Impact of Diabetes Quality Assurance Program on Quality of Diabetes Care in Primary Care Clinics

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Impact of Diabetes Quality Assurance Program on Quality of Diabetes Care in Primary Care Clinics

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December, 2020

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ABSTRACT

Impact of Diabetes Quality Assurance Program on Quality of Diabetes Care in Primary Care Clinics

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Background: To improve the quality of diabetes care the Health Insurance Review and Assessment Service **(**HIRA) adopted the Diabetes Quality Assurance(DQA) program in 2011. The DQA program evaluates three components; continuity of care, prescription accuracy, and completion of examinations. Primary care clinics rated for high quality by the DQA program are reported to the public and receive additional payments. In this study, we evaluated the effect of the DQA program on DQA indicators and health outcomes associated with diabetes in primary care clinics.

Methods: The National Health Insurance Service National Sample Cohort 2002 to 2015 (NHIS-NSC 2002–2015) database was used. Diabetic Patients with newly prescribed hypoglycemic medications with diagnostic codes from January 2008 to December 2010 and January 2013

to December 2015 were included in this study. Patients with diabetes who mainly visited primary care clinics were defined as cases and patients who mainly visited general hospitals were defined as controls. Difference in differences analysis was used to investigate the impact of the DQA program on the quality of diabetes care.

Results: A total of 16,232 cases and 8,669 controls were included in the study population. Two indicators of continuity of care, visit every quarter rate (OR 1.086, p<0.0001) and medication rate (OR 1.091, p<0.0001), were improved. However, prescription accuracy did not significantly change over period and institution type. The odds ratios for completion of examinations, HbA1c test rate (OR 1.175, p<0.0001), cholesterol profile test rate (OR 1.043, p<0.0001), and fundoscopy (OR 1.134, p<0.0001), were increased. There was no significant difference between diabetic nephropathy (OR 1.127, p=0.215) and neuropathy (OR 1.181, p=0.073), microvascular complications of diabetes, but diabetic retinopathy (OR 1.497, p<0.0001) significantly increased. In the subgroup analysis the odds ratios for diabetic retinopathy significantly increased in all groups, except for the group that lived in rural areas.

Conclusion: The DQA program showed different effects for DQA indicators. It had a positive effect on the completion of examination

indicators and the continuity of care indicators. Moreover, it had no significant positive effects on prescription accuracy indicators. The DQA program showed different effects on health outcome variables. Myocardial infarction, stroke, angina pectoris and diabetic retinopathy significantly increased considering period and institution type. Therefore, to reduce the occurrence of complications, it is desirable to include levels such as HbA1c, blood pressure, and lipids, which are intermediate outcome indicators, as indicators of the DQA program.

Key words : diabetes; quality assurance; quality of care; difference in difference analysis

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I. INTRODUCTION

1. Assessing the quality of care

To improve the quality of health care, assessment and accountability are one of the main agenda since 1990s after the expansion and cost containment of health care.[1] In Korea, in the 1970s and 1980s, improving access to medical care was a major part of the policy, but in the 1990s, reduction of medical expenses and improvement of quality of care became important. Subsequently, in the 2000s, access to medical care, which aimed to strengthen medical security, became a policy goal, but in the 2010s, improving the quality of medical care emerged as a key policy task.[2] Definition of quality of health care varies depending on the researchers and institutions. The Institute of Medicine (IOM) defined health care quality as "the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge."[3] This means that the quality of medical care includes not only the results of individual treatment but

also the use of medical care in society, and the benefits should be greater than the risks by comparing the benefits and risks that can be obtained through the provision of health care services. Donabedian defined healthcare as the composition of healthcare systems and actions taken within them designed to improve health or well-being.[4] It was emphasized that the quality of health care services should be measured in units of the health care system. In addition, Donabedian divided the quality of medical care into a system-based framework by dividing it into structure, process, and outcome. [5] (Fig.1). The structure consists of material resources (facilities, equipment and money), human resources (number and qualification), and organizational structure, and the process refers to the patient search process, practitioner diagnosis, and treatment process occurring in the giving and receiving care process. Finally, outcome refers to the health status of the patient or group and includes satisfaction. These structures, processes, and outcomes are not independent, but the likelihood that a good process will come out of a good structure increases, and a good outcome is obtained. The quality of care can be evaluated only when there is an understanding of the linkages of these structures, processes, and results.

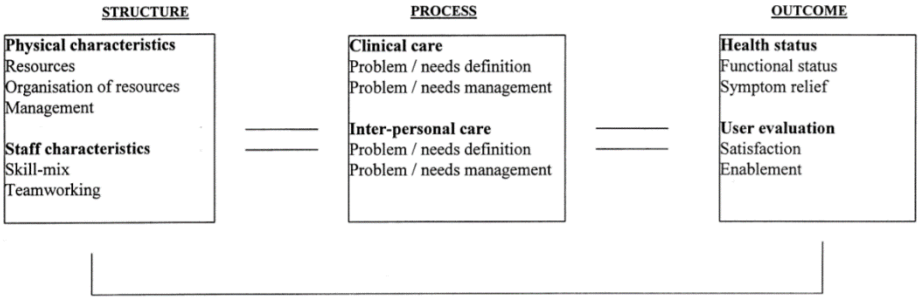

Figure 1 A system base model for assessing care[6]
Sources: Campbell SM, Roland MO, Buetow SA. Defining quality of care. *Social Science & Medicine*. 2000;51:1611-1625

Translating Research into Action for Diabetes(TRIAD) study was conducted by the Centers for Disease Control and National Institute of Diabetes and Digestive and Kidney Diseases.[7] TRIAD study was multicenter, prospective observational study for assessing associations between structures, strategies and quality of diabetes care and patient outcomes. It has three components based on the Donabedian's model for assessing health care. First, system factors(structure) consist of health system structure, disease management strategy (performance feedback, physician reminders, patient reminders, guideline use, formal case management, and patient education resources), management of referral care, clinician payments, incentives, cost-containment strategies and data systems. Second, the process of care consists of periodic HbA1c, lipid and microalbuminuria testing, retinal examinations, foot examination, smoking cessation counseling, and aspirin prescription. Third, health outcomes consist of glycemic, blood pressure, LDL-c control, cardiovascular disease, nephropathy/ESRD, retinopathy, mortality health status, symptoms and utilization and costs.

The conceptual model for TRIAD study is designed to investigate not only how system-level structures and strategies affect outcomes of diabetes care but also how patient-level characteristics directly affect outcomes.[8] In this model, fixed patient factors can affect patient-physician interaction and clinical and psychological factors that are associated with the patient's condition. Interaction between the patient and physician is mediated by system factors such as performance feedback, reminders, patient education, and out-of-pocket costs. Furthermore, these system factors are mediated by the process of care which are simple examinations and evidence-based care processes. These care processes can affect the outcomes of diabetes care directly and indirectly via the behaviors of patients. Patients' behavior, which consists of adherence to management, self-management, physical activity, healthy diet and smoking cessation, is a key mediator that affects outcomes of diabetes care. Therefore, patient factors, patient-physician system, and process can improve the quality of diabetes care.

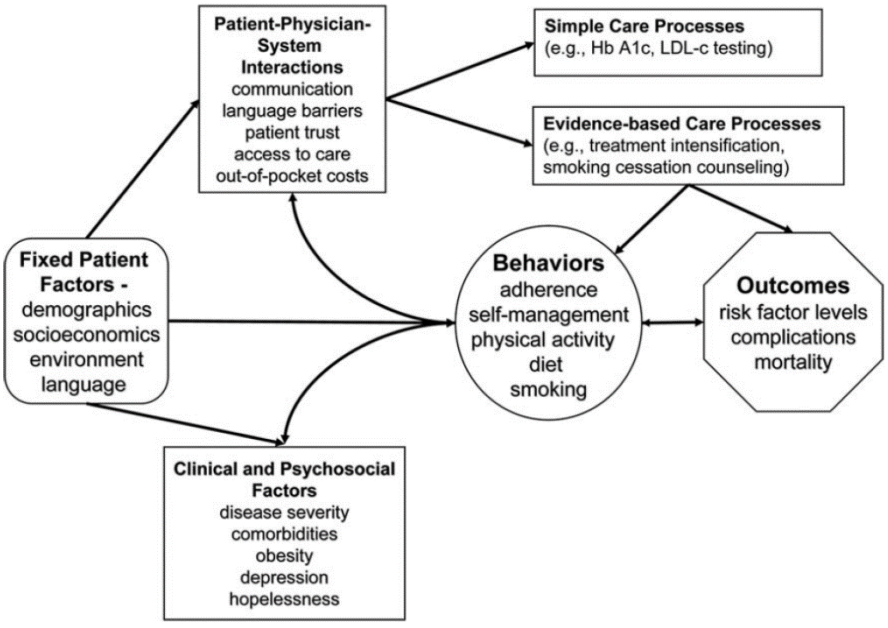

Figure 2 TRIAD conceptual model for relationships of patient factors and patient-system interactions with processes and outcomes of care
Source: Group TS. Health systems, patients factors, and quality of care for diabetes: A synthesis of findings from the triad study. *Diabetes Care*. 2010;33:940-947

2. Objectives

This study examines whether diabetes quality assurance (DQA) programs affect the quality of diabetes care in primary clinics.

