

BMJ Open Patient and provider factors associated with enrolment in the pre-end-stage renal disease pay-for-performance programme in Taiwan: a cross-sectional study

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ABSTRACT

Objective The incidence and prevalence of end-stage renal disease (ESRD) in Taiwan have been ranked the highest worldwide. Therefore, the National Health Insurance Administration has implemented the pre-ESRD pay-for-performance (P4P) programme since November 2006, which had significantly reduced the incidence of dialysis and all-cause mortality. This study aimed to identify the factors associated with the enrolment in the pre-ESRD P4P programme.

Design Cross-sectional study.

Setting The National Health Insurance research database 2007–2012 in Taiwan.

Participants Patients with prevalent pre-ESRD aged more than 18 years between January 2007 and December 2012 were enrolled. Patient demographics and hospital characteristics between P4P and non-P4P groups were compared. A logistic regression model was used to analyse the factors associated with P4P enrolment, and a generalised estimating equation was used to verify the results.

Primary outcome measure Enrolment in the pre-ESRD P4P programme.

Results In total, 82 991 patients were enrolled in the programme, with a 45.6% participation rate. Patients who were males (adjusted OR (AOR)=0.89, 95% CI=0.86 to 0.91) and employed (AOR=0.95, 95% CI=0.92 to 0.97) had a significantly lower probability to be enrolled in the programme. Older patients (66–75 years old, AOR=1.23, 95% CI=1.14 to 1.33) and those with higher Charlson Comorbidities Index (CCI 5+, AOR=4.01, 95% CI=3.55 to 4.53) tended to be enrolled in the programme, while those in the 76+ years age group were not (AOR=1.03, 95% CI=0.95 to 1.13). Hospitals located in the central (AOR=1.48, 95% CI=1.05 to 2.08) and Kao-Ping regions (AOR=1.62, 95% CI=1.18 to 2.22) also tended to enrol patients in the pre-ESRD P4P programme. Enrolment rates increased over time.

Conclusion Pre-ESRD patients of the female gender, greater age and more comorbidities were more likely to be enrolled in the pre-ESRD P4P programme. Healthcare providers and health authorities should focus attention on patients who are male, younger and with less

Strengths and limitations of this study

- We used the nationwide health insurance data which is representative for the whole Taiwan population.
- Both detailed patient and provider factors were analysed, and a generalised estimating equation was used to verify the results.
- This was a cross-sectional study, in which it is difficult to investigate causal relationships.
- Laboratory data were not available in the health insurance data set.
- The national health insurance system and the pre-end-stage renal disease pay-for-performance programme are unique in Taiwan, and the results may not apply to other countries in the world.

comorbidities to improve the healthcare quality and equality for all pre-ESRD patients.

INTRODUCTION

Chronic kidney disease (CKD) is a well-known risk factor for cardiovascular disease,¹ which increases morbidities and mortalities and causes large-scale health expenditure worldwide. The global prevalence of CKD was estimated to be ranging from 11% to 13%, and the prevalence of CKD stages 3–5 was 10.6%.² Taiwan has the highest prevalence of end-stage renal disease (ESRD) in the world,³ and the costs of dialysis constitute 8% of the total medical expenditure.⁴ In many countries, including the UK, the USA, Australia, Canada and Japan, a pay-for-performance (P4P) programme has been introduced for the care of the CKD or dialysis population.^{5–9}

The pre-ESRD P4P programme in Taiwan had significantly reduced the incidence of dialysis and all-cause mortality. The time to dialysis treatment is significantly longer in patients enrolled in the P4P programme,

compared with those who didn't receive healthcare from the P4P programme.⁴ In addition, even when kidney function deteriorated and the patient required long-term dialysis, the 4-year total healthcare expenditures of patients enrolled in the P4P programme continued to show a 68% reduction compared with those without healthcare from the P4P programme. The mortality within 3 years of dialysis of the patients with P4P programme care was also significantly lower than those without P4P programme care.¹⁰

Although pre-ESRD P4P programme could significantly improve the outcome in patients with CKD, it was estimated that the participation rate in the P4P programme is less than 50%.⁶ The participation rate in pre-ESRD programme before dialysis has increased year by year, from 25.1% in 2010 to 36.7% in 2014.¹¹ Many patients with advanced stages of CKD may not receive sufficient healthcare,¹² which could lead to poor disease prognosis, life quality and additional health expenditure. The relationship between covariates and enrolment in the pre-ESRD P4P programme is unclear. Therefore, this study aimed to investigate factors associated with patient enrolment in the pre-ESRD P4P programme in Taiwan.

