the differences in the number of visits to medical institutions and the MFPC of hypertensive patients before and after the COVID-19 importation. In the multiple regression analysis, the patient's gender, age, region of residence, insurance type, CCI, diabetes status, duration of hypertension and type of medical institution most frequently used were adjusted. To consider the repeated measurement, a generalized estimating equation model was used, and CORRW type was applied for the covariance structure. In addition, to confirm the effect of telemedicine (non-face-to-face telephone consultation and prescription, untact treatment is used by Korean government), temporarily permitted because of the COVID-19 pandemic since February 24, 2020, additional analysis was performed with data that deleted telemedicine cases. SAS Enterprise Guide 7.1 was used for all statistical analysis.

Results

Characteristics of the study population

Table 1 shows the general characteristics of the study populations. A total of 5,791,812 hypertensive patients, 2,826,779 males and 2,965,033 females are included. During the Before period, 2,446,950 (42.25%) of the population accounted for the 60–74-year-olds at the highest proportion. Among the

study case population, 1,394,230 patients (24.07%) had diabetes, and those with more than 10 years of hypertension (2,978,121 or 51.42%) were among the majority with the mean CCI of 0.6347. As for the type of insurance, NHI accounted for the majority with 5,526,514 (95.42%). By region, Gyeonggi Province had the largest number of residents at 1,366,235 (23.59%), followed by Seoul at 985,945 (17.02%) and Busan at 407,245 (7.03%). The most frequently used medical institutions before the appearance of COVID-19 were clinics (4,537,548, 78.34%), and the proportion increased to 4,677,502 (80.76%) after the appearance of COVID-19. After the manifestation of the virus the proportion of tertiary hospitals and general hospitals increased by 0.01%p and 0.03%p, respectively, and the proportions of hospitals and public health institutions decreased by 0.09%p and 2.37%p, respectively.

Table 2 shows the MFPC before and after the importation of COVID-19. The MFPC in the Before period was 0.9507, and after the appearance of the virus, it decreased by 0.0024 to 0.9483, which was statistically significant. By patient characteristics, MFPC significantly decreased after the importation of COVID-19 in most groups, but there were some groups that increased. By age, MFPC decreased in all groups over 60 years old (60 to 74: -0.0033; 75 and more: -0.0057), and it increased in all groups under 60 years old (0 to 20: +0.0066; 30 to 44: +0.0047; 45 to 69: +0.0008), and it was statistically significant. Based on the hypertension duration, the MFPC increased from 0.9373 points to 0.9467 points after the COVID 19 appearance in groups with less than 2 years of hypertension and it decreased significantly in groups with a longer period of hypertension. By region MFPC increased in Jeju Island by 0.0039 points, Gyeongsangnam-do 0.0024 points, Jeollabuk-do 0.0031 points, Daegu 0.0014 points increased, and it decreased significantly in other areas, with no statistically significant difference in Sejong, Chungcheongnam-do, Daejeon and Incheon. By the most frequently used medical institutions, the MFPC increased in tertiary general hospitals (0.0033 points), general hospitals (0.0009 points), and hospitals (0.0047 points), while it decreased in clinics (-0.0024 points) and public health institutions (-0.0507 points).

Table 3 shows the number of visits per patient before and after the appearance of COVID-19. The number of visit days before COVID-19 was 8.3347 days, which decreased significantly statistically to 8.1363 days thereafter. By patient characteristics, the number of visits significantly decreased in all population groups except for the population with a prevalence of hypertension in the past 2 years. In particular, there was a greater decrease in the number of visits among women (before: 8.6337, after: 8.4084), patients of 75 and over (before: 9.3258, after: 8.9850), patients with diabetes (before: 9.0337, after: 8.7701), patients with over 10 years of hypertension (before: 8.6758, after: 8.4107), medical aid beneficiaries (before: 10.3710, after: 10.1173), residents of Sejong-si (before: 8.5040, after: 8.2302), and those who mainly use public health institutions (before: 6.0694, after: 5.6009).

Multiple linear regression analysis

Table 4 shows the results of the multiple regression analysis for MFPC. When the confounding variables were adjusted, the MFPC decreased by 0.0031 points after the appearance of COVID-19, which was statistically significant (p -value < 0.0001). It also shows the results of the multiple regression analysis for MFPC when telemedicine case is excluded. When the independent variables were adjusted, the MFPC after the appearance of COVID-19 was significantly statistically decreased, which was the same as when telemedicine case was included (β : -0.0031, p -value < 0.0001).