The objectives of this study are as follows:

(1) To investigate the effect of the DQA program on its indicators:
Difference between DQA indicators before and after the DQA program

(2) To investigate the effect of the DQA program on diabetes care outcomes:
Incidence of diabetes complications (diabetic nephropathy, neuropathy, retinopathy, angina pectoris, myocardial infarction, and stroke)

3. Diabetes Quality Assurance programs

In studies such as the UK Prospective Diabetes Study (UKPDS) [9] and Diabetes Control Complication Trial (DCCT) [10] in the 1980s, it was found that keeping blood sugar, blood pressure, and cholesterol levels low in diabetic patients reduces complications. In addition, in the late 1990s, through a diabetes prevention program (DPP) trial and a DPP outcome study (DPPOS), it was found that lifestyle improvement in diabetic risk groups slowed the morbidity of diabetes.[11] Much effort has been made to improve the quality of treatment of diabetic patients and risk groups using this “current professional knowledge”, and quality assessment was used as one of the many efforts.

A. US, Diabetes Recognition Program (DRP) by National Committee for Quality Assurance (NCQA)

NCQA developed performance measures, specifications and guidance for evaluating performance.[12] Based on performance outcomes, NCQA recognizes physicians or physician groups, and health plans offer payment incentives to improve the quality of care. If the physician purchases the DRP package, patient sampling should be conducted and a year's worth of medical records should be submitted in the Data Collection Tool (DCT) of NCQA. Then, NCQA evaluates and scores the data based on four outcome measures and four process measures[13]. The DRP indicators are a total of 100.0 points, and 70.0 points are needed to achieve recognition. NCQA awards recognition and the physicians or physician groups are eligible for a fee for performance rewards.

Table 1 Scoring of Measures for Diabetes Recognition Program

Scored Measures	Threshold	Points
HbA1c Control >9.0 %*	≤15%	15.0
HbA1c Control <8.0%	65%	10.0
HbA1c Control <7.0%	40%	7.0
Blood Pressure Control >140/90 mm Hg*	≤35%	30.0
Eye Examination	60%	12.0
Smoking and Tobacco Use and Cessation and Treatment Assistance	85%	12.0
Nephropathy Assessment	85%	7.0
Foot Examination	80%	7.0
		100.0

Source: NCQA. Diabetes recognition program (DRP). 2018;27, Sep, 2020

B. UK, Quality and Outcomes Framework (QOF) indicators for Diabetes mellitus by National Institute for Health and Care Excellence (NICE)

In2004, NICE introduced QOF indicators to evaluate clinical care, practice organization, and patient experience. First, clinical indicators target ten chronic conditions, including diabetes. Each chronic condition has its own indicators and points. Second, organizational indicators consist of five categories: records and information about patients, communication with patients, education and training, management of medicines, and management of physicians' practices. Third, the experience of patients has two components: patient surveys and length of consultation[14].

The total score of these QOF indicators is then disclosed, and a comparison of the total score and the average of each General Practitioner (GP) is provided. GPs receive incentive payments based on the score obtained. QOF consists of a total of four domains. The four domains are clinical, public health, public health-additional services, and quality improvement. The clinical domain consists of 56 indicators for 19 medical areas, with a total of 379 points. The public health domain consists of 6 indicators, with a total of 95 points. The public health-additional services domain consists of 2 indicators, totaling 11 points. Finally, quality improvements consist of a total of 4 indicators, totaling of 74 points. Table 2 shows the indicators related to diabetes in the QOF, and there are a total of 10 indicators related to diabetes in 2019, with 70 points.

Table 2 Quality and Outcomes Framework Diabetes indicators 2019/20[15]

In dicator	Points
The contractor establishes and maintains a register of all patients aged 17 or over with diabetes mellitus, which specifies the type of diabetes where a diagnosis has been confirmed	6
% patients without moderate or severe frailty, on register, with last BP, measured in last 12 months, ≤140/80 mmHg	10
% patients without moderate or severe frailty, on register, in whom last IFCC-HbA1c is ≤58 mmol/mol in preceding 12 months	17
% patients with moderate or severe frailty, on register, in whom last measured IFCC-HbA1c ≤75 mmol/mol in last 12 months	10
% patients with diabetes ≥40 years, with no CVD and without moderate or severe frailty, currently treated with a statin (exclude patients with type 2 diabetes with CVD risk score<10% recorded in preceding 3 years)	4
% patients with diabetes and a history of CVD (excluding haemorrhagic stroke) currently treated with a statin	2
% of patients with diabetes, on register, who have had influenza immunisation	3
% of patients with diabetes, on register, with a diagnosis of nephropathy(clinical proteinuria) or microalbuminuria who are currently treated with ACEI or ARB	3
% of patients with diabetes, on register, with a record of a foot examination and risk classification	4
% patients newly diagnosed with diabetes, on register in the preceding year who have a record of being referred to a structured education programme within 9 months after entry on to the diabetes register	11

Source: NICE. Quality and outcomes framework 2019/20 diabetes indicators for england. *Diabetes & Primary Care*. 2019;21:99-100

C. Belgium, Care Trajectory(CT) for T2DM by National Institute for Health and Disability Insurance (NIHDI)

Belgium has a compulsory health insurance system, covering 99% of the population. In 2009, the Belgian government launched T2 DM-CT with NIHDI to improve diabetes care.[16] T2DM-CT aimed to delay the occurrence of complications as much as possible by providing planned, integrated, evidence-based, and multidisciplinary care for early diabetic patients. T2DM-CT is a four-year contract involving patients, GPs and specialists, which aims to support the interaction between the three parties who must adhere to certain rules to receive incentives. For example, after signing a CT contract, patients receive a full refund for meetings with GPs and specialists.[17]

Table 3 Quality indicators of type 2 diabetes care trajectory (T2DM-CT)

Research domains	Parameters studied	Target frequency/target value
Recruitment of CT patients	Number of enrolled patients	
Mandatory parameters for all T2DM-CT patients	HbA1c	Freq: every 3 months
		Target value: <7 %
	LDL cholesterol	Freq: every 3 months
		Target value: <100 mg/dl
	Blood pressure	Freq: every 3 months
		Target value: <130/80 mmHg
	BMI	Freq: every 3 months
		Target value: <25 kg/m2
Disease review	Number of encounters with selected care providers	2 encounters/year with GP
		1 encounter/year with internist
	Prescription of a glucometer	Number T2DM-CT patients with prescription of glucometer
Primary prevention	Flu vaccination	Annual flu vaccination
Complications/secondary and tertiary prevention	Diabetes education	At least 1 consultation with diabetes educator/dietician
	Renal function	Freq: Serum creatinine 1×/year
	Statin use	All T2DM, except those without other cardiovascular risk factors
	Ophthalmoscopy	Freq: 1×/year

Source: Does the Belgian diabetes type 2 care trajectory improve quality of care for diabetes patients? Archives of Public Health (2015) 73:31

D. Diabetes Quality Assessment by Health Insurance Review & Assessment Service (HIRA)

The healthcare system of Korea is a mandatory single insurance provided by the National Health Insurance System(NHIS). The HIRA reviews and assesses medical claims and notifies the NHIS. The NHIS pays reimbursement to health care providers. According to the National Health Insurance Act, HIRA is responsible for assessing appropriateness of healthcare benefits since July 2000.[18] As a result of increased incidence and prevalence of diabetes due to aging of population, HIRA introduced the DQA program in 2011 to improve the quality of diabetes care and reduce complications.

The DQA program assesses diabetes care in three sections: continuity of care, prescription accuracy, and completion of examinations (Table4). The indicators are assessed in all health care facilities. However, the disclosure of assessment results and payment of incentives are only for primary care clinics.[19]

Table 4 Quality indicators used in Diabetes Quality Assurance program in Korea

Section		Indicator
Continuity of care	outpatient visit	Visit every quarter rate
	Continuity of prescription	Medication prescription rate
Prescription accuracy		Percentage of duplicated prescription by class
		Percentage of prescription of four or more classes
Completion of examinations		HbA1c test rate
		Lipid profile test rate
		Fundoscopy rate

Source: HIRA. The results for diabetes quality assessment 2013. Available from: http://biz.hira.or.kr/cms/PC/notice01/__icsFiles/afieldfile/2015/01/08/PJgr0KapYbhy.pdf.

Table 5 shows the comparison of the DQA indicators of Korea with that of the US, Belgium and the UK. Indicators in the US and the UK focus on outcome indicators and include some structure and process indicators. However, all Korean indicators focus on process indicators. Therefore, here, the study was designed to determine how the DQA program focused on process indicators affects each process indicator and how it affects outcome indicators that are not included in the DQA program.