MATERIAL AND METHODS

Details of the P4P programme

The Taiwan National Health Insurance Administration initiated the pre-ESRD P4P programme in November 2006. This is a patient care and education programme with health management of high-risk groups to improve healthcare and delay the onset of ESRD and dialysis.¹³ The patient inclusion criteria were as follows: patients with CKD stages 3b, 4 and 5 who had estimated glomerular filtration rates (eGFRs) of 30–44.9, 15–29.9 and <15 mL/min/1.73 m², respectively; and patients with proteinuria, defined as daily urine protein >1000 mg or urine protein/creatinine ratio >1000 mg/g. Multidisciplinary medical teams, including nephrologists, health education nurses and nutritionists, provided comprehensive medical assessment, laboratory examination and patient education every 3 months. Patients enrolled in the pre-ESRD P4P programme were cared for according to applicable clinical guidelines at different stages of CKD.

Physicians reported the eGFR and urine albumin/creatinine ratio (or urine protein/creatinine ratio) for every patient enrolled in the P4P programme every 6 months. In addition, physicians also evaluated each enrolled patient annually, including management plans, medication, education programme and laboratory data. Cases were to be closed when renal function deteriorated and the patient received dialysis treatment, renal transplantation or hospice care, was transferred to other hospitals or died.

The health institute and multidisciplinary medical teams gained financial incentives if they achieved specific healthcare quality indicators.¹⁴ The incentives amount to US\$40, and the incentives for follow-up every 3 months

equaled US\$20. Doctors are given incentives of US\$50 for cases for whom the decline of eGFR is less than 6 mL/min/1.73 m²/year among diabetic patients in CKD stages 3b and 4 or less than 4 mL/min/1.73 m²/year among non-diabetic patients in CKD stages 3b and 4. Doctors are given incentives of US\$100 for cases for whom the decline of eGFR is less than 6 mL/min/1.73 m²/year among diabetic patients in CKD stage 5 or less than 4 mL/min/1.73 m²/year among non-diabetic patients in CKD stage 5. Doctors are paid incentives of US\$35 if a patient in ESRD prepares their fistula or catheter well before dialysis. If patients receive a living kidney transplant from a relative, the reward for doctors is US\$167.

Data source

We used the National Health Insurance research database 2007–2012 in Taiwan, which includes inpatient and outpatient medical care information. The National Health Insurance covered nearly 99% of the Taiwanese population. Disease diagnosis, treatment procedure, drugs and health expenditure were all included in the data set.¹⁵ The data used in the study were de-identified before analysis took place.

Study population

From 01 January 2007 to 31 December 2012, patients with diagnosis codes of chronic renal failure (International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 585.xx or 581.9x) at least two times within 1 year were identified.¹⁶ The diagnosis codes of chronic renal failure (ICD-9-CM codes 585.xx or 581.9x) were coded by a nephrologist on a creatinine or proteinuria measurement. Then, those who were younger than 18 years, who had any dialysis records and who did not possess registries for beneficiaries were excluded. The final analytical sample comprised of 182 087 participants.

Outcome variable

Those with procedure code of medical care in pre-ESRD P4P programme (P3402C, P3403C and P3404C) were recognised as enrolled in the pre-ESRD P4P programme.¹³

Confounding variables

Potential confounders included sex, age (≤45, 46–55, 56–65, 66–75 and ≥76 years), socioeconomic status (dependents and employed), residential urbanity (urban and rural), Charlson Comorbidity Index (CCI), index year, accreditation level (medical centre, regional hospital, district hospital and clinic), total pre-ESRD case volume (<1300, 1300–3000 and >3000), total P4P case volume (<700, 700–1500 and >1500), P4P pre-ESRD case volume (<33%, 33%–67% and >67%) and the hospitals' geographic locations (Taipei, northern, central, southern, Kao-Ping and eastern branches). Those people without income were defined as dependent. To investigate the role of urbanisation, all 365 townships of Taiwan were stratified into two levels, urban and rural.¹⁷ The level of medical institutions in Taiwan is divided into medical centres, regional hospitals, district hospitals and clinics

according to the guidelines of the Ministry of Health and Welfare.