Table 5 shows the results of the multiple regression analysis on the number of visits per patient. When the confounding variables were adjusted, the number of visit days decreased by 0.2930 days after the appearance of COVID-19, which was statistically significant (p -value < 0.0001). The result of multiple regression analysis on the number of visits per patient when telemedicine case is excluded is also shown. Upon the adjustment of the independent variables, the number of visits per patient after the appearance of COVID-19 decreased by 0.3330 days statistically, which is 0.04 days lower compared to when telemedicine case was included.

Discussion

The purpose of the study was to identify the impact of social distancing and isolating due to the COVID-19 pandemic on the COC and outpatient visit of hypertension patients. Considering the fact that there are no family doctors in the Korean healthcare system, this study used MFPC as a proxy of COC. To examine the impact, a multiple regression conducted comparing MFPC with outpatient visits during the pre to post pandemic period. The study found a significant decrease in the MFPC and outpatient visits during the pandemic. Although both MFPC and the number of outpatient visits decreased with statistical significance, they varied in volume.

This study found a decrease in the MFPC of hypertensive patients; the size of the beta coefficient was not big enough to be considered as a significant decrease. Additionally, regardless of the patients receiving telephone prescriptions, their MFPC reported the same. MFPC represents the pattern of outpatient usage¹²; thus, study results showed that even though the pandemic impacted and limited their access to outpatient visits, the pattern of outpatient usage remained the same. Since MFPC represents the pattern of medical care utilization, its results indicate that the medical care utilization patterns of hypertension patients have not been impacted despite the nationwide initiation of COVID-19 protocols. The majority of the previous studies reported the positive impact of COC on a patient's health behaviors and health outcomes; however, a few studies reported different results. COC is, specifically, associated with positive patient and provider satisfaction¹³, reduced emergency room use⁸, decreased hospital admissions, and better immunization rates¹⁴; on the contrary, COC by provider is not associated with blood pressure control⁷. However, there is a study showing that patients with high COC levels (0.67-1.0) were more likely to have better controlled blood pressure compared to those with medium (0.40-0.66) or low COC levels (0-0.39)⁷. Better controlled blood pressure in hypertension patients leads to better health outcomes. Considering the results of these previous studies with the average MFPC of about 0.95, even with the COVID-19 protocols in effect, the health outcomes of the hypertension patient in Korea remained almost the same.

The other result shown in the study is that the number of outpatient visits has decreased. Unlike the MFPC results, on the other hand, the size of the outpatient visit number decreased significantly after the COVID-19 pandemic. When considering the telemedicine case, the number of outpatient clinic visits decreased, but not as much as the patients who did not undergo the telemedicine. The number of outpatient clinic visits reflects the volume of medical use and measures the utilization of healthcare services^{15,16}. Due to the COVID-19 protocols, unlike the medical care usage pattern, the utilization decrease was inevitable. However, as a result of telemedicine the frequency of outpatient visits has not gone down by much. Studies regarding the frequency of outpatient visits showed mixed results. A study reported that too many outpatient visits would increase the medical expenses and some of the visits are not necessary which will be inefficient in treatment¹⁷. However, this result was shown when the patients visited multiple doctors for the same condition. Another study reported a shorter return visit interval to be positively associated with blood pressure control¹⁸.

Non-face-to-face medical telephone counseling/ prescription (telemedicine is the term used in this study) has temporarily approved by Korean government due to a sudden increased number of COVID-19 diagnoses nation-wide. This increase was happened right after a mass infection occurred by an infected person visited a church in Daegu-Gyeongbuk region. The telemedicine center started to operate on March 9, 2020 in Daegu and April 21, 2020 in Seoul. There are some studies reported the positive role of telemedicine and the need of it during infectious disease pandemic era^{19,20}, especially in terms of its effectiveness^{11,21-23}. From this study, with the telemedicine case, the pattern of healthcare services use has not changed, and it also prevented utilization to be decreased significantly. Considering the fact that hypertension patient's COC had not reduced even though the utilization had decreased, this enlightens the fact that the telemedicine case is effective measure during COVID-19 pandemic period.

