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Trends in the Quality of Primary Care and Acute Care in Korea From 2008 to 2020: A Cross-sectional Study

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Objectives: Measuring the quality of care is paramount to inform policies for healthcare services. Nevertheless, little is known about the quality of primary care and acute care provided in Korea. This study investigated trends in the quality of primary care and acute care.

Methods: Case-fatality rates and avoidable hospitalization rates were used as performance indicators to assess the quality of primary care and acute care. Admission data for the period 2008 to 2020 were extracted from the National Health Insurance Claims Database. Case-fatality rates and avoidable hospitalization rates were standardized by age and sex to adjust for patients' characteristics over time, and significant changes in the rates were identified by joinpoint regression.

Results: The average annual percent change in age-/sex-standardized case-fatality rates for acute myocardial infarction was -2.3% (95% confidence interval, -4.6 to 0.0). For hemorrhagic and ischemic stroke, the age-/sex-standardized case-fatality rates were 21.8% and 5.9%, respectively in 2020; these rates decreased since 2008 (27.1 and 8.7%, respectively). The average annual percent change in age-/sex-standardized avoidable hospitalization rates ranged from -9.4% to -3.0%, with statistically significant changes between 2008 and 2020. In 2020, the avoidable hospitalization rates decreased considerably compared with the 2019 rate because of the coronavirus disease 2019 pandemic.

Conclusions: The avoidable hospitalization rates and case-fatality rates decreased overall during the past decade, but they were relatively high compared with other countries. Strengthening primary care is an essential requirement to improve patient health outcomes in the rapidly aging Korean population.

Key words: Acute care, Primary care, Case-fatality rate, Avoidable hospitalization, National Health Insurance Claims Database

INTRODUCTION

Strengthening primary care and acute care is a high-priority policy goal to ensure better health outcomes and lower costs amid rapidly rising medical expenditures in healthcare systems globally [1,2]. To achieve these goals, measuring the quality of care has been emphasized worldwide over the past several decades [3].

Different countries measure the quality of care provided in their healthcare systems using various quality indicators, but avoidable hospitalization rates (AHRs) for chronic ambulatory

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care-sensitive conditions (ACSCs) and case-fatality rates (CFRs) for acute myocardial infarction (AMI) and stroke are widely used as performance indicators [4,5]. ACSCs such as diabetes and chronic obstructive pulmonary disease (COPD) are diseases for which accessible and effective primary care can reduce the risk of complications and preventive hospitalizations. NHS Digital, the Centers for Medicare and Medicaid Services, and the Agency for Healthcare Research and Quality [6-8] have measured AHRs to provide stakeholders with information that enables them to identify policy interventions to improve the quality of primary care. The CFRs for AMI and stroke reflect the quality of acute care provided, such as whether effective medical interventions were employed and if the patient was transported rapidly enough [3]. Moreover, the Organization for Economic Cooperation and Development (OECD) regularly collects AHRs and CFRs to compare the performance of healthcare systems among OECD member countries.

Measuring the quality of care may provide stakeholders with important evidence for policy development and decision-making [1]. Nevertheless, little is known about the quality of primary care and acute care provided in Korea. This study aimed to examine trends in the quality of primary care and acute care provided in Korea and explore factors that have contributed to changes using a population-based nationwide database.

METHODS

This population-based, cross-sectional study used data from the National Health Insurance Claims Database (NHICD) collected by the Health Insurance Review & Assessment Service (HIRA). Admission data for the period 2008 to 2020 were extracted from the NHICD, which contained patients' medical records, including the diagnosis, medication prescribed, and examination notes [9]. The occurrence of death within 30 days of admission of patients who were diagnosed with AMI or stroke was obtained by linking the NHICD to the Resident Registration System of the Ministry of the Interior and Safety.

