

# Factors Related to Continuing Care and Interruption of P4P Program Participation in Patients With Diabetes

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In 2014, an estimated 415 million individuals worldwide had diabetes, and the number of individuals with diabetes is expected to rise to 642 million by 2040.<sup>1</sup> Previous studies have shown the challenges of diabetes prevention and management,<sup>2,3</sup> but better continuity of care has been associated with improved medication compliance<sup>4,5</sup> and reductions in hospitalizations,<sup>6,7</sup> emergency department visits,<sup>8</sup> mortality,<sup>9</sup> and healthcare expenses for patients with diabetes.<sup>8,10</sup>

Pay-for-performance (P4P) is a payment scheme that rewards healthcare providers for providing high-quality continuing care services.<sup>11,12</sup> In many countries—such as the United States, Australia, Germany, and the United Kingdom—P4P programs are a priority policy for promoting more efficient use of healthcare resources and enhancing the quality of care.<sup>13-15</sup>

In Taiwan, 7% of the population (1,631,599 individuals) had diabetes as of 2012, which accounts for 3.8% of the National Health Insurance program's total annual healthcare expenditure.<sup>16,17</sup> To improve the prevention and treatment of this disease, Taiwan launched a diabetes P4P program in November 2001. As part of this program, a team of care providers, consisting of physicians, nurses, nutritionists, and other healthcare professionals work together to provide examination, testing, health education, and follow-up services in an effort to reduce the occurrence of diabetic complications and comorbidities.<sup>18</sup> Healthcare organizations participating in the program must perform specific diagnosis and management tasks, including medical history, physical examination, laboratory evaluation, evaluation of the management plan, and diabetes self-management education. Patients who are enrolled in the diabetes P4P program must undergo a complete annual evaluation of their disease. If healthcare services have been provided as required by the program, the healthcare organization will receive a bonus payment: a value-added physician examination fee and a case management fee. For Taiwan's diabetes P4P program, the amount

## ABSTRACT

**Objectives:** To examine factors that influenced continuing care participation in patients with diabetes and factors contributing to interrupted participation for patients with diabetes enrolled in a diabetes pay-for-performance (P4P) program in Taiwan.

**Study Design:** Retrospective cohort analysis.

**Methods:** Data were obtained from Taiwan's National Health Insurance Research Database on patients with a new confirmed diagnosis of type 2 diabetes during 2001 to 2008, selected as 1:1 propensity score-matched P4P program enrollees and nonenrollees (totaling 396,830). Logistic regression was performed to analyze factors associated with continuing care participation and with interrupted P4P program participation after enrollment.

**Results:** Among the patients with diabetes, P4P program enrollees were 4.27 times (95% CI, 4.19-4.36) more likely to participate in continuing care than nonenrollees. Factors affecting the participation of patients with diabetes in continuing care included P4P program enrollment status, personal characteristics, health status, characteristics of the main physician, and characteristics of the main healthcare organization. Interruption of P4P program participation occurred in 78,759 (44.33%) of the enrolled patients with diabetes and was correlated with male gender, younger age (<35 years), residence in areas of highest urbanization, greater severity of diabetes complications, presence of catastrophic illness/injury, high service volume at the site of the main physician, older age (≥55 years) of the main physician, having a regional or private hospital as the main healthcare organization, and change of physician.

**Conclusions:** Taiwan's diabetes P4P program increased continuing care participation in patients with diabetes. The rate of interruption of P4P program participation among enrolled patients with diabetes, at 44.33%, should be a focus of improvement for Taiwan's health authorities.

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of the bonus payment is calculated using a point system, and the case management fee includes: 400 points awarded for the initial physician visit (once per patient), 200 points for each follow-up visit (once every 3 months), and 800 points for the annual evaluation (once per year),<sup>19</sup> where 1 point is worth around 1 New Taiwan Dollar (NTD) (30 NTD = US\$1). In 2009, 27.56% (214,340) of Taiwan's patients with diabetes were enrolled in the program.<sup>19</sup>

Previous assessments of Taiwan's diabetes P4P program have found it to effectively increase clinical guideline adherence<sup>18,20</sup>

and patient satisfaction with the quality of care,<sup>21</sup> as well as decrease inpatient care utilization.<sup>22,23</sup> In this study, we used data from the National Health Insurance database to examine factors that influence continuing care participation in patients with diabetes who either are or are not enrolled in the P4P program, and factors that affect whether interrupted participation in the P4P program occurs in patients with diabetes who are enrolled in the program. Both Taiwan and the United States provide doctors with financial incentives to enhance medical quality, and some payments are based on quality indicators. However, P4P in Taiwan is implemented by a single public insurer (National Health Insurance), whereas P4P in the United States is practiced under multiple medical insurance systems. The study results could be a policy reference for comparisons among different health insurance systems.

Previous studies have adopted variables such as gender, age, monthly salary, comorbidities,<sup>24</sup> Diabetes Complications Severity Index (DCSI) score, and hospital accreditation level<sup>22</sup> when evaluating diabetes P4P programs. On the basis of logical inference, we searched for possible variables that might account for patients joining or withdrawing from a diabetes P4P program; the topic has rarely been studied.