Comorbidities were identified from the National Health Insurance records with the definition of two or more ambulatory care claims or one inpatient claim. The following comorbidities were identified: diabetes mellitus (ICD-9-CM: 250), hypertension (ICD-9-CM: 401–405), myocardial infarction (ICD-9-CM: 410), congestive heart failure (ICD-9-CM: 428), stroke (ICD-9-CM: 433, 434 and 436), gout (ICD-9-CM: 274) and peripheral vascular disease (ICD-9-CM: 250.7, 443.00, 443.81, 443.9, 444.2 and 785.4).¹⁸

Statistical analyses

Baseline characteristics of the participants in the P4P and non-P4P groups were compared by two-sample t-test or χ^2 test in continuous and categorical variables. Logistic regression models were employed with the generalised estimating equation (GEE) methods to investigate the factors associated with enrolment in the pre-ESRD P4P programme.¹⁹ A univariable analysis was performed initially to investigate factors associated with enrolment of pre-ESRD programme. Then, a multivariable analysis adjusted by patient demographics, comorbidities and healthcare institution characteristics was conducted. We performed two multivariable models, the first of which analysed each comorbidity and the second analysed the CCI. ORs were estimated from the GEE logistic regression model. We conducted all analyses using SAS statistical software package (V.9.3).

Patient and public involvement

Patients or the public were not involved in this study. They will be informed of the study results through publications.

RESULTS

Table 1 presents the baseline demographics of the study population. In total, 182 087 patients with CKD were identified between 01 January 2007 and 31 December 2012. Among them, the mean (SD) age is 67.16 (14.51) years, and 107 638 (59.11%) were males. There were 82 991 (45.58%) and 99 096 (54.42%) in the pre-ESRD P4P and non-P4P groups, respectively. Patients who were females, of greater age, socioeconomically dependent, from rural residential areas and with comorbidities had higher participation rates. The total participation rate increased year by year. Regarding hospital characteristics, clinics, high case volumes and hospitals located in the central branch had higher participation rates.

Table 2 presents the result of the GEE logistic regression model. Model 1 is the univariate analysis of factors, namely, female patient (male, OR=0.91, 95% CI=0.88 to 0.94), greater age (76+ years old, OR=1.37, 95% CI=1.24 to 1.51) and socioeconomic dependence (employed, OR=0.88, 95% CI=0.86 to 0.91), and those with diabetes mellitus (OR=1.62, 95% CI=1.55 to 1.70), hypertension

(OR=1.90, 95% CI=1.79 to 2.01), gout (OR=1.24, 95% CI=1.19 to 1.29), peripheral vascular disease (OR=1.28, 95% CI=1.20 to 1.36) or more comorbidities (CCI 5+, OR=5.50, 95% CI=4.62 to 6.54) were more likely to be enrolled in the pre-ESRD P4P programme. In hospital characteristics, no statistically significant result was noted. Models 2 and 3 were the multivariate analyses. The result showed that patients who were females (male, adjusted OR (AOR)=0.89, 95% CI=0.86 to 0.91), of greater age except for 76+ years old (66–75 years old, AOR=1.23, 95% CI=1.14 to 1.33) and socioeconomically dependent (employed, AOR=0.95, 95% CI=0.92 to 0.97) with higher comorbidities (CCI 5+, AOR=4.01, 95% CI=3.55 to 4.53) were more likely to be enrolled in the programme. Patients who were older than 76 years did not have significantly increased odds of being enrolled in the P4P programme (AOR=1.03, 95% CI=0.95 to 1.13). Hospitals located in the central (AOR=1.48, 95% CI=1.05 to 2.08) and Kao-Ping regions (AOR=1.62, 95% CI=1.18 to 2.22) also tended to enrol patients in the pre-ESRD P4P programme.

