

BMJ Open Assessing the quality of primary healthcare for diabetes in China: multivariate analysis using the China Health and Retirement Longitudinal Study (CHARLS) Database

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ABSTRACT

Objective To assess the quality of primary healthcare (PHC) for patients with diabetes in China from 2011 to 2015.

Setting This study analysed data on 1006, 1472 and 1771 participants with diabetes who were surveyed in 2011, 2013 and 2015, respectively, in the China Health and Retirement Longitudinal Study, a nationally representative survey conducted in 29 provinces of China.

Outcome measures The study measured the proportions of patients with diabetes who received diabetes-related health education, examinations and treatments, as well as the hospital admission rate due to diabetes of these patients. Multilevel logistic regression was used to adjust sociodemographic variables.

Results According to the multivariate analysis, the proportion of patients who received diabetes-related health education decreased significantly (OR=0.74, 95% CI 0.61 to 0.90), and the proportion of those receiving examinations and treatments remained unchanged from 2011 to 2015. Diabetes-related hospitalisation increased from 4.01% in 2011 to 6.08% in 2013 (OR=1.47, 95% CI 0.97 to 2.22), and recurrent hospitalisations increased from 18.87% in 2011 to 28.45% in 2015 (OR=1.78, 95% CI 1.44 to 2.20). The proportions of patients with diabetes-related and recurrent hospitalisations in western China were higher than those in the east (OR=1.80, 95% CI 1.13 to 2.87; OR=1.92, 95% CI 1.50 to 2.45).

Conclusions Nationally, the analysis of patient-reported process and outcome indicators cannot confirm that the quality of PHC has improved in China during 2011–2015. Regional disparities in primary diabetes care require urgent resource allocation to western China. Establishing a national quality registry for PHC, which transparently reports outcomes by region and social-economic position, is essential for countries sharing the challenge of improving both quality and equity of PHC.

INTRODUCTION

Primary healthcare (PHC) refers to essential health services with the goal of improving health for all. Establishing basic clinical care serves as a cornerstone of universal health coverage, and has become a global health

Strengths and limitations of this study

- This study used nationally representative data to analyse the quality of primary healthcare (PHC) and its trends among people with diabetes in China.
- This study comprehensively used process and outcome indicators of PHC service to reflect the quality of PHC service for Chinese residents with diabetes.
- The studied population comprised patients who already knew they had diabetes, while those who had diabetes but were unaware of it were not included.
- Health education as a process indicator for quality of PHC in our study should be interpreted with caution since repeating advice annually may be unnecessary for patients with well-controlled diabetes.
- Hospitalisation among people with diabetes, a commonly used outcome indicator for quality of PHC, can also be influenced by macrolevel factors such as insurance policies and hospital bed supply.

priority since the Alma-Ata declaration of 1978.^{1 2} As an integral part of a country's healthcare system, PHC includes all areas that play a pivotal role in providing prevention, promotion, treatment and rehabilitation at an affordable costs to keep the population healthy.^{3 4} With the global rise of non-communicable chronic diseases, including diabetes, improving PHC has become an urgent and high priority policy agenda item in many countries.^{5 6} Since China is home to one fourth of the world's population with diabetes,⁷ improving quality of PHC, as means of preventing complications associated with disease progression, is of vast importance for individuals as well as on the societal level.^{8 9}

The PHC system in China has a notable history. It was instrumental in reducing the burden of communicable, maternal and neonatal diseases through the 1950s and 1970s.^{10 11} In subsequent decades, with severe

shortages in government funding¹² and weakening support for PHC providers,¹³ the development of China's PHC system has stagnated after market-based reforms in the healthcare sector were implemented.^{14 15} However, the SARS epidemic in 2002–2003 highlighted the weakened state of China's PHC system,¹⁶ and the political will to fundamentally reform the system was generated from this epidemic.¹⁷ After the launch of a new healthcare reform in 2009,¹⁸ the Chinese government increased its subsidies for PHC facilities.¹⁹ To improve access to and affordability of PHC services, the government instituted universal health insurance coverage²⁰ and the basic public health service programme,²¹ which includes health education, screening for diabetes, physical examination and follow-up assessment for patients with diabetes.²² Since, according to a recent systematic review, a regular source of primary care is significantly associated with a reduction of hospital admissions among people with diabetes,²³ government investment in quality of PHC can contribute to decreasing the preventable economic burden associated with the condition.²⁴