Several limitations of this study should be noted. First, this study used hospital administrative data for medical reimbursement or billing, which precludes clinical information meaning that it is hard to confirm whether the patient's actual blood pressure change. Thus, in the future, it is necessary to develop a patient dataset that links administrative data and clinical data on clinical variables such as lab results. Secondly, since only outpatient medical use was targeted, it may have been analyzed that if a patient was hospitalized during the follow-up period due to cardiovascular disease, a complication of hypertension, it was analyzed that he did not use medical care at all. However, in the case of high blood pressure patients with such high severity, it is very important to prevent complications through continuous medical use, so it is considered important to be included in the analysis. Therefore, future studies on hospitalization due to hypertension complications are needed. Lastly, demographic, social structural and economic factors influence medical use. However, in this study, only basic demographic variables such as gender and age, and clinical characteristic variables were included in the analysis because administrative data, which is the data for health insurance review request, was used. As a result, there is a limitation in that the patient's knowledge and attitude toward hypertension are not considered at all. Also, among demographic variables, variables closely related to access to medical institutions, such as residence and income, were not included. To minimize this limitation, in this study, proxy of social economic status and their income level was used as their health insurance status, and a proxy for the participant's condition, CCI was used and controlled. Although, in the future, it is necessary to develop a patient dataset that links administrative data and survey data on social and psychological variables.

Despite its limitations, our study has several strengths. First, the study used nationally representative data. Second, to our knowledge, this study was the first to examine the impact of COVID-19 protocols on hypertension patients' COC in South Korea. Lastly, considering whether the participants were treated by using telemedicine enriches with the interpretation.

Conclusions

Our results suggest that COVID-19 protocols did not effect on hypertension patient's COC but had impact on their outpatient frequency. Additionally, when telemedicine cases are considered, COC was the same, but the patient's outpatient frequency had decreased, but not as much as when telemedicine cases were considered. Future studies should consider the inpatient cases whether COVID-19 protocols impacted on hypertensive patient's complication admissions. It is hoped that this information will be a useful reference for further studies of chronic disease patient's COC during pandemic of infections and telemedicine's impact.

Declarations

Conflicts of Interest

The authors declare no competing interests.

Author Contributions

SL has made substantial contributions to the conception, design of the work, interpretation of data, and have drafted the introduction and discussion section of the work or substantively revised it. SC has made substantial contributions to the design of the work and analysis of data. Lastly, HP has made substantial contributions to the design of the work, the acquisition, analysis, interpretation of data, and has drafted the method and result section of the work and revised it. All authors have approved the submitted version and have agreed to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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Tables

Table 1. General characteristics of population							(cases, %)
	Total		Period				p-value
			Before(2019)		After(2020)		
Gender							
Man	5,653,558	(48.81)	2826779	(48.81)	2826779	(48.81)	1.0000
Woman	5,930,066	(51.19)	2965033	(51.19)	2965033	(51.19)	
Age group							
75 and more	2,674,728	(23.09)	1280358	(22.11)	1394370	(24.07)	<.0001
60 to 74	4,974,598	(42.95)	2446950	(42.25)	2527648	(43.64)	
45 to 59	3,403,191	(29.38)	1775890	(30.66)	1627301	(28.10)	
30 to 44	508,882	(4.39)	276419	(4.77)	232463	(4.01)	
0 to 29	22,225	(0.19)	12195	(0.21)	10030	(0.17)	
Diabetes Mellitus							
Yes	2,890,161	(24.95)	1394230	(24.07)	1495931	(25.83)	<.0001
No	8,693,463	(75.05)	4397582	(75.93)	4295881	(74.17)	
Hypertension							
less than 2 years	678,704	(5.86)	471291	(8.14)	207413	(3.58)	<.0001
2 to 4 years	2,102,954	(18.15)	1020221	(17.61)	1082733	(18.69)	
5 to 9 years	2,576,125	(22.24)	1322179	(22.83)	1253946	(21.65)	
10 years and more	6,225,841	(53.75)	2978121	(51.42)	3247720	(56.07)	
CCI	0.6402	±0.9352	0.6347	±0.9227	0.6456	±0.9474	<.0001
Insurance type							
Medical aid	530,857	(4.58)	265298	(4.58)	265559	(4.59)	0.7138
NHI	11,052,767	(95.42)	5526514	(95.42)	5526253	(95.41)	
Region (province)							
Sejong-si	47,252	(0.41)	23625	(0.41)	23627	(0.41)	1.0000
Jeju-si	143,228	(1.24)	71614	(1.24)	71614	(1.24)	
Gyeongsangnam-do	741,163	(6.40)	370577	(6.40)	370586	(6.40)	
Gyeongsangbuk-do	699,928	(6.04)	349961	(6.04)	349967	(6.04)	
Jeollanam-do	524,119	(4.52)	262059	(4.52)	262060	(4.52)	
Jeollabuk-do	499,754	(4.31)	249875	(4.31)	249879	(4.31)	
Chungcheongnam-do	522,166	(4.51)	261081	(4.51)	261085	(4.51)	
Chungcheongbuk-do	405,470	(3.50)	202734	(3.50)	202736	(3.50)	
Gangwon-do	444,728	(3.84)	222363	(3.84)	222365	(3.84)	
Gyeonggi-do	2,732,476	(23.59)	1366235	(23.59)	1366241	(23.59)	
Ulsan-si	226,247	(1.95)	113124	(1.95)	113123	(1.95)	
Daejeon-si	313,209	(2.70)	156606	(2.70)	156603	(2.70)	
Gwangju-si	279,906	(2.42)	139953	(2.42)	139953	(2.42)	
Daegu-si	549,508	(4.74)	274755	(4.74)	274753	(4.74)	
Incheon-si	668,122	(5.77)	334060	(5.77)	334062	(5.77)	
Busan-si	814,482	(7.03)	407245	(7.03)	407237	(7.03)	
Seoul-si	1,971,866	(17.02)	985945	(17.02)	985921	(17.02)	

