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The association between participation in a pay-for-performance program and macrovascular complications in patients with type 2 diabetes in Taiwan: A nationwide population-based cohort study☆

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ABSTRACT

Objective. Diabetes and diabetes-related complications are major causes of morbidity and mortality worldwide and contribute substantially to health care costs. Proper care can prevent or delay vascular complications in people with type 2 diabetes. We sought to examine whether a diabetes pay-for-performance (P4P) program under Taiwan's National Health Insurance program decreased risk of macrovascular complications in type 2 diabetes patients, and associated risk factors.

Research design and method. We conducted a longitudinal observational case and control cohort study using two nationwide population-based databases in Taiwan, 2007–2012. Type 2 diabetes patients with a primary diabetes diagnosis in year 2007 and 2008 were included. We excluded patients with any diabetes complications within 2 years before the index date. A propensity score matching approach was used to determine comparable P4P and non-P4P groups. We followed each P4P and non-P4P patient until December 31, 2012. Complication incidence rates per 1000 person-years for each complication were calculated.

Results. Overall, our results indicated that P4P patients had lower risk of macrovascular complications than non–P4P patients. Specifically, hazard ratios (95% confidence intervals) were 0.84 (0.80–0.88) for stroke, 0.83 (0.75–0.92) for myocardial infarction, 0.72 (0.60–0.85) for atrial fibrillation, 0.93 (0.87–0.98) for heart failure, 0.61 (0.50–0.73) for gangrene, and 0.83 (0.74–0.93) for ulcer of lower limbs.

Conclusions. Compared with patients not enrolled in the P4P program, P4P patients had lower risk of developing serious vascular complications. Our empirical findings provide evidence for the potential long-term benefit of P4P programs in reducing risks of macrovascular complications.

Introduction

Diabetes and diabetes-related complications are a major cause of morbidity and mortality worldwide and contribute substantially to health care costs (Deshpande et al., 2008). In a 2014 report from the International Diabetes Federation, it was estimated that more than 387 million people worldwide have diabetes and by 2035 this will rise to 592 million; 4.9 million deaths and at least USD 612 billion in health expenditure resulted from diabetes in 2014 (IDF, 2014). Type 2 diabetes accounts for 90% to 95% of all diagnosed diabetes. Diabetes is a strong independent predictor of cardiovascular diseases (CVD), stroke, and peripheral vascular diseases (PVD) (Deshpande et al., 2008; Fowler, 2008). To date, there are no known ways to prevent type 1 diabetes, while existing studies have shown that adequate and tight control of blood sugar levels, blood pressure, and blood lipid levels through intensive management of risk factors, organization of care, or health promotion can prevent or delay vascular complications in people with type 2

☆ We assure that each author meets authorship requirements. We declare that none of the authors has a conflict of interest with regard to this manuscript.

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diabetes (Fowler, 2008; Gregg et al., 2014; Kent et al., 2013; Nickerson and Dutta, 2012; O'Keefe et al., 2011; Turnbull et al., 2009).

Pay for performance (P4P) has been embraced by many developed nations as a strategy to improve health care delivery and quality for patients with diabetes. For example, the United Kingdom's quality and outcome framework and Australia's P4P programs pay extra bonuses to reward improvement in providing good quality of care for diabetes patients (Campbell et al., 2009; Greene, 2013). Although numerous studies have examined the impact of P4P programs on quality of care for type 2 diabetes, much less is known about the effect on preventing diabetes-related vascular complications (Alshamsan et al., 2010; Campbell et al., 2009; Diabetes Prevention Program Outcomes Study Research et al., 2013; Doran and Kontopantelis, 2013; Glickman et al., 2007; Knight et al., 2005; Pimouguet et al., 2011; Rosenthal et al., 2005; Ryan and Doran, 2012). Two studies examined the associations between intensive care and vascular complications; results were mixed and inconclusive. In one study, Duckworth et al. (2009) conducted a randomized controlled trial (Veterans Affairs Diabetes Trial) in 2000 and enrolled 1791 men and women with uncontrolled type 2 diabetes to examine the effect of intensive glucose control on a composite cardiovascular event (e.g., myocardial infarction, stroke, congestive heart failure, amputation for ischemic gangrene) during 5 years of follow-up. Their results suggested that intensive glucose control in type 2 diabetes patients had no significant effect on the rates of major cardiovascular events (Duckworth et al., 2009). In the other study, Chen et al. (2011) examined the association between a CVD P4P program and coronary events among CVD patients in Hawaii using administrative claims data from 1999 to 2006. They found that patients who received the CVD P4P care were less likely to experience coronary events (Chen et al., 2011). Nevertheless, few studies have examined the effect on vascular complications of an incentive scheme in a diabetes P4P program with comprehensive diabetes care.

We sought to examine whether a diabetes P4P program under the national health insurance (NHI) program in Taiwan affected the risks of macrovascular complications (e.g., CVD, stroke, and PVD) in type 2 diabetes patients, and the associated risk factors. Ideally, effectiveness of an incentivized quality improvement program should be tested with randomized trials. However, given that vascular disease events are rare and long-term follow-up for observing the events is costly, and considering ethical issues, a randomized trial is not feasible for large-scale policy interventions. Therefore, we used a population-based cohort study design in evaluating the effect of the diabetes P4P program in enrolled P4P patients compared with a control group of patients not participating in the P4P program. Specifically, we used data from two nationwide population-based databases in Taiwan from 2007 to 2012 to examine the extent to which the P4P program and other risk factors were associated with the incidence rates of CVD, stroke, and PVD.