Despite the importance of PHC system reform in China, there remains insufficient evidence for the quality of the current system and the effect of those policy changes.²⁵ Considering that PHC doctors in China are unevenly distributed across the country, with rates ranging from 0.52 to 1.13 per 1000 population,²⁵ variation in quality of primary diabetes care is likely. However, few studies have directly investigated the quality of PHC using a national representative sample, and most investigations were regional surveys in individual Chinese cities.^{26 27} This lack of evidence makes it difficult for policy-makers to judge whether past investments have effectively improved the performance of the PHC system and where more resources are needed to mitigate disparity in quality. In this study, through analysing a nationally representative dataset, we aim to assess the quality of PHC in China and to provide suggestions for policy and practice improvements for ensuring efficient delivery of high-quality care nationally.

METHODS

Data sources

We drew data from 1006, 1472 and 1771 participants with diabetes who were surveyed in 2011, 2013 and 2015, respectively, in the China Health and Retirement Longitudinal Study (CHARLS), a survey of a nationally representative sample of individuals in China aged 45 years or older. Through multistage probability sampling, the CHARLS national survey was first conducted in 2011, and it covered 28 provinces, 150 counties/districts, and 450 village/urban communities across the country.²⁸ A detailed description of CHARLS can be found in the article by Zhao *et al.*²⁹ Individuals who participated in the first wave (2011) of the CHARLS survey were followed up every 2 years. Also, additional participants were recruited to the study during the second (2013) and

third (2015) waves of the study using the same sampling methods,^{28 29} in order to enhance the degree to which the sample represented China's adult population. A major element of the survey was devoted to recording the demographic background, health status and healthcare utilisation, and so on, of patients. The data on healthcare utilisation included detailed records of hospital admission during the previous year (via retrospective self-report) and patient information on socioeconomic status and biomarker results. Given its completeness in health-related information and the representativeness of its sample, CHARLS has considerable advantages for studying the quality of PHC in China.

Indicators and variables

The evaluation indicators of PHC quality

We used well-established indicators for evaluating the quality of PHC for diabetes. First is the incidence of hospitalisation among people with diabetes, which is often seen as one of the most important ambulatory care-sensitive conditions.^{30 31} The basic assumption for using this indicator was that improved quality of PHC is associated with lower rates of diabetes-related hospitalisations and recurrent hospitalisations.^{32 33} Therefore, the rates of hospitalisation for patients with diabetes can indicate the outcome of PHC services. Other commonly used indicators are based on guidelines for the prevention and control of diabetes, and include diabetes-related health education and blood glucose monitoring.³⁴ This study involved both kinds of indicators in measuring PHC quality, including diabetes-related health education, examinations, medical treatments and diabetes-related hospitalisation and recurrent hospitalisations. Diabetes-related health education in this study means health advice patients received from doctors. The hospitalisation-related questions included the number of hospitalisations in the past year and the name of the disease for which hospitalisation was needed. Due to changes in the survey's questions, data for diabetes-associated hospitalisation were available only for 2011 and 2013, while data for recurrent hospitalisation were available for 2011 and 2015. All indicators were obtained from the CHARLS dataset, which comprised patients' self-reported responses. The survey measured a series of indicators to ensure that the information is reliable and that consistency is maintained within each participant's answers.²⁹

Independent variables

Independent variables were selected to control for confounding factors that may be related to the utilisation of primary care and hospitalisation services, including age, gender, marital status, comorbidities, highest level of educational qualification obtained, household living expenditure per year, type of insurance, provincial region and residence (rural/urban). Age was classified into the following groups: 45–55, 55–65, 65–75 and above 75 years old. Marital status was categorised as 'with spouse' and 'without a spouse'. Household living expenditure per

year was stratified into five groups. Since CHARLS participants may have other forms of income beside salary, such as pension and financial support from family members, we chose this variable as a proxy for socioeconomic status. The comorbidities index was calculated as the sum of diagnosed medical conditions each patient had besides diabetes.

Data analysis

All analyses were conducted using Stata V.13.1 (Stata Corp. LP). Descriptive statistics on the sample's demographic characteristics, utilisation of primary care and hospitalisations were calculated as average values for each of the different regions. In addition, we used logistic regression analysis with OR to examine the relationship between self-reported use or delivery of medical services and some control covariates, including demographic and sociogeographic variables in the analysis.