Institution type							
Tertiary hospitals	317,701	(2.74)	158515	(2.74)	159186	(2.75)	<.0001
General hospitals	999,470	(8.63)	498776	(8.61)	500694	(8.64)	
Hospitals	644,628	(5.56)	324860	(5.61)	319768	(5.52)	
Public health centers	406,775	(3.51)	272113	(4.70)	134662	(2.33)	
Clinics	9,215,050	(79.55)	4537548	(78.34)	4677502	(80.76)	
Total	11,583,624	(100.00)	5791812	(100.00)	5791812	(100.00)	

Table 2. MFPC of general population

(Means±SD)

	Total		Period				p-value
			Before(2019)		After(2020)		
Gender							
Man	0.9502	±0.1221	0.9515	±0.1207	0.9488	±0.1235	<.0001
Woman	0.9488	±0.1218	0.9499	±0.1204	0.9477	±0.1231	<.0001
Age group							
75 and more	0.9427	±0.1274	0.9457	±0.1241	0.9400	±0.1303	<.0001
60 to 74	0.9516	±0.1189	0.9533	±0.1167	0.9500	±0.1208	<.0001
45 to 59	0.9530	±0.1196	0.9526	±0.1200	0.9535	±0.1191	<.0001
30 to 44	0.9409	±0.1344	0.9387	±0.1364	0.9435	±0.1320	<.0001
0 to 29	0.9313	±0.1454	0.9284	±0.1477	0.9350	±0.1424	0.0007
Diabetes Mellitus							
Yes	0.9538	±0.1161	0.9553	±0.1142	0.9524	±0.1178	<.0001
No	0.9480	±0.1238	0.9492	±0.1224	0.9468	±0.1252	<.0001
Hypertension							
less than 2 years	0.9402	±0.1327	0.9373	±0.1354	0.9467	±0.1262	<.0001
2 to 4 years	0.9514	±0.1210	0.9517	±0.1205	0.9510	±0.1215	<.0001
5 to 9 years	0.9511	±0.1206	0.9523	±0.1193	0.9499	±0.1221	<.0001
10 years and more	0.9492	±0.1215	0.9517	±0.1184	0.9468	±0.1242	<.0001
Insurance type							
Medical aid	0.9479	±0.1215	0.9486	±0.1207	0.9472	±0.1224	<.0001
NHI	0.9496	±0.1220	0.9508	±0.1205	0.9483	±0.1234	<.0001
Region (province)							
Sejong-si	0.9426	±0.1301	0.9434	±0.1294	0.9418	±0.1308	0.1912
Jeju-si	0.9530	±0.1174	0.9511	±0.1203	0.9550	±0.1144	<.0001
Gyeongsangnam-do	0.9531	±0.1173	0.9519	±0.1186	0.9543	±0.1159	<.0001
Gyeongsangbuk-do	0.9505	±0.1198	0.9529	±0.1171	0.9482	±0.1225	<.0001
Jeollanam-do	0.9449	±0.1246	0.9475	±0.1212	0.9423	±0.1279	<.0001
Jeollabuk-do	0.9522	±0.1177	0.9506	±0.1198	0.9537	±0.1156	<.0001
Chungcheongnam-do	0.9459	±0.1248	0.9461	±0.1248	0.9457	±0.1248	0.2047
Chungcheongbuk-do	0.9484	±0.1226	0.9517	±0.1186	0.9451	±0.1263	<.0001
Gangwon-do	0.9475	±0.1232	0.9521	±0.1174	0.9430	±0.1286	<.0001
Gyeonggi-do	0.9475	±0.1251	0.9488	±0.1236	0.9462	±0.1267	<.0001
Ulsan-si	0.9559	±0.1148	0.9597	±0.1091	0.9521	±0.1201	<.0001
Daejeon-si	0.9522	±0.1183	0.9526	±0.1180	0.9518	±0.1186	0.0690
Gwangju-si	0.9476	±0.1238	0.9497	±0.1214	0.9456	±0.1260	<.0001
Daegu-si	0.9560	±0.1134	0.9553	±0.1149	0.9567	±0.1119	<.0001
Incheon-si	0.9521	±0.1190	0.9522	±0.1191	0.9519	±0.1189	0.1824
Busan-si	0.9531	±0.1182	0.9559	±0.1146	0.9504	±0.1216	<.0001
Seoul-si	0.9474	±0.1248	0.9485	±0.1235	0.9462	±0.1261	<.0001
Institution type							