## METHODS

### Data Source and Participants

In this retrospective cohort study, analysis was performed with secondary data obtained from the National Health Insurance Research Database maintained by Taiwan's National Health Research Institutes. The study population consisted of all patients with a confirmed diagnosis of type 2 diabetes from 2001 through 2008. Patients with diabetes were defined as individuals with 1 hospitalization, or 3 or more outpatient visits within 365 days, in

### Take-Away Points

This study examined factors associated with continuing care participation in patients with diabetes and with interrupted participation for those patients enrolled in a diabetes pay-for-performance (P4P) program.

- Taiwan's P4P program increased the rate of continuing care in patients with diabetes.
- Factors that correlated with the participation of patients with diabetes in continuing care included the patient's P4P program enrollment status, personal characteristics, health status, characteristics of the main physician, and characteristics of the main healthcare organization.
- Factors associated with interrupted participation by patients with diabetes in the P4P program after enrollment included male gender, younger age (<35 years), residence in areas of the highest urbanization level, greater severity of diabetes complications, presence of catastrophic illness or injury, high service volume at the site of the main physician, older age (≥55 years) of the main physician, having a regional or private hospital as the main healthcare organization, and change of physician.

which the primary or secondary diagnosis was diabetes (*International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 250.x or A-code A181*).<sup>25</sup> Patients with diabetes in pregnancy (*ICD-9-CM code 648.0*), or diabetes that is gestational (648.8) or neonatal (775.1), or had abnormal glucose tolerance (790.2) were excluded from the study. Patients with diabetes whose outpatient records had ever been designated with the specific treatment code "E4" (for the diabetes P4P program) were defined as P4P program enrollees (N = 198,420). All study subjects were followed until the end of 2009.

Propensity score matching was performed on the basis of personal characteristics (gender, age, monthly salary, and residence urbanization level); health status (comorbidity, severity of diabetes complications, and presence or absence of catastrophic illness or injury); and characteristics of the healthcare organization (level and ownership type) in order to match P4P enrollees 1:1 with nonenrollees among patients with diabetes. This resulted in a sample of 396,830 patients for analysis. For the analysis of factors related to interrupted participation in the diabetes P4P program after enrollment, we excluded enrollees, totaling 20,744, who did not reach the time point for their annual evaluation (29 full weeks after enrollment), leaving 177,676 enrollees for the analysis. To encourage medical teams to improve their monitoring of and continual care for patients, the National Health Insurance Administration in Taiwan has established payment regulations for its diabetes P4P program. Patients with diabetes who have been in the P4P program for 29 weeks can participate in yearly evaluations, and the doctor can receive the annual case management fee for each patient.

### Description of Variables

The dependent variables examined in this study included whether participation in the diabetes P4P program

was interrupted and whether continuing care participation was maintained. The independent variables analyzed included personal characteristics; health status; characteristics of the main physician seen (age and annual service volume), and characteristics of the main healthcare organization utilized. The National Health Insurance Administration in Taiwan has identified 30 types of severe illness or injury as catastrophic illnesses or injuries (eg, malignant neoplasm, type 1 diabetes, chronic renal failure, cerebrovascular disease, rare disease).

Further details on the variables are as follows: 1) continuing care participation was defined as having at least 1 diabetes-related physician visit every 3 months and at least 4 such visits per year following a confirmed diabetes diagnosis for patients not enrolled in the P4P program, or following P4P program enrollment for enrollees. Otherwise, patients were considered to lack continuing care participation. 2) Uninterrupted diabetes P4P program participation was defined as having regular diabetes visits during the year following P4P program enrollment, and then undergoing the annual evaluation of diabetes disease (prescription code P1409C). Enrolled patients who failed to complete the first annual diabetes evaluation were considered to have interrupted participation in the diabetes P4P program. 3) Monthly salaries were taken to be the monthly salary amounts used in the determination of National Health Insurance premiums. 4) The urbanization level of the residence area was designated as 1 of 7 levels, with level 1 corresponding to the highest level of urbanization and level 7 to the lowest. 5) Comorbidity was assessed using the Deyo modification of the Charlson comorbidity score. Each patient's *ICD-9-CM* primary and secondary diagnosis codes were converted to weighted numerical scores, which were then summed to give the patient's Charlson comorbidity index (CCI).<sup>26</sup> 6) The severity of diabetes complications was assessed using the categories of diabetes complications described by Young et al (retinopathy, nephropathy, neuropathy, stroke, cardiovascular disease, peripheral vascular disease, and metabolic complications). Each patient's *ICD-9-CM* primary and secondary diagnosis codes were converted to weighted numerical scores, which were then summed to give the patient's DCSI.<sup>27</sup> 7) Physician service volume was computed as the annual service volume of the patient's main physician, categorized by the quartile method as high ( $\geq 75\%$ ), medium ( $\geq 25\%$  and  $< 75\%$ ), or low ( $< 25\%$ ). 8) The characteristics of the main healthcare organization utilized were classified in terms of its level and ownership type. 9) Low-income household status was defined as belonging to a household in which the average monthly in-

come per person falls below the lowest living index, which is 60% of the living expenditure per person in the previous year in the household's local area.<sup>28</sup>

This study was approved by the Institutional Review Board of China Medical University and Hospital (IRB No. 20130326C).