Variables and Measures

CFRs and AHRs were used to investigate the quality of primary care and acute care, respectively. There is no consensus on which conditions should be included in the list of ACSCs [10]. This study included AHRs for asthma, COPD, congestive heart failure (CHF), hypertension, and diabetes, which were collected by the OECD, to compare them with other countries. The AHR was defined as the number of hospital admissions with a principal diagnosis of certain diseases among people aged 15 years and older per 100 000 people. International Classification of Disease, 10th revision (ICD-10) codes for the diseases that we included in our study are as follows: asthma (J45.x, J46.x), COPD (J40, J41.x, J42, J43.x, J44.x), CHF (I11.0, I13.0, I13.2, I50.0, I50.1, I50.9), hypertension (I10.x, I11.9, I12.9, I13.9), and diabetes (E10.x, E11.x, E13.x, E14.x). Admissions resulting from the transfer of a patient from another hospital and where the patient died during the admission process were excluded from the study sample, as these deaths were considered to be unavoidable [11]. Data regarding the number of the general population were obtained from the National Statistical Office of Korea and utilized as the denominator for the AHR.

AMI and stroke are representative of diseases requiring acute care within the "golden hour" [12]. We included CFRs for AMI and stroke, which were also collected by the OECD. The CFR is defined as the percentage of patients aged 45 years and older who die within 30 days following admission with a primary diagnosis of AMI (ICD-10: I21.x, I22.x) and stroke (ICD-10: I60.x-I62.x for hemorrhagic stroke, I63.x and I64.x for ischemic stroke).

Statistical Analysis

The CFRs and AHRs were calculated for the period from 2008 to 2020, and then standardized by age and sex to adjust for patients' characteristics over time. Age-/sex-standardized CFRs and AHRs were estimated using the direct method with reference to the 2010 OECD population aged 45 years and older admitted to hospitals for AMI or stroke, and the 2010 OECD population aged 15 years and older, respectively [11]. Changes in age-/sex-standardized CFRs and AHRs were quantified by joinpoint regression, which was utilized to find the inflection points. In years in which trend changes occurred, the annual percent change (APC), the average annual percent change (AAPC), and their 95% confidence intervals (CIs) were estimated. The slopes were categorized as increasing or decreasing if the estimated slope differed significantly from 0 [13].

For statistical analysis, SAS Enterprise Guide 7.1. (SAS Institute Inc., Cary, NC, USA) and Joinpoint regression version 4.9.0.1 (National Cancer Institute, Bethesda, MD, USA) were used. A p-value <0.05 was considered statistically significant.

Ethics Statement

This study was approved by the Institutional Review Board of the HIRA (No. 2023-038-001).

Table 1. Trends in the age-/sex-standardized case-fatality rate and avoidable hospitalization rate from 2008 to 2020

Indicators	Conditions	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Age-/sex-standardized case-fatality rate (%)	AMI	14.2	12.9	12.2	10.9	10.8	10.6	10.3	10.2	12.1	12.0	11.2	11.0	10.6
	Hemorrhagic stroke	27.1	26.6	26.4	26.3	24.8	24.9	23.3	22.7	22.7	22.6	22.1	21.7	21.8
	Ischemic stroke	8.7	8.0	8.1	7.8	7.6	7.3	7.1	6.7	6.5	6.2	5.6	5.8	5.9
Age-/sex-standardized avoidable hospitalization rate (per 100 000 population)	Asthma	113.7	107.0	100.5	98.6	105.2	94.5	91.2	91.4	86.8	81.3	74.8	65.0	38.5
	COPD	249.5	233.3	216.7	207.1	230.5	201.6	206.8	209.3	194.0	183.1	181.8	152.4	88.5
	CHF	113.6	108.2	105.7	100.2	96.4	89.5	90.3	90.5	89.5	88.7	91.6	88.5	77.2
	Hypertension	196.2	206.1	199.6	161.0	143.9	130.3	121.9	113.5	104.6	92.0	82.0	74.1	56.3
	Diabetes	349.6	351.7	344.8	322.3	302.3	289.8	277.0	264.2	259.9	246.1	237.8	224.7	191.2

AMI, acute myocardial infarction; COPD, chronic obstructive pulmonary diseases; CHF, congestive heart failure.