Table 5 Indicators of diabetes quality assurance programs

		NCQA	QOF	NIHDI	HIRA
Screening and prevent macro/micro vascular complications					
HbA1c	Treatment goal**	○	○	○	
	Examination*	○	○	○	○
Blood pressure	Treatment goal**	○	○	○	
Cholesterol	Treatment*		○	○	
	Assessment*			○	○
DM Nephropathy	Treatment*	○	○		○
	Assessment*			○	△
Eye examination*		○			○
Foot examination*		○	○		
Reduce risk of diabetes related illness					
Maintaining registration*			○	○	
Continuity of care*				○	○
Refferal to education*			○	○	
Assist Smoking Cessation*		○			
Flu immunization*			○	○	
Complying with practice guideline					
Prescription accuracy*					○

*Indicators for process, **Indicators for outcome

II. MATERIALS AND METHODS

1. Study population

This study used the National Health Insurance Service National Sample Cohort 2002 to 2015(NHIS-NSC 2002–2015). The Korea National Health Insurance Service (KNHIS) is a single mandatory medical insurer system that provides universal healthcare coverage. The NHIS-NSC data represent the entire Korean population because 2.1% of the entire population in 2006 was sampled from the KNHIS claim database. The baseline NHIS-NSC randomly sampled 1,011,638 individuals from 48,222,537 individuals in 2006. A total of 2,142 strata, composed of age, sex, region and income, were used for the sampling process. The NHIS-NSC database contains all claim data and data considered for strata from 2002 to 2015.

This study aimed to analyze the effect of the DQA program on the quality of care. Hence, 24,901 individuals who met all three of the following criteria were considered to have diabetes: (1) diagnosed with type II diabetes as the main diagnosis code (Korean Classification of Disease [KCD] codes E11, E13 and E14); (2) prescribed oral hypoglycemic medication or subcutaneous insulin injection; and (3) visited clinic at least two times to exclude a visit for screening.

NHIS-NSC 2002-2015 does not contain the brand name of the drugs to prevent commercial use, and only the generic names are provided by ATC codes. Table6 shows the drugs classes and generic names provided by HIRA's DQA report.

Table 6 The classes and generic names of anti-diabetic drugs

Drug class	Generic name
Biguanide	Metformin HCl
Sulfonylurea	Glibenclamide
	Gliclazide
Meglitinide	Mitiglinide Calcium hydrate
	Nateglinide
α-glocsidase inhibitor	Acarbose
	Miglitol
Thiazolidinedione	Lobeglitazone sulfate
	pioglitazone HCl
DPP-IV inhibitor	Alogliptin
	Anagliptin
	Evogliptin
	Gemigliptin
	Linagliptin
SGLT-2 inhibitor	Dapagliflozin
	Empagliflozin
Insulin	Insulin aspart
	Insulin glulisine
	Insulin lispro
	Insulin glargine
GLP-1 receptor agonist	Albiglutide
	Dulaglutide

Source: HIRA. The results for diabetes quality assessment 2013. Available from: http://biz.hira.or.kr/cms/PC/notice01/__icsFiles/afieldfile/2015/01/08/PJgr0KapYbhy.pdf.

2. Study design

To investigate the effect of the DQA program, difference in differences analysis(DID) was used. DID analysis is a method for calculating the difference between experimental and control groups before and after the intervention. DID analysis is a quasi-experimental study that compares the results of an experimental group with a control group and is used in several fields where experimental research is difficult due to ethical or cost reasons. DID is a method that can adjust underlying time-dependent trends in outcomes unrelated to policy change.[20]

In this study, HIRA adopted the DQA program in January 2011 and disclosed the results of the DQA program in September 2012 in primary care clinics. The general hospitals were not subject to the DQA program and were defined as the control group. To adjust the severity between the clinic and the hospital of newly diagnosed diabetes patients, the number of prescribed drug classes and insulin use were adjusted.

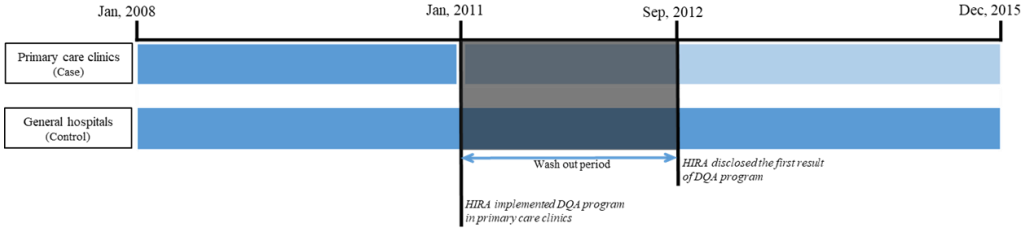

Figure 3 Study period for DID analysis of DQA program

3. Variables

A. Dependent variables

The dependent variables of this study were quality indicators of the DQA program and secondary health outcomes. The DQA program indicators consist of three sections: (1) continuity of care, (2) prescription accuracy, (3) completion of examinations, and (4) health outcomes associated with diabetes complications.

(A) Continuity of care

Visit every quarter (VEQ) and medication prescription rate(MPR) were used to evaluate continuity of care. VEQ is defined as if the patients who visited the health care facility at least once per quarter.

MPR is defined as the prescription of oral hypoglycemic agents are over 290 days per year.

(B) Prescription Accuracy

Prescription accuracy was evaluated as the presence of duplicated prescriptions (DP) per quarter by hypoglycemic drug classes and the presence of prescriptions of four or more hypoglycemic drug classes(EP).

(C) Completion of examinations

Completion of examination was evaluated by whether HbA1c, lipid profile and fundoscopy tests were performed at least once per quarter.

(D) Health outcomes associated with diabetes complications

The health outcomes used in this study included a total of six diseases, including three macrovascular complications of diabetes and three microvascular complications. For macrovascular complications, myocardial infarction (I21, I22), ischemic stroke (I63), and angina pectoris (I20) were used. For microvascular complications, diabetic nephropathy (N08.3), neuropathy (G59.0, G63.2 and G99.0), and retinopathy (H36.0) were used.

B. Interesting variables

The interesting variables of this study were the period before and after the DQA program and medical institutions: 2008 to 2010 was the period before the DQA program, and 2013 to 2015 was the period after the DQA program. The most visited primary care clinics or general hospitals during the study period for people who visited at least twice were defined as medical institutions.

C. Independent variables

The independent variables of this study were sex (male or female), age (-65, 65–75, >75), region(metropolitan, city, or rural), equivalent household income level (low, middle, high), prescribed classes of oral hypoglycemic agents (1, 2, ≥3), prescribed insulin injection, and Carlson Comorbidity Index (CCI; 0, 4, 4+, score was calculated without diabetes and its complications).

4. Statistical analysis

In this study, the following equation for DID analysis using generalized estimating equation(GEE) was used to investigate the effect of the DQA program.

$$G[E(Y_{it})] = \beta_0 + \beta_1 Treat_i + \beta_2 After_t + \beta_3 (Treat_i \times After_t) + \gamma Z_{it}$$

t : Time period (year or quarter; depends on depedant variables)

$Treat_i$: Test group and Control group (primary clinics and tertiary hospitals)

$After_t$: Period after DQA program adopted

Z_{it} : Independent variables

5. Ethics statement

This study design was approved by the Institutional Review Board of Yonsei University Health System (IRB No.: Y-2020-0114).

III. RESULTS

1. General characteristics of the study population

The general characteristics of the study population are shown in Table 7. A total of 24,901 newly diagnosed diabetes patients were included in this study. A total of 16,232 (65.2%) patients with diabetes mainly visited primary care clinics, and 8,660 (34.8%) patients mainly visited general hospitals.

The prescription of insulin injection was higher in patients who mainly visited the hospital (5.1%) than in those who visited the primary care clinic (1.7%, $p<0.0001$), and the patient group with a CCI score 5 or higher and higher income was more frequent in the patient group that mainly visited the hospital.

Table 7 General characteristics of study population

		Total (%)		Primary care clinics(%)		General hospitals(%)		
Number of patients		24,901		16,232	65.2	8,669	34.8	***P*-value**
Age								
	-54	10,735	43.1	6,854	42.2	3881	44.8	<0.0001
	55-64	6,582	26.4	4,295	26.5	2,287	26.4	
	65-74	5,230	21.0	3,524	21.7	1,706	19.7	
	75-	2,354	9.5	1,559	9.6	795	9.2	
Sex								<0.0001
	Male	13,776	55.3	8,737	53.8	5,039	58.1	
	Female	11,125	44.7	7,495	46.2	3,630	41.9	
Income								<0.0001
	High	9,622	38.6	6,009	37.0	3,613	41.7	
	Middle	8,389	33.7	5,584	34.4	2,805	32.4	
	Low	6,721	27.0	4,536	27.9	2,185	25.2	
Region								0.001
	Metropolitan	11,457	46.0	7,440	45.8	4,017	46.3	
	City	10,704	43.0	6,916	42.6	3,788	43.7	
	Rural	2,740	11.0	1,876	11.6	864	10.0	
Hypertension								0.445
	No	6,328	25.4	4,100	25.3	2,228	25.7	
	Yes	18,573	74.6	12,132	74.7	6,441	74.3	
Hyperlipidemia								<0.0001
	No	2,428	9.8	1,719	10.6	709	8.2	
	Yes	22,473	90.2	14,513	89.4	7,960	91.8	
Prescribed classes of hypoglycemic agents								<0.0001
	1	10,841	43.5	6,933	42.7	3,908	45.1	
	2	10,112	40.6	6,793	41.8	3,319	38.3	
	>3	3,950	15.9	2,507	15.4	1,443	16.6	
Prescribed insulin injection								<0.0001
	No	24,184	97.1	15,958	98.3	8,226	94.9	
	Yes	719	2.9	275	1.7	444	5.1	
CCI								<0.0001
	0-1	10,240	41.1	7,099	43.7	3,141	36.2	
	2-3	7,283	29.2	4,903	30.2	2,380	27.5	
	3-4	4,023	16.2	2,455	15.1	1,568	18.1	
	≥5	3,357	13.5	1,776	10.9	1,581	18.2	
Year								<0.0001
	2008	4,071	16.3	2,724	16.8	1,347	15.5	
	2009	4,406	17.7	2,913	17.9	1,493	17.2	
	2010	4,270	17.1	2,788	17.2	1,482	17.1	
	2013	4,074	16.4	2,643	16.3	1,431	16.5	
	2014	3,658	14.7	2,369	14.6	1,289	14.9	
	2015	4,424	17.8	2,796	17.2	1,628	18.8	
Survival	Yes	24,323	97.7	15,996	98.5	8,327	96.1	<0.0001
	No	578	2.3	236	1.5	342	3.9	