Method

Description of P4P program

A diabetes P4P program was implemented by Taiwan's NHI at the end of 2001 in an effort to improve the quality of health care for diabetes patients. The program consists of several important features. First, only physicians who specialized in metabolic disorders or endocrinology or who had attended a training program for diabetes care were eligible to participate in the P4P program (Chen et al., 2012; Cheng et al., 2012; Lee et al., 2010). Second, physicians and their medical care team members at the various hospitals and clinics are expected to work as coordinated physician-led multi-disciplinary teams adhering to the diabetes clinical guidelines established for the care of diabetes patients enrolled in the P4P program (Chen et al., 2013). Third, in addition to the regular and usual care, P4P patients received extra comprehensive provision of care, including medical history assessment, physical examination, laboratory evaluation, management plan evaluation, and diabetes self-management health education (Chen et al., 2012; Cheng et al., 2012; Hsieh et al., 2015; Lee et al., 2010). Forth, the timing of incentive payment is both prospectively and retrospectively depend on the incentive target. Specifically, for improving process outcomes, the participating P4P physicians received an extra TWD 450 (USD 15) in addition to regular physician fees, TWD 1845 (USD 60) per initial enrollment visit, TWD 875 (USD 30) per follow-up visit, and TWD 2245 (USD 75) per annual evaluation visit prospectively. Furthermore, extra financial incentives were paid retrospectively for improvements in patients' intermediate outcome (e.g., an increase in the percentage of patients with controlled HbA1c). A composite score for each participating physician is calculated based on two negative outcomes (i.e., percentage of HbA1c > 9.5% and percentage of LDL > 130 mg/dl) and one positive outcome indicator (percentage of HbA1c < 7%). Physicians receive quality rewards of TWD 1000 (USD 30) per each enrollee that completes the annual follow-up if his or her performance ranked within the top 25% of the composite scores found for all participating physicians (Chen et al., 2012; Cheng et al., 2012; Hsieh et al., 2015; Lee et al., 2010). P4P programs provided a good opportunity to understand quality of care for patients with diabetes in the real world.

Study design and data source

We conducted a longitudinal observational case and control cohort study using two nationwide population-based databases in Taiwan from 2007 to 2012. One database was the nationwide diabetes P4P database, from which we could precisely identify whether patients were enrolled in the P4P program. The other was the NHI administrative claims database, from which we could obtain information on patient comorbid conditions and health provider characteristics. The unit of analysis was at the patient level. This study was approved by the Institutional Review Board at Kaohsiung Medical University Hospital in Taiwan.

Study population

Using nationwide NHI claims data, we included diabetes patients with primary diabetes diagnosed (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] codes 250.xx or A-code 181) in at least two outpatient visits or at least one inpatient hospitalization in each year, 2007 and 2008. Using the P4P database, we identified newly enrolled P4P patients for the P4P cohorts during the patient identification period and defined the index date as the date of first enrollment. We then identified non-P4P diabetes patients for the comparison groups who were not found to be enrolled in the P4P program during the above-stated time period. Given that non-P4P patients lacked specific enrollment index dates, we randomly assigned index dates based on the dynamic frequency distribution of time exposure to the P4P intervention from the P4P group (Harvey et al., 2012). We excluded patients who had type 1 diabetes (ICD-9-CM codes 250.x1 or 250.x3) because they made up less than 1% of total newly enrolled diabetes patients, patients who were aged younger than 18 years on the index date, and patients with specific exclusions (i.e., sex variable missing or data were erroneous; complete administrative claim records were not found). Appendix Fig. 1.A provides more information about study inclusion and exclusion criteria.

As the same patient may have multiple outpatient visits to different health care providers, we applied the plurality provider algorithm for assigning a non-P4P patient to the most frequently seen physician, defined as one who billed for the greatest number of care visits during the identification period, as what has been done in previous studies (Cheng et al., 2012; Pham et al., 2007). We directly assigned P4P patients to the physician who enrolled them into the P4P program as the most frequently seen physician. In total, there were 11,894 physicians treating 76,901 P4P patients and 826,612 non-P4P patients. About 9.30% of the diabetes populations were newly enrolled in the P4P program.

We further excluded patients with any diabetes complications at the outpatient visits or inpatient hospitalizations using NHI administrative claims within 2 years before the index date. Lists of diabetes-related complications were based on the diabetes complication severity index (DCSI), which uses ICD-9-CM coding adaptations and has been commonly used to identify diabetes severity (Young et al., 2008). The DCSI takes into consideration seven categories of complications (identified by ICD-9-CM codes): cardiovascular complications, nephropathy, retinopathy, PVD, stroke, neuropathy, and metabolic disorders. More details about DCSI complications appear in Appendix Table 1.A. After exclusion of patients with any diabetes complications, a total of 34,710 P4P and 341,312 non-P4P type 2 diabetes patients were included in the final analysis.

Outcomes of interest

The major outcome of interest was incidence of macrovascular complications in P4P and non-P4P patients during the following-up period. Seven