DISCUSSION

Our study demonstrated that patients with greater age except for 76+ years old, of the female gender, socioeconomic dependence and with diabetes, hypertension, gouty arthritis and peripheral vascular disease were more likely to be included in the pre-ESRD P4P programme. Hospitals located in the central and Kao-Ping regions also tended to enrol patients in the pre-ESRD P4P programme.

It was reported that diabetic patients with greater age and more comorbidities tended to be excluded from diabetes mellitus P4P programmes in Taiwan.²⁰ Another study also indicated that patients with greater diabetes complication severity index and CCI tended to be excluded from the diabetes mellitus P4P programme.²¹ In addition, patients of the male gender, younger than 35 years, living in urban areas, with greater diabetes complication severity index and commodity were more likely to interrupt the diabetes mellitus P4P programme.²² According to the design of diabetes mellitus P4P programme, physicians reported better haemoglobin A1c (HbA1c) and low-density lipoprotein (LDL) levels among participants and wound up reaping the reward for higher performance even if the care quality of all of their diabetic patients was not improved. Physicians may tend to choose healthier patients to join the diabetes mellitus P4P programme.²³ In contrast, the pre-ESRD P4P programme rewards physicians according to several domains, including patient health status (blood pressure, LDL, triglyceride, HbA1c and haemoglobin levels), patient participation in nutrition and nursing education programmes, and the proportion of well-prepared fistula. Health institutes would not potentially exclude patients of greater age or with more comorbidities to gain higher payments.

Management of the pre-ESRD P4P programme in Taiwan is straightforward. The incentives of new patient

Table 1 Comparison of the baseline demographics of the patients enrolled or not enrolled in the pre-ESRD pay-for-performance (P4P) programme

Factors	Total (n=182087)	Number of P4P (%) (n=82991)	Number of non-P4P (%) (n=99096)	Participation rate (%) (45.58%)	P value
Patient demographics					
Sex					
Female	74 449 (40.89%)	35 094 (42.29%)	39 355 (39.71%)	47.14%	<0.001
Male	107 638 (59.11%)	47 897 (57.71%)	59 741 (60.29%)	44.50%	
Age in years, mean (SD)	67.16 (14.51)	67.62 (13.36)	66.77 (15.40)		<0.001
Age, years					
≤45	14 541 (7.99%)	5 113 (6.16%)	9 428 (9.51%)	35.16%	
46–55	21 122 (11.60%)	9 250 (11.15%)	11 872 (11.98%)	43.79%	
56–65	36 128 (19.84%)	17 250 (20.79%)	18 878 (19.05%)	47.75%	
66–75	47 610 (26.15%)	23 506 (28.32%)	24 104 (24.32%)	49.37%	
76+	62 686 (34.43%)	27 872 (33.58%)	34 814 (35.13%)	44.46%	
Socioeconomic status					
Dependents	61 635 (33.85%)	29 351 (35.37%)	32 284 (32.58%)	47.62%	<0.001
Employed	120 452 (66.15%)	53 640 (64.63%)	66 812 (67.42%)	44.53%	
Residential urbanity					
Rural	51 305 (28.18%)	23 839 (28.72%)	27 466 (27.72%)	46.47%	<0.001
Urban	130 782 (71.82%)	59 152 (71.28%)	71 630 (72.28%)	45.23%	
Comorbidities					
Diabetes mellitus	78 453 (43.09%)	41 741 (50.30%)	36 712 (37.05%)	53.21%	<0.001
Hypertension	130 163 (71.48%)	65 801 (79.29%)	64 362 (64.95%)	50.55%	<0.001
Myocardial infarction	1334 (1.08%)	1065 (1.28%)	1152 (1.16%)	79.84%	0.02
Congestive heart failure	18 487 (10.15%)	8878 (10.70%)	9609 (9.70%)	48.02%	<0.001
Stroke	15 397 (8.46%)	7 323 (8.82%)	8 074 (8.15%)	47.56%	<0.001
Gout	35 607 (19.55%)	17 809 (21.46%)	17 798 (17.96%)	50.02%	<0.001
Peripheral vascular disease	7 199 (3.95%)	3 835 (4.62%)	3 364 (3.39%)	53.27%	<0.001
Charlson Comorbidity Index (mean, SD)	3.10 (2.20)	4.02 (2.11)	3.24 (2.31)		<0.001
Charlson Comorbidity Index					
0	14 832 (8.15%)	2 339 (2.82%)	12 493 (12.61%)	15.77%	<0.001
1–2	45 456 (24.96%)	17 722 (21.35%)	27 734 (27.99%)	38.99%	
3–4	65 070 (35.74%)	31 870 (38.40%)	33 200 (33.50%)	48.98%	
5+	56 729 (31.15%)	31 060 (37.43%)	25 669 (25.90%)	54.75%	