RESULTS

Changes in Case-fatality Rates for Acute Myocardial Infarction and Stroke

As shown in Table 1, the age-/sex-standardized CFRs for AMI and stroke decreased significantly between 2008 and 2020. The CFR for AMI in 2008 was 14.2%, while in 2020 it was 10.6%. The AAPC was -2.3% (95% CI, -4.6 to 0.0) with borderline significance (Table 2). Joinpoints were detected in 2013 and 2017. The APC between 2013 and 2017 increased, but this increase was not statistically significant ($p=0.154$).

With regard to hemorrhagic stroke, the age-/sex-standardized CFR was 21.8% in 2020 and decreased steadily since 2008 (27.1%), with an AAPC of -1.8% (95% CI, -2.7 to -0.9). We found that the downward trend between 2011 and 2015 was significantly greater than in other periods. Our results indicate that the age-/sex-standardized CFR for ischemic stroke decreased overall, without any inflection points, and the AAPC was -3.5% (95% CI, -4.0 to -3.1).

Changes in Avoidable Hospitalization Rates

The age-/sex-standardized AHRs for all diseases decreased considerably between 2008 and 2020 (Table 1). In 2020, the AHRs for asthma and COPD were 38.5 per 100 000 people and 88.5 per 100 000 people, respectively; the AAPC was -7.8% (95% CI, -10.1 to -5.5) and -7.1% (95% CI, -10.3 to -3.9), respectively (Table 2). Asthma and COPD had the same inflection point, and the APCs for the 2018 to 2020 period (-27.4 and -27.2%, respectively) were larger than those for the 2008 to 2018 period (-3.3 and -2.5%, respectively). Unlike other diseases, the AHR for CHF increased only slightly between 2013 and 2018, and the APC did not show a significant change (0.1%; 95% CI, -0.8 to 0.9; $p=0.860$). The AHRs for hypertension and diabetes were 56.3 per 100 000 and 191.2 per 100 000 people in 2020, respectively, reflecting decreases of 71.3% and 45.3%, respectively, since 2008 with no inflection point.

DISCUSSION

After 2008, the age-/sex-standardized CFRs for hemorrhagic and ischemic strokes decreased, with AAPCs of -1.8% and -3.5%, respectively. The age-/sex-standardized CFR for AMI increased temporarily between 2013 and 2017, but decreased again after 2017. The age-/sex-standardized AHRs also decreased substantially. In particular, a relatively large decrease was observed in 2020 during the coronavirus disease 2019 (COVID-19) pandemic.

The age-/sex-standardized CFRs for AMI, and hemorrhagic and ischemic strokes decreased between 2008 and 2020. The decrease in CFRs observed in this study is in line with previous trends in other countries [14-16]. The health outcomes of AMI and stroke patients are determined not only by rapid and effective medical interventions in the hospital, but also by interventions outside the hospital, such as the management of risk factors for cardio/cerebrovascular disease, emergency responses, and timely transport of patients. Many countries, including Korea, have implemented a variety of interventions to improve health outcomes, which have resulted in a decrease in mortality [3]. Lecoffre et al. [17] reported that France established a national strategy for the management of stroke patients, including the establishment of stroke units in hospitals in 2000, and as a result, in-hospital mortality decreased by 17.1% in patients with ischemic stroke. In Korea, the decrease in CFRs for AMI and stroke can be explained by improvements in therapeutic technologies and effective interventions implemented by clinical societies and the Ministry of Health and

Table 2. Results of joinpoint regression for the case-fatality rate and avoidable hospitalization rate