The general characteristics of the study population before and after the intervention are displayed in Table 8. Income and residential area were constant in the group that mainly visited primary clinics, but the ratio of the metropolitan city dwelling group(p=0.030) and the high-income group(p=0.018) decreased in the group that mainly visited the hospital. Before and after the policy was implemented, the number of prescriptions for one drug class and less than 1 point of CCI increased in both primary clinics (p<0.0001) and hospital visit groups (p<0.0001). However, insulin prescription decreased in the group that mainly visited primary care clinics (p<0.0001), but remained unchanged in the group that mainly visited general hospitals (p=0.721).

Table 8 General characteristics of study population by before and after intervention

		Primary care clinics (n=16,232)					General hospitals (n=8,669)				
		Before intervention(%)		After intervention(%)		*p*-value	Before intervention(%)		After intervention(%)		*p*-value
		2008-2010		2013-2015			2008-2010		2013-2015		
Number of patients		8,424		7,808			4,321		4,348		
Age											
	-55	3645	43.3	3209	41.1	<0.0001	1,960	45.4	1921	44.2	0.035
	55-65	2,125	25.2	2,170	27.8		1,146	26.5	1,141	26.2	
	65-75	1,897	22.5	1,627	20.8		858	19.9	848	19.5	
	75-	757	9.0	802	10.3		357	8.3	438	10.1	
Sex						0.082					0.943
	Male	4,479	53.2	4,258	54.5		2,510	58.1	1,529	58.2	
	Female	3,945	46.8	3,550	45.5		1,811	41.9	1,819	41.8	
Income						0.785					0.018
	High	3,110	36.9	2,899	37.1		1,862	43.1	1,751	40.3	
	Middle	2,883	34.2	2,701	34.6		1,348	31.2	1,457	33.5	
	Low	2,372	28.2	2,164	27.7		1,075	24.9	1,110	25.5	
Region						0.063					0.030
	Metropolitan	3,854	45.8	3,586	45.9		2,061	47.7	1,956	45.0	
	City	3,550	42.1	3,366	43.1		1,830	42.4	1,958	45.0	
	Rural	1,020	12.1	856	11.0		430	10.0	434	10.0	
Hypertension						<0.0001					<0.0001
	No	1,779	21.1	2,321	29.7		836	19.3	1,392	32.0	
	Yes	6,645	78.9	5,487	70.3		3,485	80.7	2,956	68.0	
Hyperlipidemia						0.028					0.011
	No	849	10.1	870	11.1		321	7.4	388	8.9	
	Yes	7,575	89.9	6,938	88.9		4,000	92.6	3,960	91.1	
Prescribed classes of hypoglycemic agents						<0.0001					<0.0001
	1	3,164	37.6	3,769	48.3		1,790	41.4	2,118	48.7	
	2	3,559	42.2	3,234	41.4		1,681	38.9	1,638	37.7	
	>3	1,702	20.2	805	10.3		851	19.7	592	13.6	
Prescribed insulin injection						<0.0001					0.721
	No	8,227	97.7	7,731	99.0		4,097	94.8	4,129	95.0	
	Yes	198	2.4	77	1.0		225	5.2	219	5.0	
CCI						<0.0001					<0.0001
	0-1	3,170	37.6	3,929	50.3		1,316	30.5	1,825	42.0	
	2-3	2,661	31.6	2,242	28.7		1,178	27.3	1,202	27.6	
	3-4	1,456	17.3	999	12.8		865	20.0	703	16.2	
	≥5	1,138	13.5	638	8.2		963	22.3	618	14.2	

2. Result of the change of DQA indicators over intervention period and institution

Figure 4 shows the indicators for continuity of care, which was measured based on visit every quarter and medication prescription rates. In the group that visited primary clinics, the visit every quarter rate changed from 71.3% before intervention to 74.7% after intervention, and in the group that visited hospitals, the rate changed from 67.1% to 65.7%. In the group that visited the primary clinics, the prescription rate changed from 52.1% before intervention to 65.0% after intervention, and in the group that visited hospitals, the rate changed from 53.3% to 62.1%.

Figure 5 shows the indicators for accuracy of prescription, which was measured by duplication of prescription rate and prescription of four or more classes of drug rate. In the group that visited primary clinics, the duplication prescription rate changed from 0.13% before intervention to 0.17% after intervention, and in the group that visited general hospitals, the rate changed from 0.14% to 0.24%. In the group that visited primary clinics, the prescription of four or more classes of drug rate changed from 0.4% before intervention to 0.8% after intervention, and in the group that visited general hospitals the rate changed from 0.6% to 1.1%.

Figure 6 shows indicators for examination completion rate of cholesterol profile, HbA1c, and fundoscopy. In the group that visited primary clinics, the cholesterol profile test rate changed from 58.6% before intervention to 63.3% after intervention, and in the group that visited general hospitals, the rate changed from 74.4% to 76.0%. In the group that visited the primary clinics, the HbA1c test rate

changed from 51.7% before intervention to 65.8% after intervention, and in the group that visited general hospitals, the rate changed from 71.1% to 76.0%. In the group that visited primary clinics, the fundoscopy rate changed from 15.8% before intervention to 20.2% after intervention, and in the group that visited general hospitals, the rate changed from 26.3% to 29.9%.