Continued

Table 1 Continued

Factors	Total (n=182087)	Number of P4P (%) (n=82991)	Number of non-P4P (%) (n=99096)	Participation rate (%) (45.58%)	P value
Index year					<0.001
2007	27 790 (15.26%)	8947 (10.78%)	18 843 (19.01%)	32.20%	
2008	23 665 (13.00%)	11 619 (14.00%)	12 046 (12.16%)	49.10%	
2009	26 713 (14.67%)	14 640 (17.64%)	12 073 (12.18%)	54.80%	
2010	26 705 (14.67%)	14 089 (16.98%)	12 616 (12.73%)	52.76%	
2011	32 257 (17.72%)	16 462 (19.84%)	15 795 (15.94%)	51.03%	
2012	44 957 (24.69%)	17 234 (20.77%)	27 723 (27.98%)	38.33%	
Hospital characteristic					
Accreditation level					<0.001
Clinic	6159 (3.38%)	3004 (3.62%)	3155 (3.18%)	48.77%	
Medical centre	68 716 (37.74%)	30 753 (37.06%)	37 963 (38.31%)	44.75%	
Regional hospital	85 307 (46.85%)	40 086 (48.30%)	45 221 (45.63%)	46.99%	
District hospital	21 905 (12.03%)	9148 (11.02%)	12 757 (12.87%)	41.76%	
P4P case volume					<0.001
Low (<700)	65 932 (36.21%)	27 131 (32.69%)	38 801 (39.15%)	41.15%	
Medium (700–1500)	56 472 (31.01%)	24 599 (29.64%)	31 873 (32.16%)	43.56%	
High (1500+)	59 683 (32.78%)	31 261 (37.67%)	28 422 (28.68%)	52.38%	
Pre-ESRD case volume					<0.001
Low (<1300)	62 047 (34.08%)	28 519 (34.36%)	33 528 (33.83%)	45.96%	
Medium (1300–3000)	56 907 (31.25%)	26 612 (32.07%)	30 295 (30.57%)	46.76%	
High (3000+)	63 133 (34.67%)	27 860 (33.57%)	35 273 (35.59%)	44.13%	
Hospital's geographic location					<0.001
Eastern branch	5195 (2.85%)	2217 (2.67%)	2978 (3.01%)	42.68%	
Taipei branch	55 376 (30.41%)	24 862 (29.96%)	30 514 (30.79%)	44.90%	
Northern branch	22 271 (12.23%)	6980 (8.41%)	15 291 (15.43%)	31.34%	
Central branch	35 319 (19.40%)	18 039 (21.74%)	17 280 (17.44%)	51.07%	
Southern branch	30 711 (16.87%)	13 366 (16.11%)	17 345 (17.50%)	43.52%	
Kao-Ping branch	33 215 (18.24%)	17 527 (21.12%)	15 688 (15.83%)	52.77%	

ESRD, end-stage renal disease.