Variables	Segment 1	APC (95% CI)	*p*-value	Segment 2	APC (95% CI)	*p*-value	Segment 3	APC (95% CI)	*p*-value	AAPC (95% CI)	*p*-value
Age-/sex-standardized case-fatality rate (%)											
AMI	2008-2013	-6.3 (-9.3, -3.3)	0.003	2013-2017	4.5 (-2.3, 11.8)	0.154	2017-2020	-4.3 (-10.3, 2.1)	0.141	-2.3 (-4.6, 0.0)	0.047
Hemorrhagic stroke	2008-2011	-1.1 (-3.5, 1.5)	0.321	2011-2015	-3.3 (-5.9, -0.7)	0.022	2015-2020	-1.0 (-2.1, 0.2)	0.083	-1.8 (-2.7, -0.9)	<0.001
Ischemic stroke	2008-2020	-3.5 (-4.0, -3.1)	<0.001	-	-	-	-	-		-3.5 (-4.0, -3.1)	<0.001
Age-/sex-standardized avoidable hospitalization rate (per 100 000 population)											
Asthma	2008-2018	-3.3 (-4.1, -2.4)	<0.001	2018-2020	-27.4 (-38.8, -13.9)	0.003	-	-	-	-7.8 (-10.1, -5.5)	<0.001
COPD	2008-2018	-2.5 (-3.7, -1.3)	0.001	2018-2020	-27.2 (-42.5, -7.8)	0.015	-	-	-	-7.1 (-10.3, -3.9)	<0.001
CHF	2008-2013	-4.6 (-5.0, -4.1)	<0.001	2013-2018	0.1 (-0.8, 0.9)	0.860	2018-2020	-6.6 (-9.4, -3.8)	0.002	-3.0 (-3.5, -2.5)	<0.001
Hypertension	2008-2020	-9.4 (-10.5, -8.3)	<0.001	-	-	-	-	-	-	-9.4 (-10.5, -8.3)	<0.001
Diabetes	2008-2020	-4.5 (-5.0, -4.0)	<0.001	-	-	-	-	-	-	-4.5 (-5.0, -4.0)	<0.001

APC, annual percent change; AAPC, average annual percent change; AMI, acute myocardial infarction; COPD, chronic obstructive pulmonary diseases; CHF, congestive heart failure; CI, confidence interval.

Welfare (MOHW). The Korean Society of Cardiology has implemented a cardiovascular intervention institute/specialist certification system [18], and the Korean Stroke Society strongly recommended the establishment of stroke units within hospitals [19]. Nationwide programs have been implemented by national institutions commissioned by the MOHW. The HIRA conducted the National Quality Assessment Program (NQAP) [20] and the National Medical Center evaluated emergency medical services institutions [21]. In addition, regional cardio/cerebrovascular centers were designated to provide comprehensive condition management [22].

Compared with OECD countries based on the 2019 data, the age-/sex-standardized CFR of 11.0% for AMI was higher than the OECD average of 8.8%, while the CFR for stroke was lower than the OECD average, showing contradictory results [23]. This can be explained by considering in-hospital and out-of-hospital factors [1]. With regard to in-hospital factors, the quality of in-hospital care has improved in terms of a decrease in CFRs for AMI and stroke over the past decade. The HIRA reported that the rates of brain scan and thrombolysis therapy initiated within 60 minutes of hospital arrival for ischemic stroke in 2018 were 99.1% and 94.9%, respectively, a significant increase compared with the 2008 rates (83.5 and 47.6%, respectively) [20]. In 2018, the number of emergency institutions that met the criteria, including health employment and physical and technical resources, was 91.0%, a substantial increase compared with the 2009 figures (40.0%) [21]. Regarding out-of-hospital factors, the following explanations can be given: first, the awareness of AMI and stroke symptoms in 2020 was low (50.6 and 57.5%, respectively) [24]. However, the awareness of the early symptoms of stroke was higher than that of AMI because the incidence of stroke in Korea is twice as high as that in Western countries. Because patients in Korea visit the hospital immediately after experiencing symptoms, there are many patients who are treated with mild symptoms, such as transient ischemic attacks. Second, the median time between symptom onset and hospital arrival for AMI gradually decreased from 156 minutes in 2008 to 140 minutes in 2012; however, this time was still longer than the recommended median time [18]. This means that patients present to hospitals long after the onset of symptoms and let the disease progress too long before seeking treatment. We suggest that promoting awareness and education about the symptoms of AMI and stroke is needed to improve patients' health outcomes. Lastly, a large portion of the incidence of AMI and stroke was

explained by major modifiable risk factors such as high blood pressure and diabetes. Kim et al. [18] reported that the prevalence of hypertension, diabetes, and dyslipidemia increased in AMI patients; therefore, it is possible that the patients' condition was already serious upon arrival at the hospital. In contrast, acute stroke events have become less frequent as a result of a decline in risk factors [21,25].