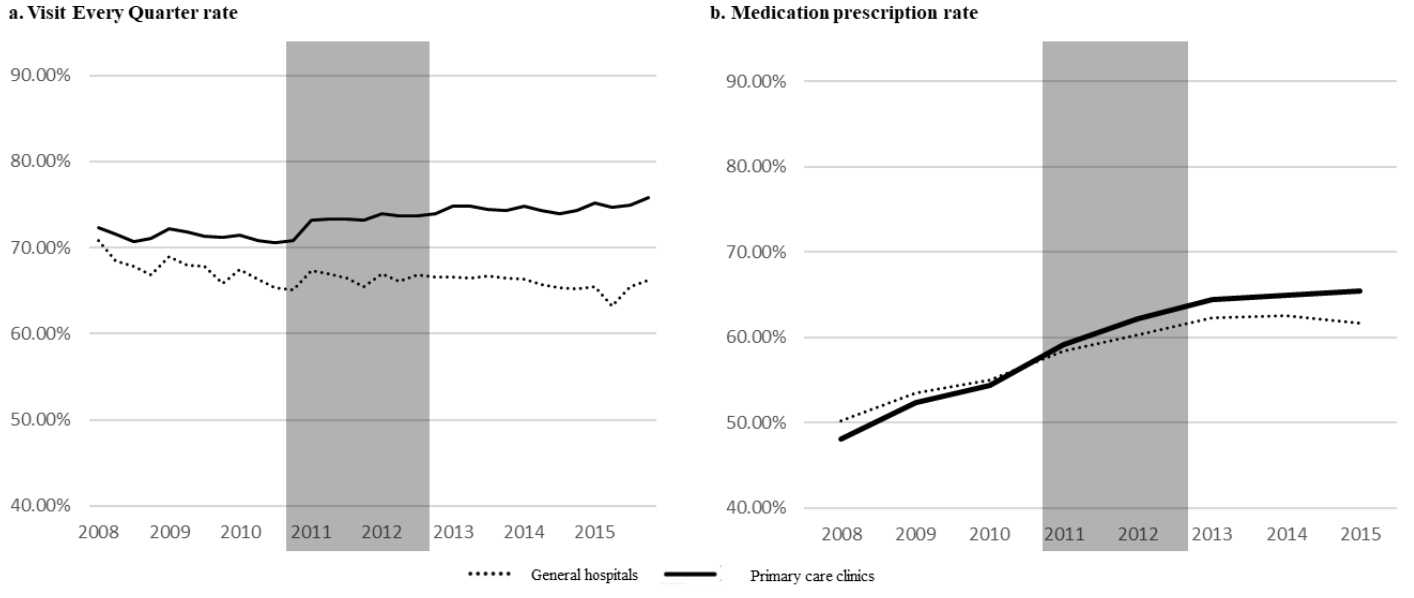

Figure 4 Continuity of care rate by medical institutions

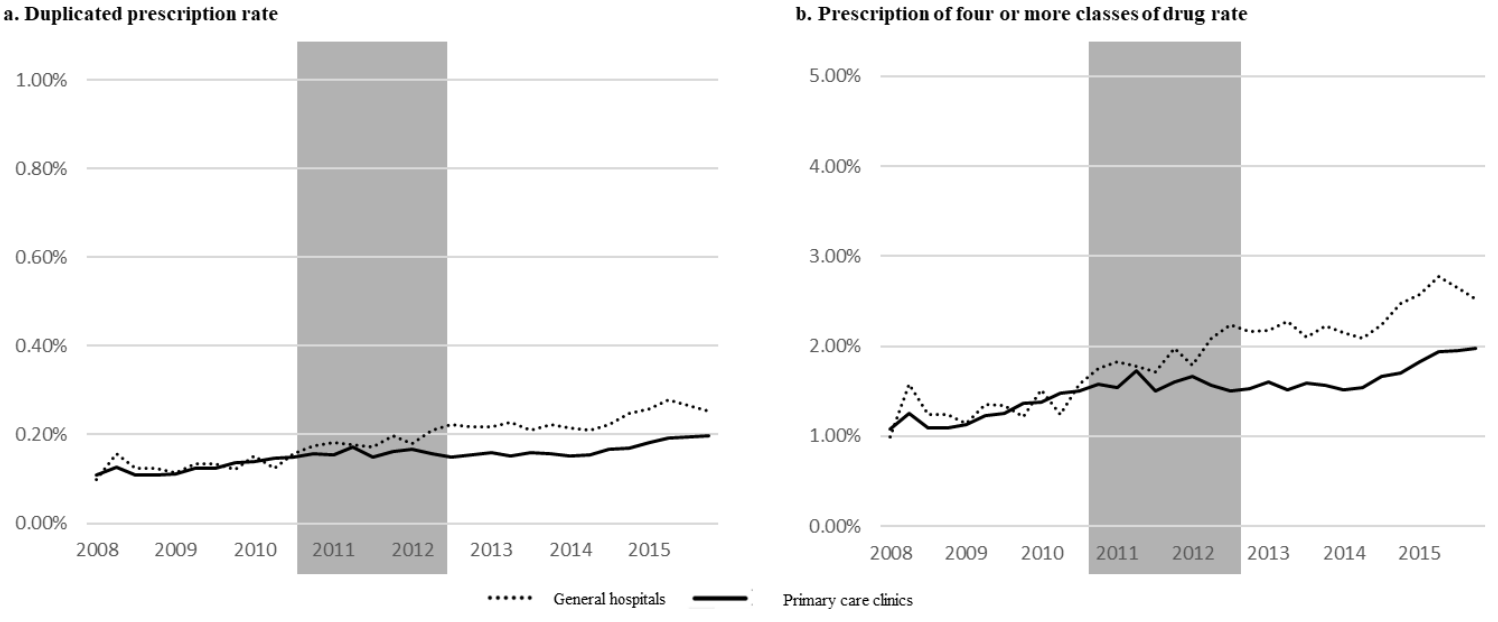

Figure 5 Prescription accuracy rate by medical institutions

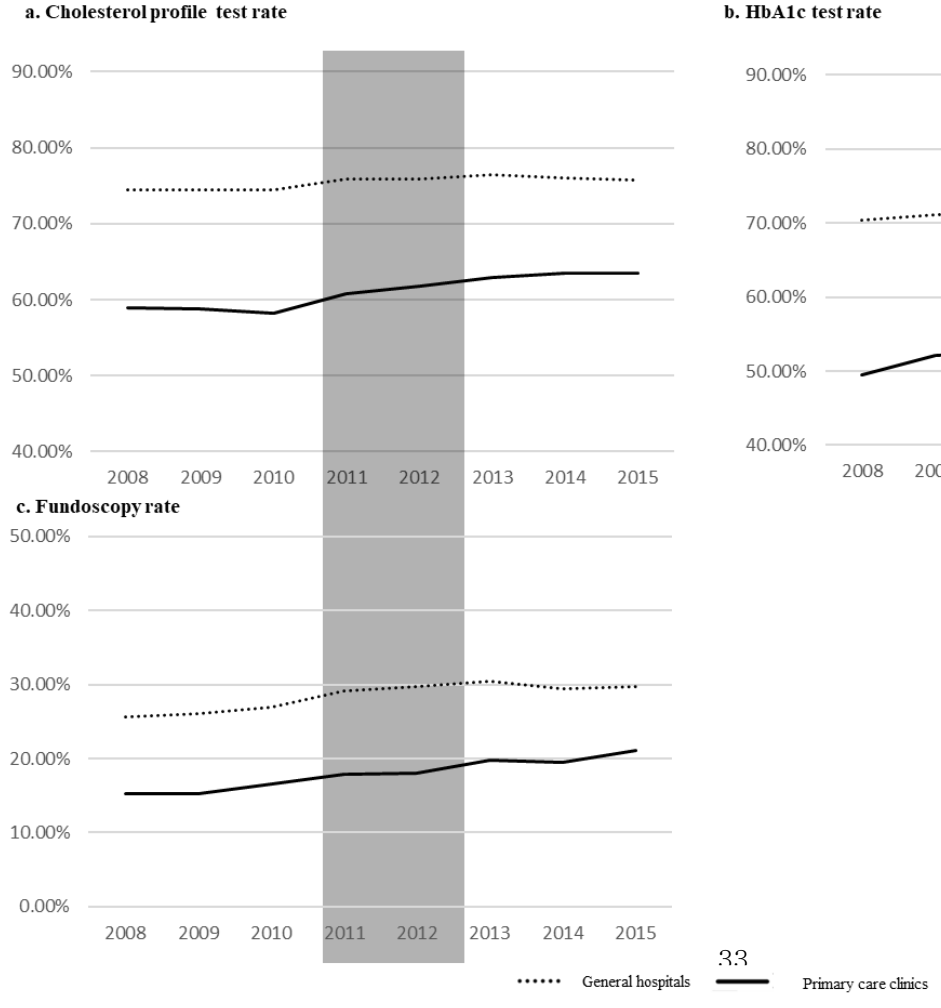

Figure 6 Examination completion rate by medical institutions

Table 9 reports the result of the DID analysis for DQA indicators of primary care clinics and general hospitals. Two indicators that make up the continuity of care were improved. The odds ratio for VEQ is 1.086 ($p<0.0001$), and the odds ratio for medication rate is 1.091 ($p<0.0001$), considering the differences before and after the implementation of policy and institution types. However, prescription accuracy did not significantly change over period and institution types. Completion of examinations of HbA1c, cholesterol profile, and fundoscopy changed significantly. The odds ratio for HbA1c test rate is 1.175 ($p<0.0001$), cholesterol profile test rate is 1.043 ($p<0.0001$), and fundoscopy is 1.134 ($p<0.0001$).

Table 9. Rate of diabetes quality indicators change over time in primary care clinics and general hospital

			Continuity of care				Prescription accuracy				Completion of examination					
			VEQ		Medication rate		Duplicated prescription		Prescription of 4 or more classes		HbA1c		Cholesterol profile		Fundoscopy	
Difference, primary care clinic-general hospitals			1.042	***	0.935	**	0.870		0.844		0.756	***	0.831	***	0.617	***
Difference, implementation period			0.928	***	1.263	***	1.688	**	1.671	***	1.063	***	1.027	**	1.142	***
Difference in change, primary care clinic-general hospitals			1.086	***	1.091	***	1.071		1.085		1.175	***	1.043	***	1.134	***
Intercept β			0.514	***	0.229	***	0.004	***	0.005	***	0.430	***	0.368	***	0.130	***
Age																
	<54	**1.000**														
	55-64		1.049	***	1.157	***	0.880	*	0.852	***	1.002		0.995		1.168	***
	65-74		1.035	**	1.158	***	0.733		0.703	***	0.957	***	0.976	***	1.494	***
	75≥		0.958	***	1.081	***	0.624		0.590	***	0.849	***	0.903	***	1.323	***
Sex																
	Female	**1.000**														
	Male		0.960	***	0.936	***	0.978		1.025		0.983	**	0.968	***	0.837	***
Income																
	High	**1.000**														
	Middle		0.995		0.976	**	1.091		1.121	**	0.976	***	0.982	**	0.943	***
	Low		0.988	**	0.975	**	1.113		1.148	**	0.968	***	0.991	*	0.998	
Region																
	Metropolitan	**1.000**														
	City		0.997		0.996		0.953		0.967		0.981	**	0.992		0.933	***
	Rural		0.967	***	0.943	***	0.967		0.976		0.896	***	0.953	***	0.857	***
Hypertension																
	No	**1.000**														
	Yes		1.139	***	1.207	***	1.165		1.140		1.021	**	1.052	***	0.985	
Hyperlipidemia																
	No	**1.000**														
	Yes		1.229	***	1.339	***	1.797	**	1.870	***	1.580	***	1.825	***	1.530	***
Prescribed no. of hypoglycemic agent																
	1	**1.000**														
	2		1.143	***	1.418	***	1.834	***			1.156	***	1.042	***	1.095	***
	3>		1.206	***	1.658	***	7.674	***			1.226	***	1.073	***	1.168	***
Prescribed insulin injection																
	No	**1.000**														
	Yes		0.930	**	0.535	***	0.790		0.859		1.100	***	1.068	***	1.561	***
CCI																
	0-1	**1.000**														
	2-3		1.018	**	1.028	**	1.107		1.071		1.040	***	1.117	***	1.243	
	3-4		0.985	*	0.975	**	0.954		0.923		1.050	***	1.188	***	1.324	**
	≥5		0.951	***	0.890	***	0.839		0.796		1.084	***	1.282	***	1.340	***

**** p-value<0.05 **p-value<0.01, ***p-value<0.0001***

We conducted a subgroup analysis to examine which subgroup had more influence on DQA indicators. Two indicators of continuity care were not significant in rural areas, considering the differences before and after the implementation of the DQA program and institution types. The odds ratio for fundoscopy test rate was not significant in older age and rural area groups.