Table 2 Factors associated with enrolment in the pre-ESRD pay-for-performance programme by generalised estimating equation logistic regression model

Factors	Model 1		Model 2		Model 3	
	OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Patient demographics						
Sex						
Female	Ref		Ref		Ref	
Male	0.91	0.88 to 0.94	0.89	0.86 to 0.91	0.89	0.86 to 0.91
Age, years						
≤45	Ref		Ref		Ref	
46–55	1.38	1.30 to 1.46	1.17	1.12 to 1.23	1.18	1.13 to 1.24
56–65	1.57	1.47 to 1.69	1.22	1.15 to 1.30	1.25	1.17 to 1.33
66–75	1.66	1.52 to 1.80	1.23	1.15 to 1.32	1.23	1.14 to 1.33
76+	1.37	1.24 to 1.51	1.08	1.00 to 1.17	1.03	0.95 to 1.13
Socioeconomic status						
Dependents	Ref		Ref		Ref	
Employed	0.88	0.86 to 0.91	0.95	0.92 to 0.98	0.95	0.92 to 0.97
Residential urbanity						
Rural	Ref		Ref		Ref	
Urban	1.01	0.98 to 1.04	0.99	0.93 to 1.05	1	0.94 to 1.06
Comorbidities						
Diabetes mellitus	1.62	1.55 to 1.70	1.48	1.43 to 1.54		
Hypertension	1.9	1.79 to 2.01	1.6	1.54 to 1.66		
Myocardial infarction	1.06	0.96 to 1.16	0.9	0.83 to 0.98		
Congestive heart failure	1.08	1.02 to 1.15	0.97	0.93 to 1.01		
Stroke	1.06	1.01 to 1.11	0.95	0.91 to 0.99		
Gout	1.24	1.19 to 1.29	1.21	1.17 to 1.26		
Peripheral vascular disease	1.28	1.20 to 1.36	1.07	1.01 to 1.13		
Charlson Comorbidity Index						
0	Ref				Ref	
1–2	3.07	2.71 to 3.48			2.38	2.19 to 2.59
3–4	4.49	3.85 to 5.23			3.32	3.00 to 3.68
5+	5.5	4.62 to 6.54			4.01	3.55 to 4.53
Index year						
2007	Ref		Ref		Ref	
2008	1.89	1.51 to 2.37	2.36	1.85 to 3.01	2.37	1.86 to 3.02
2009	2.33	1.84 to 2.97	3.29	2.52 to 4.29	3.28	2.52 to 4.27
2010	2.18	1.70 to 2.80	3.09	2.33 to 4.09	3.09	2.33 to 4.09
2011	2.05	1.60 to 2.62	2.7	2.05 to 3.54	2.74	2.09 to 3.59
2012	1.23	0.96 to 1.57	1.6	1.23 to 2.10	1.64	1.26 to 2.15
Hospital characteristic						
Accreditation level						
Clinic	Ref		Ref		Ref	
Medical centre	0.95	0.69 to 1.31	0.86	0.38 to 1.94	0.81	0.35 to 1.83
Regional hospital	0.9	0.66 to 1.22	0.9	0.43 to 1.91	0.84	0.40 to 1.78
District hospital	0.75	0.54 to 1.03	0.74	0.35 to 1.58	0.7	0.32 to 1.49
Pre-ESRD case volume						

Continued

Table 2 Continued

Factors	Model 1		Model 2		Model 3	
	OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Low (<1300)	Ref		Ref		Ref	
Medium (1300–3000)	1.13	0.88 to 1.45	0.92	0.67 to 1.27	0.92	0.67 to 1.26
High (3000+)	1.06	0.77 to 1.47	0.92	0.56 to 1.50	0.9	0.55 to 1.46
Hospital's geographic location						
Eastern branch	Ref		Ref		Ref	
Taipei branch	1	0.69 to 1.45	1.14	0.82 to 1.60	1.19	0.84 to 1.68
Northern branch	1.28	0.96 to 1.69	0.63	0.29 to 1.34	0.64	0.30 to 1.38
Central branch	0.96	0.66 to 1.40	1.45	1.03 to 2.03	1.48	1.05 to 2.08
Southern branch	1.13	0.82 to 1.54	1.07	0.73 to 1.57	1.1	0.75 to 1.62
Kao-Ping branch	0.71	0.46 to 1.11	1.58	1.16 to 2.15	1.62	1.18 to 2.22

Model 1 is the univariate analysis.