The AHRs showed an overall decline in the period studied, and the decrease was even greater in 2020 because of the COVID-19 pandemic. This downward trend was also reported in other countries [3]. In the United States, the AHRs for ACSC in 2014 were 1426 per 100 000 people, and this rate has been decreasing since 2005 [26]. In Korea, national programs such as the NQAP for chronic diseases [20], the Chronic Disease Care System program [27], the Korean Community-based Noncommunicable Disease Prevention and Control program [28], and the Pilot Project for Primary Care Chronic Disease Management [29] have been implemented to encourage the public to manage chronic diseases. According to the NQAP report on chronic diseases, the medication adherence rate in 2019 was 91.9% for both hypertension and diabetes, reflecting slight increases since 2011, when the rates were 88.9% and 88.0%, respectively [20]. In addition, the rates of treatment for patients with hypertension and diabetes improved substantially from 2005 to the period between 2016 to 2018 (hypertension: from 49.6 to 65.3%, diabetes: from 49.0 to 66.2%) [30].

Our results indicated that the AHRs of diabetes, asthma, and hypertension, but not COPD and CHF, were higher than that of OECD countries based on the 2019 data [23]. The age-/sex-standardized AHRs for asthma and diabetes were 65 per 100 000 people and 224.7 per 100 000 people, respectively, which were twice as high as the OECD averages (34.2 per 100 000 people and 116.2 per 100 000 people, respectively). Although the AHRs for COPD and CHF were lower than the OECD averages, the AHR for CHF (88.5 per 100 000 people) was about one-third of the OECD average of 213.6 per 100 000 people. The AHR for hypertension was 74.1 per 100 000 people, which was comparable to the OECD average of 73 per 100 000 people.

Previous studies have reported that high AHRs could be explained primarily by the healthcare delivery system, healthcare resources, and prevalence and severity of diseases [5,31]. Nevertheless, Korea's high AHRs may be caused by structural problems, including aspects of the healthcare delivery system and healthcare resources, such as the number of hospital beds. Although there are some limitations in comparing the prevalence of hypertension and diabetes because of different data sources and population age, the prevalence in Korea is not high compared with other countries [32,33]. Unfortunately, studies that compare the severity of these diseases among countries were not found. We suggest that the results of our study could possibly be explained by the nature of Korea's healthcare system, in that Korea has achieved universal health coverage with a private-oriented healthcare provider system in a short period of time. Similarly, the OECD reported that primary care in Korea's healthcare delivery system is not yet well-established, which is a major reason for the high AHRs compared with other OECD countries. The number of hospital beds available is one of the factors contributing to AHRs. Kim et al. [31] reported that a larger number of hospital beds was associated with increased AHRs for ACSCs in Korea.

This study was not without limitations. First, an examination of the CFRs and AHRs alone is not sufficient for a comprehensive investigation of the quality of acute care and primary care being provided. However, these have been found to be indirect indicators representing the level of the quality of emergency care provided and the care level involved in the management of patients with chronic diseases, respectively. In addition, many countries have used these indicators to assess the quality of care [34]. Second, patients admitted to hospital with the specified diseases were extracted from the NHICD based on the primary diagnosis. As the information in the NHICD is collected for payments of medical expenses, there may be scope for inaccuracies. However, the accuracy of diagnoses was higher for the diseases included in this study than for other diseases [35]. Third, the CFR and AHR in 2020 should be interpreted in the context of the COVID-19 pandemic. The CFRs for AMI and stroke in 2020 did not significantly increase compared to 2019, whereas the AHRs decreased considerably. These changes may reflect restrictions in access to health care resulting from hospital closures, rather than the quality of care provided during the pandemic. Lastly, factors affecting the indicators, including the severity of diseases and the age of the study population, were not clearly presented. Further exploratory studies are needed to investigate factors contributing to changes in the quality indicators.