Table 10 Subgroup analysis of rate of diabetes quality indicators change over time in primary care clinics and general hospitals

		Continuity of care				Completion of examination					
		VEQ		Medication rate		HbA1c		Cholesterol profile		Fundoscopy	
Age											
	<65	1.100	***	1.107	***	1.172	***	1.034	**	1.167	***
	≥65	1.058	***	1.071	**	1.192	***	1.059	***	1.065	
Income	High	1.105	***	1.101	***	1.165	***	1.039	**	1.139	**
	Middle	1.093	***	1.080	**	1.180	***	1.045	**	1.115	**
	Low	1.069	***	1.077	**	1.194	***	1.044	**	1.165	**
Region	Metropolitan	1.117	***	1.110	***	1.170	***	1.037	**	1.138	***
	City	1.073	***	1.080	***	1.169	***	1.045	**	1.146	***
	Rural	0.989		1.011		1.209	***	1.058	**	1.030	
CCI	≤3	1.098	***	1.094	***	1.191	***	1.051	**	1.183	***
	≥4	1.053	***	1.064	**	1.140	***	1.036	**	1.109	**

※**odds ratios were calculated adjusting age, sex, income, region, hypertension, hyperlipidemia, prescribed number of hypoglycemic agents, prescribed insulin injection and CCI**

**** p-value<0.05 **p-value<0.01, ***p-value<0.0001***

3. The result of change of health outcomes over intervention period and institution

To estimate the effect of the DQA program on health care outcomes associated with diabetes complications, we analyzed six diseases. Figure 7 displays the changes in the incidence of microvascular complications. The incidence of diabetic nephropathy was 11.9 per 1,000 persons before the DQA program and 11.2 per 1,000 persons after the program in the group that visited primary care clinics, and the incidence was 10.0 per 1,000 persons and 10.5 per 1,000 persons in the group that visited general hospitals. The incidence of diabetic neuropathy was 42.6 per 1,000 persons before the DQA program and 38.2 per 1,000 persons after the program in the group that visited primary care clinics, with an incidence of 98.9 per 1,000 persons and 125.9 in the group that visited general hospitals. The incidence of diabetic retinopathy was 21.6 per 1,000 persons before the DQA program and 31.0 per 1,000 persons after the program in the group that visited primary care clinics, and the incidence was 47.7 per 1,000 persons and 47.4 per group that visited general hospitals.

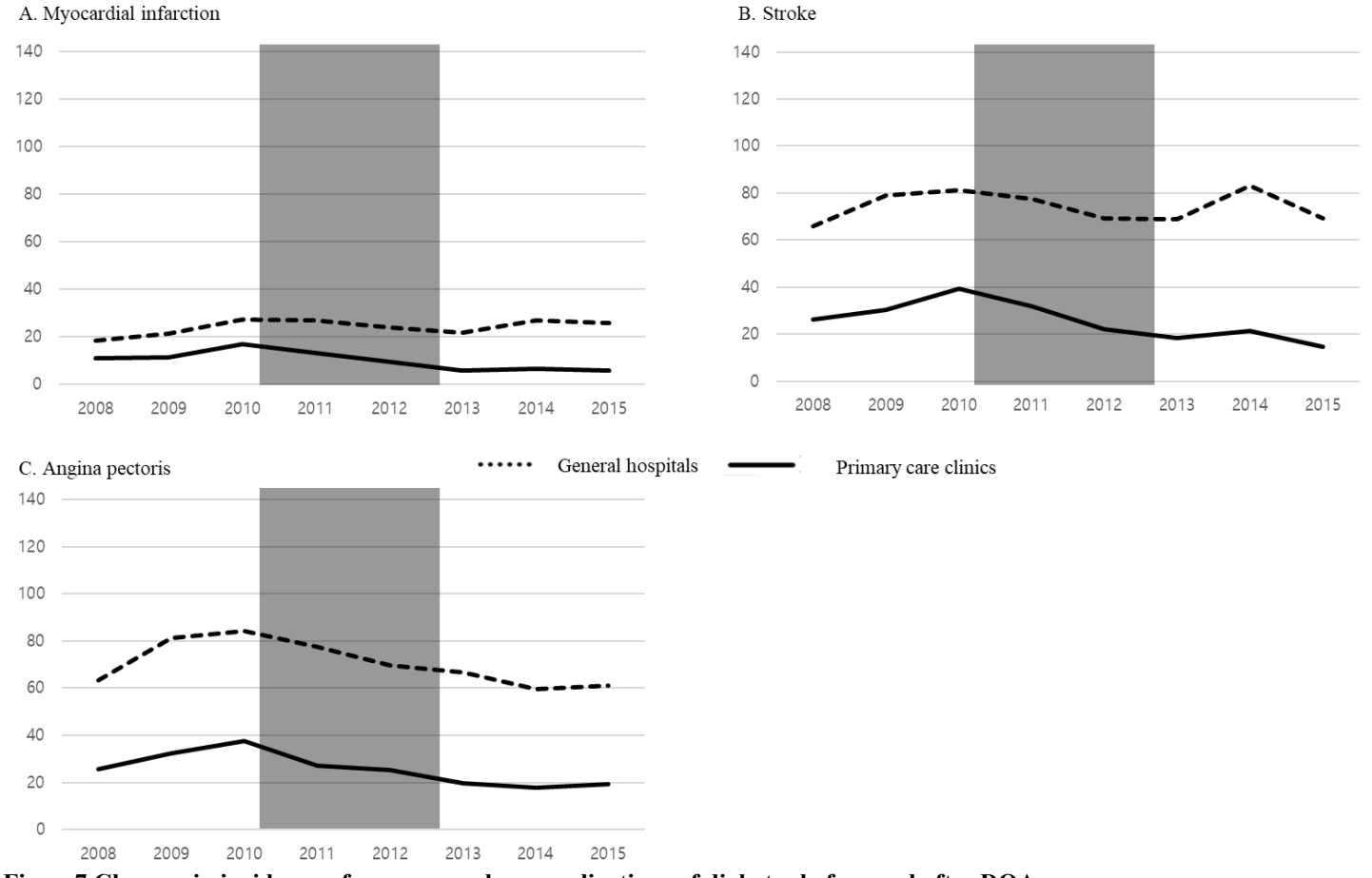

Figure7 Changes in incidence of macrovascular complications of diabetes before and after DQA program