### Statistical Analysis

First, descriptive statistics were used to examine the distribution of different variables—personal characteristics, health status, characteristics of the main physician, characteristics of the main healthcare organization, and continuing care participation—in the study participants, who were distinguished by whether they were enrolled in the P4P program and whether interruption occurred in their participation in the P4P program after enrollment. The distributions were expressed as percentages and means.

Next, the  $\chi^2$  test and *t* test were used to examine each variable's association with continuing care participation in diabetes P4P program enrollees and nonenrollees, as well as association with interrupted P4P program participation in the enrollees. Logistic regression analysis was performed to examine factors that influenced continuing care participation in patients with diabetes.

Finally, logistic regression was employed to examine factors that influenced whether interruption occurred in the participation of patients with diabetes in the P4P program after enrollment. In this study, all statistical analyses were performed using SAS 9.3 software (SAS Institute, Cary, North Carolina) for Windows. A *P* value less than .05 was considered statistically significant.

## RESULTS

Among the patients with diabetes analyzed in this study, the P4P program enrollees and the propensity score–matched nonenrollees were not significantly different in any of the matched variables, as shown in **Table 1**. The majority of the program enrollees participated in continuing care, defined as having at least 1 diabetes-related physician visit every 3 months (71.82%, vs 27.67% who did not), as shown in **Table 2**. With respect to personal characteristics, all patients with diabetes characterized by female gender (49.99%), aged 35 to 64 years (50.37%–52.35%), a monthly salary of NTD17,281–22,800 (50.60%), and residence in urbanization level 4 or 5 areas (50.77%) had higher rates of continuing care participation. As for health status, a CCI of 2 (60.19%), a DCSI of 1 (65.13%), and the absence of catastrophic illness or injury (50.88%) corresponded to higher rates of continuing care participa-

**Table 1.** Comparisons of Study Subjects After Propensity Score Matching for P4P Participating Status

Variable	1:1 Matched						P
	Total		Non-P4P		P4P		
	N	%	n <sub>1</sub>	%	n <sub>2</sub>	%	
Total	396,830	100.00	198,415	50.00	198,415	50.00	–
Gender							.874
Female	188,014	47.38	93,982	47.37	94,032	47.39	
Male	208,816	52.62	104,433	52.63	104,383	52.61	
Age, years							.806
<35	16,360	4.12	8102	4.08	8258	4.16	
35-44	51,675	13.02	25,775	12.99	25,900	13.05	
45-54	115,446	29.09	57,721	29.09	57,725	29.09	
55-64	109,350	27.56	54,728	27.58	54,622	27.53	
65-74	74,147	18.68	37,114	18.71	37,033	18.66	
≥75	29,852	7.52	14,975	7.55	14,877	7.50	
Monthly salary (NTD)							.933
Low-income households	3815	0.96	1870	0.94	1945	0.98	
≤17,280	21,320	5.37	10,661	5.37	10,659	5.37	
17,281-22,800	173,318	43.68	86,721	43.71	86,597	43.64	
22,801-28,800	92,635	23.34	46,350	23.36	46,285	23.33	
28,801-36,300	31,574	7.96	15,748	7.94	15,826	7.98	
36,301-45,800	36,986	9.32	18,472	9.31	18,514	9.33	
≥45,801	37,182	9.37	18,593	9.37	18,589	9.37	
CCI score							.805
0	37,097	9.35	18,441	9.29	18,656	9.40	
1-3	148,334	37.38	74,167	37.38	74,167	37.38	
4-6	117,834	29.69	59,003	29.74	58,831	29.65	
7-9	62,627	15.78	31,351	15.80	31,276	15.76	
≥10	30,938	7.80	15,453	7.79	15,485	7.80	
DCSI score							.948
0	219,307	55.26	109,738	55.31	109,569	55.22	
1	92,872	23.40	46,398	23.38	46,474	23.42	
2	50,164	12.64	25,073	12.64	25,091	12.65	
≥3	34,487	8.69	17,206	8.67	17,281	8.71	
Catastrophic illness							.544
No	373,472	94.11	186,781	94.14	186,691	94.09	
Yes	23,358	5.89	11,634	5.86	11,724	5.91	
Level of healthcare organization							.810
Medical center	64,330	16.21	32,260	16.26	32,070	16.16	
Regional	142,551	35.92	71,289	35.93	71,262	35.92	
District	77,353	19.49	38,674	19.49	38,679	19.49	
Clinic	112,596	28.37	56,192	28.32	56,404	28.43	
Ownership of organization							.420
Public	95,135	23.97	47,459	23.92	47,676	24.03	
Nonpublic	301,695	76.03	150,956	76.08	150,739	75.97	

CCI indicates Charlson comorbidity index; DCSI, Diabetes Complications Severity Index; NTD, New Taiwan Dollar; P4P, pay-for-performance.