The AHRs and CFRs, which are widely used performance indicators for primary care and acute care, respectively, have decreased overall over the past decade in Korea. Nevertheless, there are still further challenges to improving patients' health outcomes, including efforts to raise awareness of the causes

and signs of AMI and how to manage modifiable risk factors. The development of a functional and effective primary care system is the main priority for strengthening the quality of care in the rapidly aging Korean population.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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AUTHOR CONTRIBUTIONS

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REFERENCES

1. Organisation for Economic Cooperation and Development (OECD). OECD reviews of health care quality: Korea 2012 [cited 2022 Jul 22]. Available from: https://www.oecd.org/publications/oecd-reviews-of-health-care-quality-korea-9789264173446-en.htm.
2. Freund T, Campbell SM, Geissler S, Kunz CU, Mahler C, Peters-Klimm F, et al. Strategies for reducing potentially avoidable hospitalizations for ambulatory care-sensitive conditions. Ann Fam Med 2013;11(4):363-370.
3. Organisation for Economic Cooperation and Development (OECD). Health at a glance 2021: OECD indicators. Paris: OECD Publishing; 2021, p. 164-167.
4. Rocha JV, Santana R, Tello JE. Hospitalization for ambulatory care sensitive conditions: what conditions make inter-country comparisons possible? Health Policy Open 2021;2:100030.
5. Van Loenen T, Faber MJ, Westert GP, Van den Berg MJ. The impact of primary care organization on avoidable hospital admissions for diabetes in 23 countries. Scand J Prim Health Care 2016;34(1):5-12.
6. NHS Digital. NHS outcomes framework (NHS of): national statistics, open data, experimental statistics, official statistics; 2022 [cited 2022 Jul 22]. Available from: https://digital.nhs.uk/data-and-information/publications/statistical/nhs-outcomes-framework.
7. Centers for Medicare and Medicaid Services. 2021 National impact assessment of the Centers for Medicare & Medicaid Services (CMS) quality measures report [cited 2022 Jul 22]. Available from: https://www.cms.gov/files/document/2021-national-impact-assessment-report.pdf.
8. Agency for Healthcare Research and Quality (AHRQ). AHRQ quality indicators—guide to prevention quality indicators: hospital admission for ambulatory care sensitive conditions; 2001 [cited 2022 Jul 22]. Available from: https://www.ahrq.gov/downloads/pub/ahrqqi/pqiguide.pdf.
9. Kim JA, Yoon S, Kim LY, Kim DS. Towards actualizing the value potential of Korea Health Insurance Review and Assessment (HIRA) data as a resource for health research: strengths, limitations, applications, and strategies for optimal use of HIRA data. J Korean Med Sci 2017;32(5):718-728.
10. van Loenen T, van den Berg MJ, Westert GP, Faber MJ. Organizational aspects of primary care related to avoidable hospitalization: a systematic review. Fam Pract 2014;31(5):502-516.
11. Organisation for Economic Cooperation and Development. Health care quality and outcome (HCQO) 2020-21 indicator definitions [cited 2022 Jul 22]. Available from: https://oecd.org/els/health-systems/Definitions-of-Health-Care-Quality-Outcomes.pdf.
12. Cho KH, Nam CM, Lee SG, Kim TH, Lee SH, Park EC. Measuring of quality of care in patients with stroke and acute myocardial infarction: an application of algebra effectiveness model. Medicine (Baltimore) 2019;98(20):e15353.
13. Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. Stat Med 2000;19(3):335-351.
14. Kunst AE, Amiri M, Janssen F. The decline in stroke mortality: exploration of future trends in 7 Western European countries.