Tertiary hospitals	0.9287	±0.1532	0.9271	±0.1545	0.9304	±0.1520	<.0001
General hospitals	0.9457	±0.1328	0.9453	±0.1329	0.9462	±0.1328	0.0004
Hospitals	0.9365	±0.1398	0.9342	±0.1419	0.9388	±0.1375	<.0001
Public health centers	0.9269	±0.1392	0.9436	±0.1249	0.8930	±0.1592	<.0001
Clinics	0.9525	±0.1170	0.9537	±0.1155	0.9513	±0.1184	<.0001
Total	0.9495	±0.1219	0.9507	±0.1205	0.9483	±0.1233	<.0001

Table 3. Number of outpatient clinic visit per patient (Means±SD)

	Total		Period				p-value
			Before(2019)		After(2020)		
Gender							
Man	7.9359	±4.9085	8.0210	±4.8419	7.8509	±4.9727	<.0001
Woman	8.5211	±5.3288	8.6337	±5.3613	8.4084	±5.2937	<.0001
Age group							
75 and more	9.1481	±6.4048	9.3258	±6.4997	8.9850	±6.3121	<.0001
60 to 74	8.2590	±4.9318	8.3717	±4.9426	8.1498	±4.9188	<.0001
45 to 59	7.6344	±4.2311	7.7310	±4.1811	7.5289	±4.2825	<.0001
30 to 44	7.2854	±4.3218	7.3500	±4.1215	7.2085	±4.5474	<.0001
0 to 29	6.9444	±4.6984	7.0664	±4.4038	6.7961	±5.0297	<.0001
Diabetes Mellitus							
Yes	8.8972	±5.3672	9.0337	±5.3461	8.7701	±5.3836	<.0001
No	8.0155	±5.0380	8.1130	±5.0307	7.9156	±5.0434	<.0001
Hypertension							
less than 2 years	7.7525	±4.1013	7.6707	±4.1057	7.9384	±4.0852	<.0001
2 to 4 years	7.7778	±4.3948	7.9137	±4.4198	7.6497	±4.3673	<.0001
5 to 9 years	8.0065	±4.8322	8.1278	±4.8228	7.8786	±4.8387	<.0001
10 years and more	8.5375	±5.5548	8.6758	±5.5768	8.4107	±5.5316	<.0001
Insurance type							
Medical aid	10.2440	±7.1895	10.3710	±7.2322	10.1173	±7.1443	<.0001
NHI	8.1390	±4.9963	8.2369	±4.9791	8.0411	±5.0115	<.0001
Region (province)							
Sejong-si	8.3671	±4.7620	8.5040	±4.8872	8.2302	±4.6295	<.0001
Jeju-si	8.0476	±4.5007	8.1087	±4.4124	7.9865	±4.5866	<.0001
Gyeongsangnam-do	8.3869	±4.9862	8.4923	±4.9973	8.2815	±4.9729	<.0001
Gyeongsangbuk-do	8.7201	±4.9404	8.8362	±4.9922	8.6040	±4.8854	<.0001
Jeollanam-do	9.2460	±7.0298	9.3577	±7.0874	9.1343	±6.9699	<.0001
Jeollabuk-do	9.3156	±6.6059	9.3957	±6.5387	9.2355	±6.6716	<.0001
Chungcheongnam-do	8.6725	±5.7471	8.7796	±5.6281	8.5654	±5.8617	<.0001
Chungcheongbuk-do	8.5476	±5.0932	8.6793	±5.0696	8.4158	±5.1133	<.0001
Gangwon-do	7.9901	±4.3045	8.1072	±4.2810	7.8730	±4.3248	<.0001
Gyeonggi-do	7.7192	±4.5631	7.8172	±4.5204	7.6211	±4.6033	<.0001
Ulsan-si	7.8877	±4.3847	7.9901	±4.4511	7.7854	±4.3148	<.0001
Daejeon-si	8.7308	±4.9401	8.8511	±5.0355	8.6105	±4.8399	<.0001
Gwangju-si	8.9130	±5.9559	8.9953	±6.0133	8.8308	±5.8969	<.0001
Daegu-si	8.8127	±5.2820	8.9259	±5.2352	8.6994	±5.3259	<.0001
Incheon-si	8.2082	±4.7261	8.3253	±4.7811	8.0910	±4.6675	<.0001
Busan-si	8.1732	±4.4690	8.2547	±4.4206	8.0918	±4.5155	<.0001
Seoul-si	7.8048	±5.2366	7.8836	±5.2198	7.7259	±5.2521	<.0001
Institution type							