Two-level random-intercept model using logistic regression

$$Y = (\tau_0 + \tau_1 \textit{Community} + \tau_2 \textit{Individual}) + (\delta_0 + \delta_1)$$

where Y represents patients with diabetes receiving health education advice from doctors, medical examinations; *individual-level* variables includes age, gender, marital status, comorbidities, the highest level of educational qualification obtained, household living expenditure per year, and type of insurance; *community-level* characteristics includes rural–urban difference and regional location.

Public and patient involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

Sociodemographic characteristics

Table 1 presents the summary measures and frequency distributions of basic characteristics of respondents among CHARLS respondents in 2011, 2013 and 2015. During the three waves of the survey, the proportion of participants diagnosed with diabetes markedly increased. Of the 17 708, 18 604 and 21 091 people who had completed the interview in 2011, 2013 and 2015, respectively, there were 1006 (5.68%), 1472 (7.91%) and 1771 (8.40%) patients diagnosed with diabetes, respectively. Age was categorised into 4 groups: 45–55, 55–65, 65–75 and 75+ years old; the proportions of patients in the group aged 65–75 years old and the group older than 75 years old increased from 2011 to 2015 in accordance with the ageing of the survey's participants. On average, more than 50% of the participants diagnosed with diabetes were women, and this was slightly more than that for those who were men. More than 80% of the patients with diabetes were married. The proportion of patients with diabetes without any other comorbidity has risen from 13.65% to 25.17% from 2011 to 2015 ($\chi^2=56.80$, 95% CI 11.52% to

15.79%, 95% CI 23.12% to 27.23%). More than half of the patients with diabetes lived in urban areas, yet the relative proportion of participants with diagnosed diabetes living in rural areas has gradually increased from 2011 to 2015 ($\chi^2=57.63$, CI 40.49% to 46.66%, 95% CI 45.14% to 49.86%). Furthermore, approximately 5.72%, 3.29%, and 3.02% of participants with diabetes were not covered by medical insurance in 2011, 2013 and 2015, respectively.

PHC quality indicators

Patients with diabetes receiving health education advice from doctors

The proportion of patients with diabetes receiving health education advice from doctors is shown in **table 2**. There were five important lifestyle components, including diet, exercise, weight control, smoking cessation and foot self-care. For the surveys in 2011 and 2015, there were 982 (98.59%) and 1655 (96.22%) patients, respectively, who answered this question. In 2011, the percentages of patients receiving advice for diet, exercise, weight control, smoking cessation and foot self-care were 70.37% (95% CI 67.5% to 72.24%), 46.95% (95% CI 42.54% to 48.74%), 36.46% (95% CI 32.43% to 38.40%), 26.68% (95% CI 23.94% to 29.41%) and 14.36% (95% CI 12.19% to 16.53%), respectively. Compared with 2011, there were more patients in 2015 who were advised to conduct foot self-care (95% CI 16.32% to 19.96%) while changes in the provision of other health advice were not significant.

Patients with diabetes receiving medical examinations

The proportion of patients with diabetes who received medical examination is shown in **table 2**. There were four main tests, including measurement of blood glucose, urine glucose, microalbuminuria and fundus examination. For the surveys in 2011 and 2015, there were 966 (96.99%) and 1623 (94.36%) patients, respectively, who answered this question. In 2011, the percentages of patients who received the aforementioned medical examinations were about 77.43%, 41.20%, 22.36% and 23.81%, respectively. Compared with 2011, there were slight changes in these rates in 2015 in our sample; however, these were not statistically significant. Among the four examinations, most people (more than 77% of the patients) received the blood glucose test, which was higher than the other three tests in both 2011 and 2015.