■ **Table 2** Distribution of Various Characteristics in Patients With Diabetes With and Without Continuing Care Participation

Variable	Total		No Continuing Care		Continuing Care		P
	N	%	n <sub>1</sub>	%	n <sub>2</sub>	%	
Total	396,830	100.00	199,438	50.26	197,392	49.74	–
P4P participating status							<.001
No P4P	198,415	50.00	143,515	72.33	54,900	27.67	
P4P	198,415	50.00	55,923	28.18	142,492	71.82	
Gender							.004
Female	188,014	47.38	94,033	50.01	93,981	49.99	
Male	208,816	52.62	105,405	50.48	103,411	49.52	
Patient age, years							<.001
<35	20,496	5.16	11,418	55.71	9,078	44.29	
35-44	61,242	15.43	29,184	47.65	32,058	52.35	
45-54	123,960	31.24	59,625	48.10	64,335	51.90	
55-64	102,243	25.76	50,745	49.63	51,498	50.37	
65-74	66,053	16.65	34,698	52.53	31,355	47.47	
≥75	22,836	5.75	13,768	60.29	9,068	39.71	
Average age, years (mean ± SD)	55.05 ± 12.61		55.49 ± 13.19		54.60 ± 11.98		<.001 <sup>a</sup>
Monthly salary (NTD)							<.001
Low-income households	3815	0.96	1979	51.87	1836	48.13	
≤17,280	21,320	5.37	10,898	51.12	10,422	48.88	
17,281-22,800	173,318	43.68	85,627	49.40	87,691	50.60	
22,801-28,800	92,635	23.34	47,994	51.81	44,641	48.19	
28,801-36,300	31,574	7.96	15,853	50.21	15,721	49.79	
36,301-45,800	36,986	9.32	18,483	49.97	18,503	50.03	
≥45,801	37,182	9.37	18,604	50.03	18,578	49.97	
Urbanization of residence area <sup>b</sup>							<.001
Level 1	110,653	27.88	57,154	51.65	53,499	48.35	
Level 2/3	182,168	45.91	90,693	49.79	91,475	50.21	
Level 4/5	70,239	17.70	34,581	49.23	35,658	50.77	
Level 6/7	33,770	8.51	17,010	50.37	16,760	49.63	

(continued)

tion in the all patients with diabetes. Higher rates of continuing care were also observed in patients whose main physicians were aged 45 to 54 years (63.86%) or had a high service volume (70.67%), and in patients whose main healthcare organization was a district hospital (50.63%), a clinic (50.09%), or a public hospital (50.53%).

### Factors Affecting Continuing Care Participation in Patients With Diabetes

Logistic regression analysis revealed that patients with diabetes who are enrolled in the P4P program were more likely to participate in continuing care (having at least 1 diabetes-related physician visit every 3 months) than those not enrolled in the program by a factor of 4.27 (95% CI,

4.19-4.36), as shown in **Table 3**. Increased odds of continuing care participation were associated with all patient characteristics of female gender, aged 35 to 74 years (odds ratio [OR], 1.05-1.40), and residence in urbanization level 2 or 3 areas (OR, 1.07). With respect to health status, any patients with diabetes with a CCI of 2 (OR, 1.59), with a DCSI of 1 (OR, 1.58), or without catastrophic illness or injury were more likely to participate in continuing care. As for physician and health organization characteristics, higher odds of continuing care participation were found for any patients with diabetes whose care was provided mainly by a physician aged 35 to 44 years (OR, 1.15) or with a high service volume (OR, 3.01), and mainly by a clinic (OR, 1.12) or a public hospital. In particular, physician service volume was

**Table 2** Distribution of Various Characteristics in Patients With Diabetes With and Without Continuing Care Participation (*continued*)

Variable	Total		No Continuing Care		Continuing Care		P
	N	%	n <sub>1</sub>	%	n <sub>2</sub>	%	
CCI score							<.001
0	208,284	52.49	109,555	52.60	98,729	47.40	
1	80,842	20.37	42,253	52.27	38,589	47.73	
2	56,913	14.34	22,655	39.81	34,258	60.19	
≥3	50,791	12.80	24,975	49.17	25,816	50.83	
DCSI score							<.001
0	315,267	79.45	165,312	52.44	149,955	47.56	
1	46,980	11.84	16,381	34.87	30,599	65.13	
2	26,143	6.59	13,436	51.39	12,707	48.61	
≥3	8440	2.13	4309	51.05	4131	48.95	
Catastrophic illness							<.001
No	363,837	91.69	178,708	49.12	185,129	50.88	
Yes	32,993	8.31	20,730	62.83	12,263	37.17	
Physician's age, years							<.001
<35	143,706	36.21	95,227	66.27	48,479	33.73	
35-44	147,542	37.18	64,794	43.92	82,748	56.08	
45-54	79,804	20.11	28,840	36.14	50,964	63.86	
≥55	25,778	6.50	10,577	41.03	15,201	58.97	
Physician's annual service volume							<.001
Low	99,039	24.96	79,292	80.06	19,747	19.94	
Medium	198,566	50.04	91,042	45.85	107,524	54.15	
High	99,225	25.00	29,104	29.33	70,121	70.67	
Level of healthcare organization							<.001
Medical center	64,330	16.21	32,227	50.10	32,103	49.90	
Regional	142,551	35.92	72,830	51.09	69,721	48.91	
District	77,353	19.49	38,189	49.37	39,164	50.63	
Clinic	112,596	28.37	56,192	49.91	56,404	50.09	
Ownership of organization							<.001
Public	95,135	23.97	47,059	49.47	48,076	50.53	
Nonpublic	301,695	76.03	152,379	50.51	149,316	49.49	