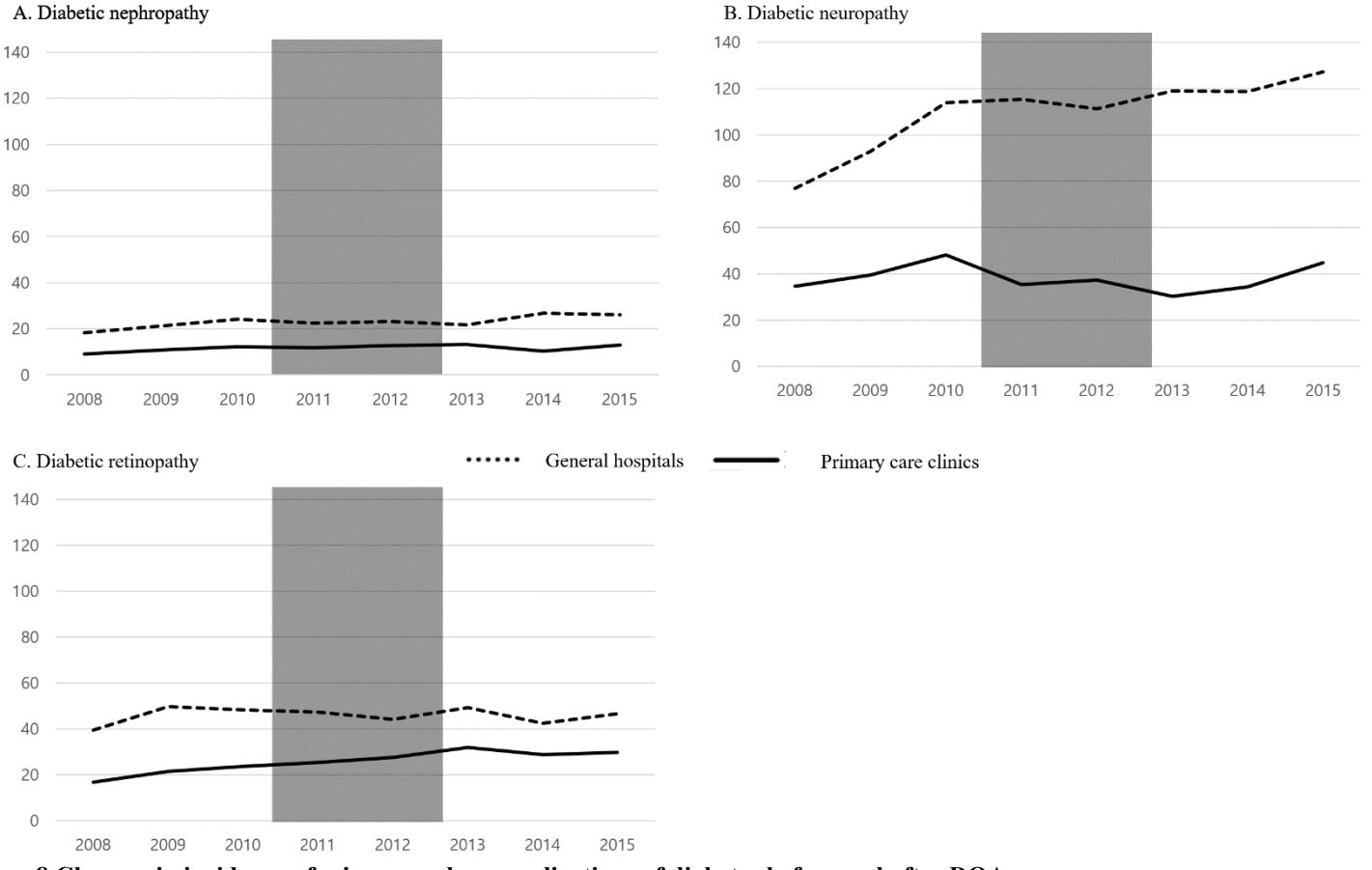

Figure 8 Changes in incidence of microvascular complications of diabetes before and after DQA program

Table 11 shows the results of the DID analysis for outcome variables of primary care clinics and general hospitals. Diabetic nephropathy (p=0.215) and diabetic neuropathy (p=0.073) did not significantly increase, considering the differences before and after policy implementation and institution types. However, the odds ratio for diabetic retinopathy is 1.497 (p<0.0001), considering the differences before and after the implementation of policy and institution types.

Table 11 Change of incidence of diabetes complications over time in primary care clinics and general hospital

		MI		Stroke		Angina		Diabetic nephropathy		Diabetic neuropathy		Diabetic retinopathy	
Intercept β		0.002	***	0.003	***	0.010	***	0.004	***	0.011	***	0.031	***
Difference, primary care clinic-general hospitals		0.503	***	0.617	***	0.660	***	0.239	***	0.640	***	0.549	***
Difference, implementation period		0.580	***	0.492	***	0.613	***	0.845		0.611	***	0.883	
Difference in change, primary care clinic-general hospitals		1.654	***	1.514	**	1.310	**	1.127		1.181		1.497	***
Age													
	<55	**1.000 (reference)**											
	55-65	0.877		1.414	***	1.015		0.847	**	0.928		0.979	
	65-75	1.107		2.097	***	1.085		0.835	*	1.033		0.963	
	75≥	1.355	**	2.607	***	1.113		0.810	**	0.962		0.768	***
Sex													
	Female	**1.000 (reference)**											
	Male	1.286	***	1.126	**	1.072	*	1.005		0.921		0.870	***
Income													
	High	**1.000 (reference)**											
	Middle	1.028		1.080		1.011		1.024		1.076		0.951	
	Low	1.165	*	1.152	**	1.019		0.893		1.211	***	1.004	
Region													
	Metropolitan	**1.000 (reference)**											
	City	0.931		1.131	*	0.997		1.096		1.121		1.024	
	Rural	01.335	**	1.233	**	1.062		0.884		1.241	***	0.963	
Hypertension													
	No	**1.000 (reference)**											
	Yes	2.177	***	2.250	***	1.989	***	1.033		1.168	**	1.033	
Hyperlipidemia													
	No	**1.000 (reference)**											
	Yes	1.729	**	1.605	***	1.359	**	3.073	***	1.577	***	1.434	***
Prescribed no. of hypoglycemic agent													
	1	**1.000 (reference)**											
	2	1.001		0.920		1.036		1.430	**	1.292	***	1.372	***
	3>	0.967		0.887		0.977		1.400	**	1.551	***	1.517	***
Prescribed insulin injection													
	No	**1.000 (reference)**											
	Yes	1.210		1.075		1.218	**	1.911	***	1.694	***	1.403	***
CCI													
	0-1	**1.000 (reference)**											
	2-3	1.769	***	2.922	***	1.629	***	1.346	**	1.582	***	1.201	***
	3-4	2.544	***	4.971	***	1.959	***	1.229		2.018	***	1.268	***
	≥5	3.404	***	5.387	***	2.311	***	1.492	**	2.296	***	1.265	***

**** p-value<0.05 **p-value<0.01, ***p-value<0.0001***

We conducted a subgroup analysis to examine which subgroup had more influence on DQA indicators. Diabetic nephropathy significantly increased in the older age group. Diabetic neuropathy significantly increased in the lower CCI score group. Odds ratios for diabetic retinopathy significantly increased in all groups except the group that lived in rural areas.

Table 12 Subgroup analysis for changes of health outcomes over time in primary care clinics and general hospital

		Diabetic nephropathy		Diabetic neuropathy		Diabetic retinopathy	
		OR	*p-value*	OR	*p-value*	OR	*p-value*
Age							
	<65	0.925	0.700	1.182	0.099	1.417	***
	≥65	1.360	*	1.158	0.248	1.558	**
Income	High	1.100	0.715	1.217	0.141	1.565	***
	Middle	1.384	0.264	1.028	0.539	1.353	*
	Low	1.212	0.541	1.223	0.135	1.556	**
Region	Metropolitan	1.206	0.476	1.256	0.063	1.434	**
	City	1.091	0.709	1.135	0.284	1.581	***
	Rural	1.448	0.085	1.031	0.676	1.371	0.154
CCI	≤3	1.075	0.734	1.285	*	1.490	***
	≥4	1.567	0.088	1.096	0.399	1.565	***

※**odds ratios were calculated adjusting age, sex, income, region, hypertension, hyperlipidemia, prescribed number of hypoglycemic agents, prescribed insulin injection and CCI**

**** p-value<0.05 **p-value<0.01, ***p-value<0.0001***

IV. DISCUSSION

1. Discussion of study methods

This study aimed to investigate the impact of the DQA program on the quality of diabetes care. In this study, we evaluated the effectiveness of the DQA program using data from the NHIS-NCS, which was extracted by random stratification of 2% of the Korean population. In addition, almost 1 million patients were followed up for 10 years, and hospitalization, examination, and disease morbidity data of participants were obtained based on the ICD code and claim data.

Although the evaluation of HIRA's DQA program indicators has been performed at the hospital level, this is the first study analyze data that is representative of the entire Korean population. In addition, there have not been many studies on process indicators because studies on foreign diabetes quality assessment programs focus on outcomes, as discussed in the introduction. Therefore, this study is thought to provide a better explanation for the mechanism of the DQA process indictors influencing the outcome index.

However, this study has several limitations. First, the ICD code was used to define the cases and outcomes of this study. There are errors of misclassification or incorrect input. In the case of NHIS-NCS data, it is known that about 70% coincide with medical records in actual hospitals.[21] In addition, NHIS-NCS data is claim data and does not include the patient's examination results or exact conditions. Second, when selecting the case and controls, it was not possible to confirm the levels related to the severity of diabetes, such as

HbA1c or fasting blood sugar. Therefore, the initial number of hypoglycemic agents and insulin usage was used to correct the disease severity. Third, it was not possible to identify a direct effect of process indicators on the outcome indicators. We used the incidence of complications associated with diabetes as an outcome indicator. There are several steps that control glucose levels that affect complications of diabetes.[22, 23] Therefore, the evaluation of changes in cholesterol levels and HbA1c was necessary to identify the effect of test rate for cholesterol and HbA1c on the incidence of diabetes complications. Fourth, the NHIS-NSC data were sampled based on the population of 2006, and data from 2002 to 2005 were provided for basic patient investigation. Therefore, it is not possible to identify whether the study population had diabetes or complications of diabetes before 2002. Fifth, many other policies[24] other than the DQA program affect the occurrence of complications, and their impact could not be evaluated. Lastly, there was a problem that occurred with a sample size of NHIS-NSC. We tried to compare the group that followed the program well and the group that did not follow well, but it was not possible. The sample was extracted for about 2% of the Korean population. Therefore, 90% of the clinics managed around five or less patients and it was too small a number to evaluate the institution using DQA indicators.

Despite these limitations, this study was able to identify that HIRA's DQA program influenced in improving process indicators. These results will be of great help in revising the DQA indicator in the future. However, the effect of the DQA program's outcome indicators needs to be confirmed in subsequent studies.