Of the total respondents, there was an increased trend of the total number of diabetes tests conducted, and regional disparities in testing were significantly narrowed. In 2011, the proportions of patients with diabetes who did not receive any medical testing in the West was 30.31% (95% CI 24.62% to 36.01%), which was significantly higher compared with the East (19.19%, 95% CI 15.05% to 23.32%) and the Middle (16.37%, 95% CI 12.30% to 21.44%) regions. However, by 2015, the proportions of those who did not receive any medical testing in the West reached 20.69% (95% CI 16.68% to 24.7%), marking a reduction in regional disparities in diabetes medical testing when compared with residents of the East (17.47%,

**Table 1** Sociodemographic characteristics

Variables	2011	2013	2015	χ^2	P value
Participants with diabetes	1006	1472	1771		
Prevalence (%)	5.68	7.91	8.40		
Age (years, %)					
45–55	24.20	20.66	23.37	25.84	<0.001
55–65	43.27	41.04	36.16		
65–75	23.29	27.52	29.13		
>75	9.24	10.78	11.34		
Gender (%)					
Female	55.52	56.42	55.81	0.18	0.916
Male	44.48	43.72	44.19		
Marital status (%)					
Married	81.43	81.47	81.69	0.06	0.969
Single	18.57	18.67	18.31		
Education (%)					
Elementary school and below	63.14	60.93	61.88		
Middle school	19.64	21.59	21.33	0.64	1.000
High school	6.75	7.88	7.47		
Vocational school and above	10.47	9.60	9.32		
Comorbidity (%)					
Diabetes only	13.65	21.18	25.17		
1–2 additional diagnoses	47.89	46.54	40.41	56.80	<0.001
3≥additional diagnoses	38.45	32.28	34.42		
Region (%)					
East	38.15	37.06	38.37		
Middle	35.14	35.21	34.13	1.00	0.910
West	26.71	27.87	27.50		
Household living expenditure per year (average)	12 741.4	13 365.0	15 204.4		
Living areas (%)					
Rural	43.57	44.54	47.50	4.87	0.087*
Urban	56.43	55.59	52.50		
Medical Insurance (%)					
Employment sponsored (UEMI)	20.58	21.18	18.60		
Urban residents (URMI)	7.93	8.43	7.85		
Rural cooperative (NCMS)	59.54	62.44	59.94	57.63	<0.001
Other	6.22	4.66	10.58		
No insurance	5.72	3.29	3.02		

Bold typeface indicates $p < 0.05$.

* $p < 0.1$.

NCMS, New Cooperative Medical Scheme; UEMI, Urban Employee Medical Insurance; URMI, Urban Resident Medical Insurance.

95% CI 14.31% to 20.63%) and the Middle (18.09%, 95% CI 14.78% to 21.41%) regions.

Patients with diabetes use of different types of treatment

The bottom part of [table 2](#) presents information on medical treatments taken by patients for their diabetes, including modern pills (referred to in China as ‘western

medicine’), Traditional Chinese Medicine (TCM), insulin injections, or taking none of the above. The percentages in [table 2](#) add up to more than 100% since some respondents received a combination of treatments, such as TCM with insulin and with additional western medication. For the surveys in 2011 and 2015, there were 989 (99.30%)

Table 2 Patients with diabetes receiving health education advice, receiving medical examinations, and using medical treatments by year of survey and geographical area

Variables	Year	%	East	Middle	West
			%	%	%
Health education advice					
Diet	2011	70.37	74.01	66.86	69.77
	2015	64.95	65.26	65.32	64.04
Exercise	2011	46.95	43.50	47.84	50.78
	2015	49.00	49.14	49.04	48.76
Weight control	2011	36.46	35.01	35.45	39.92
	2015	36.37	36.46	35.55	37.30
Smoking cessation	2011	26.68	28.91	26.51	23.64
	2015	28.16	25.51	31.87	27.19
Foot self-care	2011	14.36	14.06	14.41	14.73
	2015	18.85	16.90	19.44	20.90
None	2011	23.83	20.69	27.67	23.26
	2015	29.85	29.21	29.95	30.20
Medical examinations					
Blood glucose	2011	77.43	79.73	81.29	68.90
	2015	78.93	80.45	79.61	75.86
Urine glucose	2011	41.20	36.22	45.61	42.52
	2015	39.62	38.30	41.49	39.08
Fundus examination	2011	23.81	21.89	24.85	25.20
	2015	21.38	21.79	21.28	20.92
Micro-albuminuria	2011	22.36	20.27	24.27	22.83
	2015	20.02	21.15	21.45	16.55
None	2011	21.12	19.19	16.37	30.31
	2015	18.55	17.47	18.09	20.69
Medical treatments					
Western modern medicine	2011	58.14	61.90	56.61	54.75
	2015	58.40	63.85	53.94	56.31
Insulin injections	2011	13.75	11.64	11.78	19.39
	2015	17.17	16.28	15.06	21.17
Chinese traditional medicine	2011	12.44	8.99	15.80	12.93
	2015	11.85	9.70	12.61	13.96
None	2011	28.61	27.78	27.59	31.18
	2015	29.08	25.67	32.92	29.05