CCI indicates Charlson comorbidity index; DCSI, Diabetes Complications Severity Index; NTD, New Taiwan Dollar; P4P, pay-for-performance.  
<sup>a</sup>t test.  
<sup>b</sup>Level 1 denotes the most urbanized areas.

directly correlated with the odds of continuing care participation for all patients with diabetes.

**Comparison of Characteristics Between Patients With and Without Interruption of Diabetes P4P Program Participation After Enrollment**

Of the patients with diabetes who were enrolled in the diabetes P4P program, 78,759 (44.33%) had interrupted participation in the program, as seen in **Table 4**. With

respect to personal characteristics, higher proportions of enrollees who were male (45.61%), were aged under 35 years (52.35%), had a monthly salary of NTD22,801 to NTD28,800 (46.44%), or resided in urbanization level 1 areas (46.41%) had an interruption of program participation. Among the health status characteristics, a CCI ≥10 (47.65%), a DCSI ≥3 (50.09%), and the presence of catastrophic illness or injury (47.31%) corresponded to higher rates of interrupted program participation. Interrupted

■ **Table 3.** Association of Factors With Continuing Care Participation in Patients With Diabetes

Variable	Unadjusted Model			Adjusted Model		
	OR	(95% CI)	P	OR	(95% CI)	P
P4P participating status						
No P4P	1	–	–	1	–	–
P4P	6.66	(6.57-6.75)	<.001	4.27	(4.19-4.36)	<.001
Gender						
Female	1	–	–	1	–	–
Male	0.98	(0.97-0.99)	.004	0.96	(0.95-0.98)	<.001
Patient's age, years						
<35	1	–	–	1	–	–
35-44	1.38	(1.34-1.43)	<.001	1.40	(1.35-1.45)	<.001
45-54	1.36	(1.32-1.40)	<.001	1.35	(1.31-1.40)	<.001
55-64	1.28	(1.24-1.32)	<.001	1.23	(1.19-1.27)	<.001
65-74	1.14	(1.10-1.17)	<.001	1.05	(1.01-1.09)	.013
≥75	0.83	(0.80-0.86)	<.001	0.77	(0.73-0.80)	<.001
Monthly salary (NTD)						
Low-income households	1	–	–	1	–	–
≤17,280	1.03	(0.96-1.10)	.389	0.98	(0.91-1.07)	.680
17,281-22,800	1.10	(1.04-1.18)	.003	1.08	(1.00-1.16)	.054
22,801-28,800	1.00	(0.94-1.07)	.938	0.97	(0.90-1.05)	.431
28,801-36,300	1.07	(1.00-1.14)	.052	1.00	(0.92-1.08)	.945
36,301-45,800	1.08	(1.01-1.15)	.025	1.02	(0.95-1.11)	.542
≥45,801	1.08	(1.01-1.15)	.031	1.05	(0.97-1.13)	.262
Urbanization of residence area <sup>a</sup>						
Level 1	1	–	–	1	–	–
Level 2/3	1.08	(1.06-1.09)	<.001	1.07	(1.06-1.09)	<.001
Level 4/5	1.10	(1.08-1.12)	<.001	1.04	(1.01-1.06)	.002
Level 6/7	1.05	(1.03-1.08)	<.001	1.01	(0.98-1.04)	.478
CCI score						
0	1	–	–	1	–	–
1	1.01	(1.00-1.03)	.108	1.13	(1.11-1.15)	<.001
2	1.68	(1.65-1.71)	<.001	1.59	(1.56-1.63)	<.001
≥3	1.15	(1.13-1.17)	<.001	1.43	(1.39-1.46)	<.001

(continued)

program participation also occurred at higher rates in enrollees whose main physician was aged under 35 years (48.60%) or had a high service volume (47.68%), whose main healthcare organization was a regional hospital (47.24%), and who had a change of physician (72.74%).

#### Factors Associated With Interrupted Diabetes P4P Program Participation in Enrolled Patients With Diabetes

Factors related to interruption of diabetes P4P program participation in enrolled patients with diabetes were ana-

lyzed by logistic regression, with the results shown in Table 4. Personal characteristics of the patients with diabetes that were associated with a greater likelihood of interrupted program participation were male (OR, 1.14), aged under 35 years, had a monthly salary of NTD ≤28,800, and residence in urbanization level 1 areas. With respect to health status, enrollees with a DCSI ≥3 (OR, 1.26) or with catastrophic illness or injury (OR, 1.24) were more likely to have an interruption of program participation. After we controlled for all relevant variables in the analysis model, the results changed so for enrollees whose main