2. Discussion of results

In this study, the effect of the DQA program was investigated in two ways, the process variable and the outcome variable. In previous studies, as a result of meta-analysis of provider monitoring through disease management for diabetic patients, it is known that the HbA1c test averaged 15.6%, the lipid profile test averaged 24%, and the fundus examination increased by 9%.[25] Compared to our results, HbA1c (OR: 1.175, $p<0.0001$) had a similar level, cholesterol profile (OR: 1.043, $p<0.0001$) was less effective, and fundoscopy (OR 1.134, $p<0.0001$) was more effective. These results were obtained due to the characteristics of primary care clinics. HbA1c and cholesterol profile tests were conducted at the primary clinic without referring process. More than 50% of the patients were already being tested every year, even before the policy was introduced. However, to conduct the fundoscopy examination, patients are required to visit other clinics in person, and the annual examination rate before the introduction of the policy was 15.8%. In general hospitals with ophthalmology, more than 50% of the diabetic patients who visited the endocrine department were undergoing fundoscopy test.[26] Because of this difference, it seems that the effect on fundoscopy was greater after the DQA program was introduced. In addition, in the subgroup analysis, fundoscopy rate did not significantly increase in the elderly over 65 years of age and residents in rural areas, which seems to be due to the difference between examinations that can be performed in one primary care clinic and those that cannot.

There was no statistically significant difference between the indicators related to prescription accuracy before and after the start of the DQA program.

Duplicated prescription seems to have no difference between clinics and hospitals because the real-time drug utilization review (DUR), which was implemented in December 2010, was applied to all medical institutions.[27] In addition, the DQA program did not significantly improve the prescribing behavior of doctors, as the prescribing rate of more than four classes did not show any significant improvement.

Case management for diabetes is known to lower HbA1c by 0.21%[28]–0.22%, and quality improvement programs improve HbA1c by 0.42%.[29] Strong control of blood sugar has been found to reduce micro and macrovascular complications of diabetes in several studies.[30-32] However, in this study, although the continuity of care and completion of tests, which are case management indicators, improved, the incidence of complications of diabetes was not affected or increased in primary care clinics. This is part of the policy to reinforce the medical delivery system. In the case of diabetic patients without complications, an additional fee for visiting a general hospital, and efforts to increase the disease severity of hospitals have reduced the incidence of complications at primary medical institutions. In addition, complications of diabetes are affected not only by controlling of blood glucose but also by controlling blood pressure and cholesterol levels. Therefore, in this study, we tried to compare before and after the implementation of the DQA program to see the effect, but the development of control chronic conditions had a greater influence on the reduction of diabetes complications than the policy.

Among them, an increase in diabetic retinopathy seems to be related to an increase in screening in the case of cancers with an increased incidence due to

increased screening.[33-35] However, it is difficult to evaluate the effect of policies on the incidence of complications. Various combinations of policies, lifestyle, and comorbid status are related to the incidence of diseases.

3. Policy implications

In the results of this study, HIRA's DQA program succeeded in continuity of care and completion of examination in changing the behavior of physicians in primary care clinics. However, improving the quality of care is ultimately about reducing complications and improving patients' quality of life.[4] Therefore, prescription accuracy, an index to reduce costs, needs to be improved through DUR, and an index that reflects the improvement of the direct outcome index is needed. As in the case of the US and the UK, evaluation of HbA1c, blood pressure, and cholesterol levels, which are the outcome indicators, is necessary. In addition to changing the behavior of clinics, a policy direction that encourages consumers of medical care to recognize the quality of services and select medical institutions with good diabetes management through outcome indicators is necessary.

V. CONCLUSION

In this study, it was possible to determine how the HIRA's DQA program, which was implemented in 2011, affects the quality of diabetes treatment. Among the process indicators, continuity of care and completion of tests were statistically significantly improved, but not for prescription accuracy. Diabetic nephropathy and neuropathy were unchanged, and diabetic retinopathy increased. Therefore, evaluation of HbA1c, blood pressure, and cholesterol levels, which mediate outcome indicators, is necessary in subsequent studies.

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APPENDICES

Appendix table 1 Percentage of process indicators before and after intervention.

	Primary care clinics		General hospitals	
	Before intervention	After intervention	Before intervention	After intervention
	2008-2010	2013-2015	2008-2010	2013-2015
VEQ	71.3	74.7	67.1	65.7
Medication rate	52.1	65.0	53.3	62.1
duplicated prescription	0.13	0.17	0.14	0.24
prescription of 4 or more drugs	0.42	0.83	0.65	1.13
HbA1c test	58.6	63.3	74.4	76.0
cholesterol profile test	51.7	65.8	71.1	76.2
Fundoscopy	15.8	20.2	26.3	29.9

Appendix table 2 Incidence of diabetes complications of primary care clinics (per 1,000)

	Year					
	2008	2009	2010	2013	2014	2015
Myocardial infarction						
Primary care clinics	10.9	11.5	16.8	5.7	6.6	5.7
General hospitals	18.3	21.2	27.4	21.7	26.8	26.0
Stroke						
Primary care clinics	26.2	30.5	39.5	18.4	21.2	14.8
General hospitals	66.0	78.9	81.4	68.9	83.2	69.2
Angina pectoris						
Primary care clinics	25.6	32.3	37.7	19.5	17.8	19.3
General hospitals	63.3	81.3	84.2	66.8	59.6	61.1
Diabetic nephropathy						
Primary care clinics	9.2	10.8	14.0	8.6	10.4	13.1
General hospitals	7.3	10.1	11.3	9.6	10.3	10.4
Diabetic neuropathy						
Primary care clinics	34.7	39.6	48.1	30.3	34.5	44.8
General hospitals	76.9	92.8	113.9	119.0	118.7	127.2
Diabetic retinopathy						
Primary care clinics	16.9	21.6	23.6	31.9	28.8	29.7
General hospitals	39.6	49.6	48.2	49.3	42.5	46.5

ABSTRACT (IN KOREAN)

당뇨병 적정성 평가가 일차의료기관의 당뇨병 관리 질에 미치는 영향

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문 종 윤

연구배경: 당뇨병 관리의 질을 향상시키기 위해 건강보험심사평가원은 2011 년에 당뇨병 적정성 평가를 도입하였다. 당뇨병 적정성평가는 치료의 지속성, 처방의 정확성 및 검사시행을 평가하였다. 적정성평가에서 양호 등급을 받은 의원의 목록을 일반에게 공개하고 가산 수가를 지급하였다. 본 연구에서는 이러한 당뇨병 적정성평가가 당뇨병 관련 의료의 질에 어떠한 영향을 미치는지를 분석하고자 하였다.

연구방법: 본 연구를 위해 국민건강보험공단 표본 연구 데이터베이스를 사용하였다. 당뇨 환자는 2008년 1월부터 2010년 12월까지, 2013년 1월부터 2015년 12월까지 새롭게 진단 코드와 함께 경구 혈당강하제 및 인슐린을 처방 받은

사람으로 정의하였다. 일차의료기관을 주로 방문한 당뇨병 환자를 환자군으로, 종합병원을 주로 방문한 환자를 대조군으로 정의하였다. 당뇨병 적정성평가가 당뇨병의 질에 미치는 영향을 측정하기 위해 이중차이분석법을 사용하였다.

연구결과: 환자군은 16,232명, 대조군은 8,669명이 본 연구의 분석에 사용되었다. 치료지속성을 위한 두개의 변수 모두 향상되었는데, 분기별방문율의 교차비는 1.086 ($p<0.0001$)이었으며, 치료일수율의 교차비는 1.091 ($p<0.0001$)이었다. 그러나 처방의 정확도에서는 유의한 차이를 보이지 않았다. 검사시행률에 있어서는 당화혈색소의 교차비가 1.175 ($p<0.0001$), 지질 검사의 교차비가 1.043 ($p<0.0001$), 그리고 안저검사의 교차비가 1.134 ($p<0.0001$)이었다. 하위그룹 분석에서는 안저검사의 교차비가 65세 이상군과 읍면리에 거주하는 군에서 유의하지 않았다. 결과지표에 대해서는 당뇨성신병증과 (OR 0.934, $p=0.215$) 당뇨성신경병증 (OR 1.108, $p=0.073$)에 대해서는 통계적으로 유의한 변화가 없었지만 당뇨성망막증의 교차비는 1.497 ($p<0.0001$)로 통계적으로 유의하게 증가하였다. 하위그룹 분석에서는 읍면리에 거주하는 군에서 당뇨성망막증의 교차비가 유의하게 증가하지 않았다.

결론: 당뇨병 적정성평가는 치료지속성과 검사시행에서는 통계적으로 유의한 향상을 보였으나, 처방의 정확도에서는 통계적으로 유의한 차이를 보이지 않았다. 또한 결과 지표에 있어서는 당뇨병 적정성평가 전후와 의료기관의 차이를 고려하였을 때 심근경색, 뇌졸중, 협심증, 당뇨병성 망막병증이 증가하였다. 따라서 추후에 당뇨병 적정성 평가의 지표로 중간 결과지표인 당화혈색소, 혈압, 지질 등의 수치가 들어가는 것이 합병증의 발생을 줄이기 위해 바람직하다.

핵심되는 말: 당뇨, 의료의 질, 적정성 평가, 이중차이분석