and 1654 (96.16%) patients, respectively, who answered this question in the survey. In 2011, the percentages of patients taking western medicine, insulin injections and TCM were 58.14% (95% CI 55.07% to 61.21%), 13.75% (95% CI 11.62% to 15.89%), and 12.44% (95% CI 10.39% to 14.49%), respectively. By 2015, the percentages of patients taking insulin injections increased to 17.17% (95% CI 15.32% to 18.83%) while the proportion of those taking western medicine and TCM remained without significant changes in comparison to 2011.

In-terms of regional differences, treatment of diabetes using TCM was more prevalent in the West (13.96%, 95% CI 10.91% to 17.01%) and the Middle (12.61%, 95% CI

9.94% to 15.27%) regions in comparison to East China (9.70%, 95% CI 7.46% to 11.92%) in 2015. Similarly, a greater proportion of patients with diabetes in East China (63.85%, 95% CI 60.13% to 67.56%) use western medicine when compared with those living in the Middle (53.94%, 95% CI 48.89% to 56.99%) and the West regions (56.31%, 95% CI 51.80% to 60.83%).

Hospitalisation rates among patients with diabetes

Table 3 shows the hospital admission rates for diabetes-associated and recurrent hospitalisations among people with diabetes in China. For the surveys conducted in 2011, 2013 and 2015, there were 995 (98.90%), 1452 (98.64%)

Table 3 Diabetes-associated and recurrent hospitalisations among participants with diabetes in China, 2011–2015

Year (%)			East	Middle	West
index	Year	%	%	%	%
Diabetes-associated hospitalisation					
	2011	4.01	2.72	3.82	5.56
	2013	6.08	5.44	4.31	8.05
Recurrent hospitalisations					
	2011	18.87	13.59	17.94	27.89
	2015	28.45	24.60	27.96	34.72

and 1710 (96.56%) patients, respectively, who answered hospitalisation-related questions.

During 2011–2015, the recurrent hospital admission rate among people with diabetes steeply increased from 18.87% (95% CI 16.41% to 21.32%) to 28.45% (95% CI 26.31% to 30.60%). This is while changes in the admission rate of diabetes-associated hospitalisation were more modest, from 4.01% (95% CI 2.76% to 5.27%) in 2011 to 6.08% (95% CI 4.92% to 7.23%) in 2013. Among the different regions, the proportions of recurrent hospitalisations in the West (34.72%, 95% CI 29.38% to 39.06%) were significantly higher than those in the East (13.59%, 95% CI 10.29% to 16.89%) and the Middle (27.96%, 95% CI 24.33% to 31.63%) areas of China in 2015. Similar regional differences were noted regarding diabetes-associated hospitalisations; however, they were less significant.

Sociodemographic factors predicting change in PHC services delivery and hospitalisation rates

According to the multivariate analysis (table 4), rates for receiving diabetes-related health education decreased significantly (OR=0.74, 95% CI 0.61 to 0.90), and the percentage of patients who received diabetes-related examinations and medical treatments remained largely unchanged from 2011 to 2015. Additionally, the percentage of patient who received diabetes related examinations in the West was lower than that in the East (OR=0.69, 95% CI 0.54 to 0.89). Difference in diabetes-related hospital admission rates were not significantly related to the survey year (OR=1.47, 95% CI 0.97 to 2.22), while recurrent hospital admission rates increased from 18.87% in 2011 to 28.45% in 2015 (OR=1.78, 95% CI 1.44 to 2.20). When comparing regional differences in admission rates, these were higher in the West than in the East for both diabetes-related (OR=1.80, 95% CI 1.13 to 2.87) and recurrent hospital admission rates (OR=1.92, 95% CI 1.50 to 2.45). The regression analyses also indicated that higher living expenditure and residing in urban areas were positively correlated with receiving health education, examinations and treatments.

DISCUSSION

This study used a nationally representative dataset to analyse the quality of PHC services in China for patients

with diabetes. We found that during the time period of 2011–2015 rates of patients with diabetes who received health education declined while the rates of those who received medical examinations and treatments did not increase. Regarding our measured outcomes, we have found that the rate of diabetes-associated hospitalisation remained with no significant difference while the rate of recurrent hospital admission increased.