**Table 3.** Association of Factors With Continuing Care Participation in Patients With Diabetes (*continued*)

Variable	Unadjusted Model			Adjusted Model		
	OR	(95% CI)	P	OR	(95% CI)	P
DCSI score						
0	1	–	–	1	–	–
1	2.06	(2.02-2.10)	<.001	1.58	(1.54-1.61)	<.001
2	1.04	(1.02-1.07)	.001	1.00	(0.97-1.03)	.809
≥3	1.06	(1.01-1.10)	.012	1.05	(1.00-1.11)	.065
Catastrophic illness						
No	1	–	–	1	–	–
Yes	0.57	(0.56-0.58)	<.001	0.52	(0.51-0.54)	<.001
Physician’s age, years						
<35	1	–	–	1	–	–
35-44	2.51	(2.47-2.55)	<.001	1.15	(1.13-1.17)	<.001
45-54	3.47	(3.41-3.53)	<.001	0.92	(0.89-0.94)	<.001
≥55	2.82	(2.75-2.90)	<.001	0.96	(0.93-1.00)	.031
Physician’s annual service volume						
Low	1	–	–	1	–	–
Medium	4.74	(4.66-4.83)	<.001	2.17	(2.12-2.21)	<.001
High	9.67	(9.48-9.88)	<.001	3.01	(2.93-3.09)	<.001
Level of healthcare organization						
Medical center	1	–	–	1	–	–
Regional	0.96	(0.94-0.98)	<.001	0.91	(0.89-0.93)	<.001
District	1.03	(1.01-1.05)	.007	1.06	(1.03-1.09)	<.001
Clinic	1.01	(0.99-1.03)	.441	1.12	(1.10-1.15)	<.001
Ownership of organization						
Public	1	–	–	1	–	–
Nonpublic	0.96	(0.95-0.97)	<.001	0.93	(0.91-0.94)	<.001

CCI indicates Charlson comorbidity index; DCSI, Diabetes Complications Severity Index; NTD, New Taiwan Dollar; OR, odds ratio; P4P, pay-for-performance.  
<sup>a</sup>Level 1 denotes the most urbanized areas.

physician was 55 years or older, there were increased odds of interrupted program participation (OR, 1.19; 95% CI, 1.14-1.25); additional associated factors included having a high service volume (OR, 1.56), having a regional hospital (OR, 1.22) or a private hospital (OR, 1.02) as the main healthcare organization, and having changed physicians (OR, 7.10). In particular, there was a direct correlation between physician service volume and the odds of interrupted diabetes P4P program participation in enrolled patients with diabetes.

## DISCUSSION

In this study, we showed that patients with diabetes who were enrolled in Taiwan’s diabetes P4P program were

more likely to engage in continuing care (ie, have at least 1 diabetes-related physician visit every 3 months) than their nonenrolled counterparts (Table 3). This finding is in agreement with a previous study conducted in Taiwan by Lee et al (2010).<sup>23</sup> Those authors found that patients with diabetes in the P4P program had a larger increase in the number of diabetes-specific physician visits after program enrollment (annual average increasing from 3.8 times to 6.4 times) than nonenrolled patients in the same period (from 3.5 to 3.6 times).<sup>23</sup>

One of the factors that has been associated with differences in patients’ continuing care participation is gender. Chang et al (2005) showed that female patients with diabetes were more likely than their male counterparts to take their medicine regularly and practice self-care (ex-

**Table 4.** Association of Factors With Interruption of Diabetes P4P Program Participation

Variable	Complete Annual Evaluation		No Complete Annual Evaluation		P	Adjusted Model		
	n <sub>1</sub>	%	n <sub>2</sub>	%		OR	(95% CI)	P
Total	98,917	55.67	78,759	44.33	–			
Gender					<.001			
Female	48,056	57.10	36,109	42.90		1	–	–
Male	50,861	54.39	42,650	45.61		1.14	(1.12-1.17)	<.001
Patient's age, years					<.001			
<35	3549	47.65	3899	52.35		1	–	–
35-44	12,877	54.91	10,575	45.09		0.75	(0.71-0.79)	<.001
45-54	29,336	56.49	22,599	43.51		0.72	(0.68-0.76)	<.001
55-64	27,885	57.62	20,507	42.38		0.70	(0.66-0.74)	<.001
65-74	18,733	56.27	14,556	43.73		0.74	(0.70-0.79)	<.001
≥75	6537	49.67	6,623	50.33		0.98	(0.92-1.05)	<.001
Average age, years (mean ± SD)	56.54 ± 12.04		56.48 ± 13.01		.295*			
Monthly salary (NTD)					<.001			
Low-income households	945	55.65	753	44.35		1	–	–
<17,280	6340	54.64	5264	45.36		1.04	(0.93-1.17)	.034
17,281-22,800	50,855	55.97	40,002	44.03		1.01	(0.90-1.12)	.396
22,801-28,800	18,078	53.56	15,674	46.44		1.07	(0.96-1.20)	<.001
28,801-36,300	6465	57.13	4852	42.87		0.96	(0.85-1.07)	.052
36,301-45,800	8095	56.59	6210	43.41		0.98	(0.88-1.10)	.441
≥45,801	8139	57.55	6004	42.45		0.92	(0.82-1.03)	<.001
Urbanization of residence area <sup>b</sup>					<.001			
Level 1	26,101	53.59	22,607	46.41		1	–	–
Level 2/3	46,056	56.69	35,193	43.31		0.86	(0.84-0.89)	.020
Level 4/5	18,493	56.20	14,410	43.80		0.83	(0.81-0.86)	<.001
Level 6/7	8267	55.80	6549	44.20		0.83	(0.80-0.87)	<.001
CCI score					<.001			
0	9477	55.92	7469	44.08		1	–	–
1-3	37,549	56.38	29,048	43.62		0.98	(0.94-1.01)	.395
4-6	29,540	56.07	23,143	43.93		0.96	(0.93-1.00)	.040
7-9	15,203	54.69	12,594	45.31		0.98	(0.94-1.02)	.642
≥10	7148	52.35	6505	47.65		1.00	(0.95-1.06)	.287