Tertiary hospitals	4.9222	±3.2682	5.0216	±3.1665	4.8233	±3.3635	<.0001
General hospitals	5.6255	±3.3779	5.7621	±3.2843	5.4895	±3.4632	<.0001
Hospitals	7.0832	±4.5357	7.1699	±4.2724	6.9951	±4.7869	<.0001
Public health centers	5.9143	±3.0225	6.0694	±3.2127	5.6009	±2.5673	<.0001
Clinics	8.8159	±5.2848	8.9524	±5.3055	8.6834	±5.2613	<.0001
Total	8.2355	±5.1363	8.3347	±5.1236	8.1363	±5.1471	<.0001

Table 4. Impact of the COVID-19 protocols on MFPC

	With telemedicine cases						Without telemedicine cases					
	β	S.E.	95% Confidence Limits		Z	p-value	β	S.E.	95% Confidence Limits		Z	p-value
Intercept	0.939	0.0011	0.9369	0.9412	858.89	<.0001	0.9389	0.0011	0.9368	0.9411	855.71	<.0001
Period												
After(2020)	-0.0031	0.0001	-0.0032	-0.0030	-48.3800	<.0001	-0.0031	0.0001	-0.0032	-0.0029	-47.90	<.0001
Before(2019)	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Gender												
Man	0.0003	0.0001	0.0001	0.0005	3.7600	0.0002	0.0003	0.0001	0.0002	0.0005	3.92	<.0001
Woman	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Age group												
75 and more	0.0071	0.0011	0.0049	0.0092	6.4800	<.0001	0.0072	0.0011	0.0050	0.0093	6.55	<.0001
60 to 74	0.0148	0.0011	0.0127	0.0170	13.6500	<.0001	0.0149	0.0011	0.0128	0.0171	13.70	<.0001
45 to 59	0.0160	0.0011	0.0138	0.0181	14.6900	<.0001	0.0160	0.0011	0.0139	0.0182	14.70	<.0001
30 to 44	0.0052	0.0011	0.0031	0.0074	4.7400	<.0001	0.0052	0.0011	0.0031	0.0074	4.75	<.0001
0 to 29	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Diabetes Mellitus												
Yes	0.0067	0.0001	0.0066	0.0069	77.6800	<.0001	0.0067	0.0001	0.0066	0.0069	77.74	<.0001
No	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Hypertension												
less than 2 years	-0.0102	0.0002	-0.0105	-0.0098	-56.6300	<.0001	-0.0101	0.0002	-0.0105	-0.0098	-56.41	<.0001
2 to 4 years	0.0007	0.0001	0.0005	0.0009	6.4400	<.0001	0.0007	0.0001	0.0005	0.0009	6.51	<.0001
5 to 9 years	0.0005	0.0001	0.0003	0.0007	5.0500	<.0001	0.0005	0.0001	0.0003	0.0007	4.96	<.0001
10 years and more	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
CCI	-0.0039	0.0000	-0.0040	-0.0039	-89.3700	<.0001	-0.0039	0.0000	-0.0040	-0.0039	-89.16	<.0001
Insurance type												
Medical aid	0.0004	0.0002	0.0001	0.0008	2.3000	0.0214	0.0004	0.0002	0.0001	0.0008	2.23	0.0258
NHI	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Region (province)												
Sejong-si	-0.0057	0.0007	-0.0070	-0.0044	-8.5100	<.0001	-0.0057	0.0007	-0.0070	-0.0044	-8.55	<.0001
Jeju-si	0.0060	0.0004	0.0053	0.0067	16.8200	<.0001	0.0060	0.0004	0.0053	0.0067	16.84	<.0001
Gyeongsangnam-do	0.0075	0.0002	0.0072	0.0079	42.4500	<.0001	0.0076	0.0002	0.0072	0.0079	42.61	<.0001
Gyeongsangbuk-do	0.0042	0.0002	0.0039	0.0046	22.9800	<.0001	0.0044	0.0002	0.0041	0.0048	24.08	<.0001
Jeollanam-do	-0.0002	0.0002	-0.0006	0.0002	-1.0000	0.3166	-0.0002	0.0002	-0.0006	0.0002	-0.86	0.3906
Jeollabuk-do	0.0063	0.0002	0.0059	0.0067	30.5300	<.0001	0.0063	0.0002	0.0059	0.0068	30.53	<.0001
Chungcheongnam-do	-0.0009	0.0002	-0.0013	-0.0004	-4.0100	<.0001	-0.0009	0.0002	-0.0013	-0.0004	-3.99	<.0001
Chungcheongbuk-do	0.0011	0.0002	0.0006	0.0015	4.7200	<.0001	0.0012	0.0002	0.0007	0.0016	5.11	<.0001
Gangwon-do	0.0011	0.0002	0.0007	0.0016	5.0600	<.0001	0.0012	0.0002	0.0007	0.0016	5.23	<.0001
Gyeonggi-do	0.0001	0.0001	-0.0002	0.0003	0.4600	0.6459	0.0001	0.0001	-0.0002	0.0003	0.43	0.6686
Ulsan-si	0.0084	0.0003	0.0078	0.0089	30.1700	<.0001	0.0084	0.0003	0.0078	0.0089	30.06	<.0001