The results of this study suggest that the quality of PHC in China, as measured using hospitalisation among patients with diabetes, has not improved. However, this conclusion should be cautioned by additional factors that may have influenced hospitalisation rates in the studied population. Since the average age of the cohort has risen during the measured years, the increase in hospitalisation may be partially explained by the effect of age on medical conditions requiring hospitalisation. We have addressed this methodological limitation by using age as an independent variable in the regression analysis. On the national level, additional possible contributors to the increase in hospitalisation include changes in reimbursement policies for inpatient services²⁵ and increases in hospital bed supply.^{35 36} Also, the study's false positive rate may be mildly inflated, since no adjustment for multiplicity has been made.

Diabetes is considered an ambulatory sensitive condition for which risk of hospitalisation can be reduced through timely and effective PHC services.³⁷ The hospitalisation rate for diabetes was employed as an important indicator for evaluating the quality of PHC services in several studies.^{38–40} In addition to PHC services, health insurance policies may also affect hospitalisation rates among patients with diabetes in China. To assess this effect, we have included the type of insurance plan in our regression analysis and found that there was no significant differences in hospitalisation rates between non-insured and those insured by different insurance plans. However, other insurance characteristics, such as low reimbursement caps for PHC, may favour the use of inpatient services. According to a recent study conducted in 67 rural sites in China in 2016,²⁵ reimbursement caps were set to US\$39 in PHC institutions, which allows insurers to cover only 3–5 average outpatient visits per patient annually. After these caps were reached, patients would go to tertiary hospitals, where the average cap was set to US\$58 for outpatient care and US\$21 777 for inpatient care. In such cases, patients were incentivised to use inpatient rather than outpatient services, and tertiary rather than primary care.^{41 42} Therefore, insurance policies may be another factor contributing to the high rate of hospitalisations for diabetes.

Since 2011, besides pursuing investment in improving the facilities of PHC institutions, the Chinese government has further increased its subsidies to services in all provinces,⁴³ including for the management of diabetes. This study found that the rates of patients with diabetes monitoring blood glucose increased significantly in the economically underdeveloped western region during

Table 4 Multilevel logistic regression analyses of health education, test, treatment, diabetes-associated hospitalisation and recurrent hospitalisations among patients with diabetes in China during 2011–2015