(continued)

ercise, dietary control, and weight control).<sup>29</sup> Studies in Germany<sup>30</sup> and Israel<sup>31</sup> observed a higher number of physician visits for female than male patients with diabetes. Previous research also found differing views on health-related issues between men and women and the greater social and cultural acceptability of women being weak or unhealthy.<sup>32</sup> Women with diabetes were also shown to more readily seek consultation for illness in general<sup>33</sup> and to have more diabetes-related worries.<sup>34</sup> Our results show that, compared with their male counterparts, female

patients with diabetes were more likely to participate in continuing care (Table 3) and less likely to have interrupted participation in the diabetes P4P program after enrollment (Table 4).

With respect to patient age, it has been shown that younger patients, with a shorter medical history, were less likely than older patients to have established a long-term, sustained relationship with their medical care provider or team.<sup>33</sup> Younger patients also self-reported better health status<sup>35</sup> and were less likely to

**Table 4.** Association of Factors With Interruption of Diabetes P4P Program Participation (*continued*)

Variable	Complete Annual Evaluation		No Complete Annual Evaluation		P	Adjusted Model		P
	n <sub>1</sub>	%	n <sub>2</sub>	%		OR (95% CI)		
DCSI score								
0	56,196	56.64	43,024	43.36	<.001	1	–	–
1	23,273	56.48	17,932	43.52		0.99	(0.97-1.02)	<.001
2	11,933	53.76	10,262	46.24		1.10	(1.07-1.14)	.148
≥3	7515	49.91	7541	50.09		1.26	(1.21-1.31)	<.001
Catastrophic illness								
No	93,568	55.85	73,957	44.15	<.001	1	–	–
Yes	5349	52.69	4802	47.31		1.24	(1.18-1.30)	<.001
Physician's age, years								
<35	9414	51.40	8901	48.60	<.001	1	–	–
35-44	44,619	55.90	35,202	44.10		0.90	(0.87-0.94)	<.001
45-54	35,288	57.46	26,120	42.54		0.94	(0.90-0.97)	<.001
≥55	9596	52.92	8536	47.08		1.19	(1.14-1.25)	<.001
Physician's annual service volume								
Low	25,163	56.77	19,158	43.23	<.001	1	–	–
Medium	50,402	56.81	38,318	43.19		1.11	(1.07-1.14)	<.001
High	23,352	52.32	21,283	47.68		1.56	(1.51-1.62)	<.001
Level of healthcare organization								
Medical center	15,936	56.20	12,419	43.80	<.001	1	–	–
Regional	33,493	52.76	29,991	47.24		1.22	(1.18-1.26)	<.001
District	19,707	55.93	15,529	44.07		1.06	(1.02-1.10)	.003
Clinic	29,781	58.85	20,820	41.15		1.11	(1.07-1.16)	.132
Ownership of organization								
Public	23,814	55.74	18,911	44.26	.760	1	–	–
Nonpublic	75,103	55.65	59,848	44.35		1.02	(0.99-1.05)	.145
Changing physicians								
No	81,395	71.78	31,998	28.22	<.001	1	–	–
Yes	17,522	27.26	46,761	72.74		7.10	(6.95-7.26)	<.001

<sup>a</sup>t test.

<sup>b</sup>Level 1 denotes the most urbanized areas.

have experienced severe diabetes complications.<sup>36</sup> Consistently, we found patients with diabetes aged under 35 years to have poorer continuing care participation (Table 3) and higher odds of interrupted diabetes P4P program participation (Table 4). Aller et al (2013) also showed that patients aged under 35 years and patients with poorer health status experienced less relational continuity of care with their physicians.<sup>37</sup>

As for the effect of economic status, a Brazilian study (2003) found that patients with higher income were more likely to have a continual relationship with a regular physician than those with lower income.<sup>38</sup> Our results show

that patients with diabetes earning less than or equal to NTD28,800 in monthly salary were more likely to have interrupted participation in the diabetes P4P program than those earning over NTD28,800.