Stroke 2011;42(8):2126-2130.
15. Dégano IR, Salomaa V, Veronesi G, Ferriéres J, Kirchberger I, Laks T, et al. Twenty-five-year trends in myocardial infarction attack and mortality rates, and case-fatality, in six European populations. Heart 2015;101(17):1413-1421.
16. Salah HM, Minhas AM, Khan MS, Khan SU, Ambrosy AP, Blumer V, et al. Trends in hospitalizations for heart failure, acute myocardial infarction, and stroke in the United States from 2004 to 2018. Am Heart J 2022;243:103-109.
17. Lecoffre C, de Peretti C, Gabet A, Grimaud O, Woimant F, Giroud M, et al. National trends in patients hospitalized for stroke and stroke mortality in France, 2008 to 2014. Stroke 2017;48(11):2939-2945.
18. Kim Y, Ahn Y, Cho MC, Kim CJ, Kim YJ, Jeong MH. Current status of acute myocardial infarction in Korea. Korean J Intern Med 2019;34(1):1-10.
19. Han MK, Heo JH, Rha JH, Bae HJ, Yoon BW. Recommendations for the establishment of stroke unit in Korea. Korean J Stroke 2008;10:72-75 (Korean).
20. Health Insurance Review and Assessment Service (HIRA). 2019 Report on quality assessment: results from national quality assessment program. Wonju: HIRA; 2020, p. 109-119 (Korean).
21. Lee SW. National evaluation program for emergency medical center. J Korean Med Assoc 2020;63(4):184-186 (Korean).
22. Wang JM, Kim BO, Bae JW, Oh DJ. Implementation of national health policy for the prevention and control of cardiovascular disease in South Korea: regional-local cardio-cerebrovascular center and nationwide registry. Korean Circ J 2021;51(5):383-398.
23. Organisation for Economic Cooperation and Development (OECD). Health: health care quality indicators [cited 2022 Jul 22]. Available from: http://stats.oecd.org/.
24. Park KS. Factors affecting awareness of myocardial infarction symptoms among the general public in Korea. Epidemiol Health 2020;42:e2020032.
25. Hong KS, Bang OY, Kang DW, Yu KH, Bae HJ, Lee JS, et al. Stroke statistics in Korea: part I. Epidemiology and risk factors: a report from the Korean Stroke Society and Clinical Research Center for Stroke. J Stroke 2013;15(1):2-20.
26. Agency for Healthcare Research and Quality (AHRQ). National healthcare quality and disparities report chartbook; 2017 [cited 2022 Jul 22]. Available from: https://www.ahrq.gov/research/findings/nhqrdr/chartbooks/index.html.
27. Kim W, Choy YS, Lee SA, Park EC. Implementation of the Chronic Disease Care System and its association with health care costs and continuity of care in Korean adults with type 2 diabetes mellitus. BMC Health Serv Res 2018;18(1):991.
28. Lim SM, Seo SH, Park KS, Hwangbo Y, Suh Y, Ji S, et al. Performance of a community-based noncommunicable disease control program in Korea: patients 65 years of age or older. J Korean Med Sci 2020;35(31):e268.
29. Lee JJ, Bae SG. Implementation of a care coordination system for chronic diseases. Yeungnam Univ J Med 2019;36(1):1-7.
30. Kim S, Choi S, Kim J, Park S, Kim YT, Park O, et al. Trends in health behaviors over 20 years: findings from the 1998-2018 Korea National Health and Nutrition Examination Survey. Epidemiol Health 2021;43:e2021026.
31. Kim AM, Park JH, Yoon TH, Kim Y. Hospitalizations for ambulatory care sensitive conditions as an indicator of access to primary care and excess of bed supply. BMC Health Serv Res 2019;19(1):259.
32. Bae JH, Han KD, Ko SH, Yang YS, Choi JH, Choi KM, et al. Diabetes fact sheet in Korea 2021. Diabetes Metab J 2022;46(3):417-426.
33. Kim HC, Lee H, Lee HH, Seo E, Kim E, Han J, et al. Korea hypertension fact sheet 2021: analysis of nationwide population-based data with special focus on hypertension in women. Clin Hypertens 2022;28(1):1.
34. Rotar AM, van den Berg MJ, Kringos DS, Klazinga NS. Reporting and use of the OECD Health Care Quality Indicators at national and regional level in 15 countries. Int J Qual Health Care 2016;28(3):398-404.
35. Park BJ, Sung JH, Park KD, Seo SW, Kim SH. Report of the evaluation for validity of discharged diagnosis in Korean Health Insurance Database. Seoul: Seoul National University; 2003, p. 24-25 (Korean).