Daejeon-si	0.0037	0.0003	0.0033	0.0042	14.9500	<.0001	0.0037	0.0003	0.0032	0.0042	14.88	<.0001
Gwangju-si	0.0017	0.0003	0.0012	0.0022	6.1700	<.0001	0.0017	0.0003	0.0012	0.0022	6.19	<.0001
Daegu-si	0.0089	0.0002	0.0086	0.0093	46.1800	<.0001	0.0088	0.0002	0.0084	0.0092	45.17	<.0001
Incheon-si	0.0043	0.0002	0.0040	0.0047	23.2700	<.0001	0.0043	0.0002	0.0039	0.0047	22.90	<.0001
Busan-si	0.0072	0.0002	0.0068	0.0075	41.3900	<.0001	0.0074	0.0002	0.0070	0.0077	42.39	<.0001
Seoul-si	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Institution type												
Tertiary hospitals	-0.0227	0.0003	-0.0233	-0.0221	-72.3400	<.0001	-0.0232	0.0003	-0.0238	-0.0226	-73.22	<.0001
General hospitals	-0.0065	0.0002	-0.0068	-0.0062	-41.2600	<.0001	-0.0068	0.0002	-0.0071	-0.0064	-42.62	<.0001
Hospitals	-0.0167	0.0002	-0.0171	-0.0163	-83.3900	<.0001	-0.0168	0.0002	-0.0172	-0.0164	-83.97	<.0001
Public health centers	-0.0100	0.0002	-0.0105	-0.0096	-42.2100	<.0001	-0.0103	0.0002	-0.0108	-0.0099	-43.40	<.0001
Clinics	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-

Table 5. Impact of the COVID-19 protocols on the number of outpatient clinic visit per patient