The area of residence may affect continuing care because the fast pace of life and busy work schedules in highly urbanized areas leave patients less time for healthcare-related activities. We observed less continuing care participation (Table 3) and more interruption of diabetes P4P program participation after enrollment (Table 4) in patients with diabetes residing in urbanization level 1 areas. A previous study by Lin et al (2011)

examining preventive care utilization in Taiwan found that patients with diabetes in the more urbanized northern area had a lower rate of regular use of preventive services than patients with diabetes in the southern area (36.6% vs 29.5%),<sup>39</sup> which is consistent with our finding.

A patient's health status also influences his or her continuing care. A study in Spain (2013) showed that patients with better health status (both self-rated and based on the declared number of health conditions) were better able to maintain a continuing relationship with their physicians.<sup>37</sup> In the present study, we found that patients with diabetes who had poorer health status, indicated by a greater severity of diabetes complications (DCSI  $\geq 3$ ) and the presence of catastrophic illness and injury, were more likely to have interrupted participation in the diabetes P4P program after enrollment (Table 4).

With respect to physician service volume, Katz et al (2003) showed a correlation between greater patient satisfaction with a surgical procedure and a higher number of such procedures performed at the hospital or by the surgeon.<sup>40</sup> We found in our study that the higher the physician service volume, the higher the likelihood of continuing care participation (at least 1 diabetes-related physician visit every 3 months) in patients with diabetes (Table 3). Yet, for patients with diabetes enrolled in the diabetes P4P program, the higher the physician service volume, the higher the likelihood of interrupted program participation (Table 4). We infer that there is a group of patients who preferentially seek care from high-volume physicians, but have no intention of maintaining a long-term relationship with them—this idea may form the basis for further research. This present study further analyzed the characteristics of the group of P4P patients who did not continue care from the main physicians with high service volume. With respect to personal characteristics, higher proportions of enrollees who did not have continuing care (80.44%), were male (48.57%), were aged under 35 years (54.03%), were in low-income households (53.11%), or resided in urbanization level 1 areas (50.77%) had an interruption of program participation. Among the health status characteristics, a CCI  $\geq 10$  (50.62%), a DCSI  $\geq 3$  (53.48%), and the presence of catastrophic illness or injury (52.32%) corresponded to higher rates of interruption from the main physicians with high service volume. Interruption from the P4P program also occurred at higher rates in enrollees whose main healthcare organization was a regional hospital (47.24%), a public hospital (49.60%), or who had a change of physician (80.49%).

The effect of hospital ownership type on diabetes care is related to the fact that public hospitals in Taiwan are over-

seen by health authorities and are eligible for extra health-care funding for good performance. It is thus in the interest of public hospitals to more actively promote the P4P program. Consistently, patients with diabetes who sought care at public hospitals were more likely to participate in continuing care (Table 3) and less likely to have interrupted participation in the diabetes P4P program after enrollment (Table 4) than their private hospital counterparts.

Our analysis also revealed a correlation between a change of the main physician and interruption of diabetes P4P program participation in patients with diabetes who are enrolled in such a program. A stable, long-term relationship between a patient and a physician has been found to promote familiarity, trust, and better sharing of information,<sup>41</sup> as well as to decrease information asymmetry and increase goal alignment,<sup>42</sup> and improve treatment compliance. Previous studies have also associated the length of patient-physician relationships with patients' trust in their physicians<sup>43</sup> and with patients' satisfaction with the outcomes of care.<sup>44,45</sup>

### Limitations

This study was a retrospective analysis based on data obtained from the National Health Insurance Database. The use of this secondary database limited the number of variables available for our analysis. The monthly salary, used as a proxy for economic status, does not represent an individual's entire income. Also, the database did not include information on the study participants' health beliefs and health behaviors, limiting further analysis in this study.

## CONCLUSIONS

Our analysis showed that patients with diabetes who were enrolled in Taiwan's diabetes P4P program were more likely to participate in continuing care (at least 1 diabetes-related physician visit every 3 months) than nonenrollees. Factors that affected the participation of patients with diabetes in continuing care included P4P program enrollment status, personal characteristics, health status, characteristics of the main physician, and characteristics of the main healthcare organization.

Of the patients with diabetes who enrolled in the diabetes P4P program, 44.33% had interrupted participation in the program. Male gender, younger age (<35 years), residence in areas of highest urbanization, greater severity of diabetes complications, presence of catastrophic illness or injury, older age ( $\geq 55$  years) of the main physician, high service volume of the main physician, having a regional or private hospital as the main healthcare organization,

and change of physician were the factors associated with interruption of diabetes P4P program participation in enrolled patients with diabetes. Doctors 55 years or older and those with a higher service volume must be more active in cultivating satisfactory and lasting patient–doctor relationships. For patients who are male, aged under 35 years, live in highly urbanized areas (ie, cities), have changed doctors, exhibit serious diabetes complications, or have suffered from catastrophic illnesses, doctors and case managers should strive to decrease patients' withdrawal from diabetes P4P programs, enabling patients to continue their treatment in the programs, thereby reducing the occurrence of complications.

In the future, researchers can adopt questionnaires to investigate the lifestyles and health behaviors of patients who withdraw from diabetes P4P programs and examine the major reasons for their program withdrawal. Thus, case managers and doctors can identify problems and seek solutions for such withdrawal.

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