Model 2 is the multivariate analysis with patient and hospital characteristics, and specific diseases adjusted.

Model 3 is the multivariate analysis with patient and hospital characteristics, and Charlson Comorbidity Index adjusted.

ESRD, end-stage renal disease; Ref, reference.

enrolment are US\$40, and the incentives for follow-up every 3 months are US\$20. The total incentives for each patient are US\$100 per year for the hospital. The performance was measured by the decline of eGFR, remission of proteinuria, fistula preparation and renal transplantation. There were no penalties for poor performance or the effect on outcome in the pre-ESRD P4P programme. Doctors would not be more likely to enrol healthier patients to gain more incentives. This could be the reason that patients with greater age, of the female gender, socioeconomic dependence and more comorbidities were more likely to be included in the pre-ESRD P4P programme.

Many countries have different health insurance systems and various disease management programmes. Previous studies have demonstrated that patients under health-care from the P4P programme will receive guideline-recommended tests and examinations.²⁴ A meta-analysis by Mendelson *et al* analysed 69 studies and reported that P4P programme may be related to improving the care process in an outpatient setting, but a positive association with improved health outcomes was not demonstrated.²⁵ The Taiwan National Health Insurance Administration, Ministry of Health and Welfare had implemented the early CKD P4P programme, which enrolled patients with CKD stages 1–3a; and the pre-ESRD P4P programme, which enrolled patients with CKD stages 3b–5. In recent years, many domestic research papers on CKD and pre-ESRD P4P programme have shown that patients under P4P care programme can delay the progression of CKD to the ESRD,²⁶ reduce CKD mortality and hospitalisation rate,²⁷ and slow renal function deterioration rate.²⁸ Patients also have better medical care and quality of life and reduced medical expenses.^{29 30} The CKD and pre-ESRD P4P programmes were confirmed as successful programmes. Another study confirmed that patients with

advanced stages of CKD had higher rates of established arteriovenous access before entering haemodialysis if they were under integrated P4P care programme,³¹ thus avoiding hospitalisation during dialysis, which can reduce hospitalisation costs and overall medical expenses.³¹ The patient who implemented the fistula before dialysis had a significantly lower length of hospital stay and hospitalisation costs, compared with those with no well-prepared fistula.³² It was also reported that early CKD patients had lower annual eGFR deterioration rate if they were under the care of a nephrologist.³³

This study had several strengths. We used the nationwide health insurance data which is representative for the whole Taiwan population. Both patient and provider factors were analysed, and a GEE was used to verify the results. Detailed patients and hospital characteristics were compared and analysed.

This study also had some limitations that should be mentioned. This was a cross-sectional study, in which it is difficult to investigate causal relationships. There were some uncontrolled variables. Laboratory data were not available in the health insurance data set. Patient characteristics, including education level, marriage, income, smoking and drinking habits, and medical adherence, were not included in the analysis. Physician characteristics, such as age, sex, education levels, specialisation, annual salary and the volume of serviced patients, were not available. The reward and total payment gained by health institutes and physicians from the P4P programme were not analysed. The national health insurance system and the pre-ESRD P4P programme are unique in Taiwan, and the results may not apply to other countries in the world.

CKD is a complex and multicause disease. A new concept for an integrated care plan for patients with CKD is necessary. The result of the current study indicated that those who were male, younger, socioeconomically

independent and had less comorbidities were overlooked by the pre-ESRD P4P programme. The National Health Insurance system of Taiwan covers nearly 99% of the Taiwanese population and also supports the unique pre-ESRD P4P reimbursement system. This may be the reason that those who were greater age, with socioeconomic dependence and more comorbidities were tended to receive P4P enrolment.

CONCLUSIONS

In summary, patients of the female gender, greater age except for 76+ years old, with socioeconomic dependence and more comorbidities were likely to be enrolled in the pre-ESRD P4P programme and received multidisciplinary care. In the future, policymakers must consider approaches for improving the participation rate in the pre-ESRD P4P programme to achieve better healthcare quality and disease outcome.

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