	With telemedicine cases						Without telemedicine cases					
	β	S.E.	95% Confidence Limits		Z	p-value	β	S.E.	95% Confidence Limits		Z	p-value
Intercept	8.0054	0.0353	7.9363	8.0745	227.06	<.0001	8.0105	0.0354	7.9411	8.0799	226.24	<.0001
Period												
After(2020)	-0.2930	0.0016	-0.2962	-0.2899	-181.43	<.0001	-0.3330	0.0016	-0.3362	-0.3299	-205.22	<.0001
Before(2019)	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Gender												
Man	-0.2548	0.0039	-0.2624	-0.2472	-65.77	<.0001	-0.2527	0.0039	-0.2603	-0.2451	-65.13	<.0001
Woman	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Age group												
75 and more	0.9864	0.0351	0.9176	1.0552	28.10	<.0001	0.9921	0.0353	0.9230	1.0612	28.14	<.0001
60 to 74	0.3353	0.0348	0.2671	0.4035	9.63	<.0001	0.3385	0.0350	0.2700	0.4071	9.69	<.0001
45 to 59	-0.1031	0.0347	-0.1711	-0.0350	-2.97	0.0030	-0.1040	0.0349	-0.1724	-0.0356	-2.98	0.0029
30 to 44	-0.2437	0.0350	-0.3124	-0.1750	-6.95	<.0001	-0.2434	0.0352	-0.3124	-0.1745	-6.92	<.0001
0 to 29	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
DB												
Yes	0.5026	0.0039	0.4950	0.5103	128.97	<.0001	0.5012	0.0039	0.4936	0.5089	128.37	<.0001
No	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Hypertension												
less than 2 years	-0.1023	0.0058	-0.1137	-0.0909	-17.58	<.0001	-0.1043	0.0058	-0.1157	-0.0929	-17.88	<.0001
2 to 4 years	-0.2898	0.0042	-0.2980	-0.2815	-69.11	<.0001	-0.2874	0.0042	-0.2956	-0.2792	-68.38	<.0001
5 to 9 years	-0.1826	0.0036	-0.1897	-0.1756	-50.95	<.0001	-0.1818	0.0036	-0.1888	-0.1747	-50.54	<.0001
10 years and more	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
CCI	0.1220	0.0020	0.1180	0.1260	59.93	<.0001	0.1226	0.0020	0.1186	0.1266	60.00	<.0001
Insurance type												
Medical aid	1.8853	0.0127	1.8605	1.9101	148.96	<.0001	1.8804	0.0127	1.8555	1.9052	148.34	<.0001
NHI	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Region (province)												
Sejong-si	0.4773	0.0276	0.4233	0.5314	17.31	<.0001	0.4713	0.0276	0.4173	0.5254	17.09	<.0001
Jeju-si	0.3895	0.0152	0.3597	0.4193	25.62	<.0001	0.3941	0.0152	0.3643	0.4239	25.91	<.0001
Gyeongsangnam-do	0.8056	0.0087	0.7886	0.8226	92.90	<.0001	0.8034	0.0087	0.7864	0.8205	92.50	<.0001
Gyeongsangbuk-do	1.0135	0.0087	0.9966	1.0305	117.04	<.0001	0.9992	0.0087	0.9822	1.0162	115.13	<.0001
Jeollanam-do	1.4879	0.0133	1.4619	1.5139	112.12	<.0001	1.4892	0.0133	1.4631	1.5152	112.12	<.0001
Jeollabuk-do	1.4908	0.0128	1.4658	1.5158	116.84	<.0001	1.4862	0.0128	1.4612	1.5113	116.39	<.0001
Chungcheongnam-do	0.9117	0.0111	0.8899	0.9335	82.10	<.0001	0.9063	0.0111	0.8845	0.9281	81.55	<.0001
Chungcheongbuk-do	0.7342	0.0110	0.7126	0.7558	66.60	<.0001	0.7355	0.0111	0.7139	0.7572	66.49	<.0001
Gangwon-do	0.3207	0.0092	0.3026	0.3387	34.80	<.0001	0.3257	0.0092	0.3077	0.3438	35.32	<.0001
Gyeonggi-do	0.0425	0.0058	0.0310	0.0540	7.27	<.0001	0.0414	0.0059	0.0299	0.0529	7.07	<.0001
Ulsan-si	0.3330	0.0124	0.3088	0.3573	26.90	<.0001	0.3265	0.0124	0.3023	0.3508	26.39	<.0001

Daejeon-si	0.8033	0.0120	0.7798	0.8267	67.18	<.0001	0.7987	0.0120	0.7753	0.8222	66.77	<.0001
Gwangju-si	1.2873	0.0148	1.2583	1.3164	86.77	<.0001	1.2666	0.0148	1.2375	1.2957	85.30	<.0001
Daegu-si	0.9177	0.0101	0.8978	0.9376	90.43	<.0001	0.8831	0.0102	0.8632	0.9031	86.76	<.0001
Incheon-si	0.4702	0.0085	0.4535	0.4870	55.11	<.0001	0.4712	0.0085	0.4545	0.4880	55.15	<.0001
Busan-si	0.5357	0.0077	0.5206	0.5508	69.61	<.0001	0.5343	0.0077	0.5192	0.5494	69.32	<.0001
Seoul-si	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-
Institution type												
Tertiary hospitals	-3.5721	0.0114	-3.5944	-3.5498	-314.18	<.0001	-3.5519	0.0114	-3.5743	-3.5296	-311.21	<.0001
General hospitals	-3.0503	0.0059	-3.0619	-3.0387	-515.35	<.0001	-3.0425	0.0059	-3.0541	-3.0309	-513.34	<.0001
Hospitals	-1.6180	0.0081	-1.6338	-1.6021	-200.52	<.0001	-1.6121	0.0081	-1.6279	-1.5963	-199.96	<.0001
Public health centers	-2.1993	0.0065	-2.2120	-2.1866	-339.53	<.0001	-2.2147	0.0065	-2.2275	-2.2020	-340.67	<.0001
Clinics	Ref.	-	-	-	-	-	Ref.	-	-	-	-	-