	Adjusted OR (95% CI)				
	Health education	Examinations	Treatment	Diabetes-associated hospitalisations	Recurrent hospitalisations
Individual level					
Year (ref: 2011)					
2013	–	–	–	1.47 (0.97 to 2.22)*	–
2015	0.74 (0.61 to 0.90)	1.18 (0.95 to 1.45)	0.96 (0.80 to 1.15)	–	1.78 (1.44 to 2.19)
Living expenditure per year (ref: the lowest level)					
2	1.20 (0.91 to 1.58)	1.09 (0.81 to 1.47)	1.45 (1.10 to 1.90)	1.09 (0.48 to 2.43)	0.83 (0.57 to 1.21)
3	1.15 (0.88 to 1.52)	1.50 (1.10 to 2.04)	1.56 (1.19 to 2.05)	1.63 (0.77 to 3.44)	1.98 (1.42 to 2.76)
4	1.82 (1.36 to 2.45)	1.93 (1.38 to 2.69)	1.96 (1.47 to 2.61)	2.66 (1.32 to 5.36)	2.70 (1.94 to 3.76)
5	1.44 (1.07 to 1.94)	1.76 (1.25 to 2.47)	1.56 (1.17 to 2.08)	3.19 (1.59 to 6.41)	4.79 (3.43 to 6.69)
Region (ref: east China)					
Middle China	0.86 (0.70 to 1.06)	1.11 (0.87 to 1.43)	0.86 (0.69 to 1.05)	1.10 (0.67 to 1.79)	1.27 (1.00 to 1.61)
West China	0.99 (0.79 to 1.25)	0.69 (0.53 to 0.88)	0.84 (0.67 to 1.06)	1.80 (1.13 to 2.88)	1.92 (1.50 to 2.45)
Insurance1 (ref: none)					
Urban employee medical insurance	1.05 (0.63 to 1.77)	1.53 (0.89 to 2.65)	0.78 (0.48 to 1.28)	1.21 (0.40 to 3.67)	0.93 (0.54 to 1.60)
Urban resident medical insurance	0.78 (0.45 to 1.37)	1.13 (0.62 to 2.04)	0.87 (0.51 to 1.50)	0.80 (0.23 to 2.81)	0.86 (0.47 to 1.58)
New cooperative medical insurance	0.85 (0.53 to 1.38)	1.27 (0.77 to 2.08)	0.95 (0.60 to 1.50)	1.24 (0.43 to 3.58)	1.12 (0.66 to 1.88)
Other	0.68 (0.39 to 1.17)	1.94 (1.05 to 3.59)	1.23 (0.71 to 2.13)	0.74 (0.18 to 3.02)	0.88 (0.48 to 1.61)
Comorbidities (ref: none, diabetes only)					
1–2 additional diagnoses	1.14 (0.89 to 1.47)	1.27 (0.97 to 1.68)*	0.96 (0.75 to 1.22)	0.72 (0.43 to 1.19)	1.25 (0.94 to 1.67)
3≥additional diagnoses	1.21 (0.93 to 1.57)	1.56 (1.16 to 2.09)	0.98 (0.76 to 1.27)	0.67 (0.38 to 1.15)	1.54 (1.15 to 2.06)
Education (ref: elementary school and below)					
Middle school	1.19 (0.93 to 1.53)	1.35 (1.01 to 1.80)	0.97 (0.76 to 1.23)	0.76 (0.44 to 1.31)	1.01 (0.77 to 1.31)
High school	1.72 (1.13 to 2.69)	1.37 (0.88 to 2.15)	0.96 (0.66 to 1.38)	0.49 (0.18 to 1.29)	1.27 (0.85 to 1.89)
Vocational school and above	1.09 (0.77 to 1.59)	1.66 (1.05 to 2.62)	0.85 (0.60 to 1.20)	1.06 (0.55 to 2.04)	0.76 (0.52 to 1.11)
Age	0.98 (0.97 to 0.99)	0.99 (0.98 to 1.01)	1.02 (1.01 to 1.03)	1.02 (1.00 to 1.05)	1.03 (1.02 to 1.04)
Gender (ref: female)					
Male	1.61 (1.32 to 1.95)	0.90 (0.72 to 1.11)	1.19 (0.99 to 1.44)*	0.92 (0.61 to 1.38)	1.15 (0.93 to 1.41)*
Marital status (ref: without a spouse)					
With a spouse	1.01 (0.80 to 1.28)	1.35 (1.04 to 1.75)	1.10 (0.87 to 1.39)	1.18 (0.69 to 2.04)	1.05 (0.81 to 1.37)
Random effect					

Continued

Table 4 Continued

SD/SE/ICC	Adjusted OR (95% CI)			Diabetes-associated hospitalisations	Recurrent hospitalisations
	Health education	Examinations	Treatment		
	0.012/0.017/0.0033	0.017/0.024/0.005	0.020/0.026/0.005	0.068/0.101/0.020	<0.001

Bold typeface indicates $p < 0.05$.

* $p < 0.1$.

ICC, intraclass correlation coefficient; SD, standard deviation; SE, standard error.

2011 to 2015, which may be related to improvements in local PHC facilities. However, according to the regression analysis, medical examination rates were lower while hospitalisation rates were higher among residents with diabetes living in West China in comparison with those living in eastern regions. These findings support that significant regional disparities in quality of diabetes care exist within China. Care for diabetes in western provinces is particularly challenging since the rate of PHC doctors per 1000 residents is about two times lower compared with eastern provinces. Also, Zhou *et al*⁴⁴ have shown that diabetes detection rates vary considerably between regions. After adjustment to residents' sociodemographic characteristics, diabetes detection in southwest provinces was 15.6% while in the north it was 40.4%.⁴⁴ In addition to the literature, our findings support that more financial and human resources should be dedicated to the western provinces for improving diabetes management.

International practices for improving the quality of primary healthcare for diabetes can serve as important lessons for China. People-centred integrated care (PCIC) programmes have been previously initiated and implemented in several countries, and may be relevant for China as well.^{45 46} For example, proactive case management by multidisciplinary health and social care teams can prevent at-risk individuals from unscheduled hospitalisation and increase the continuity of care.⁴⁷ In contrast, China is currently characterised as having a hospital-centric health system in which patients directly access tertiary facilities, even for mild health conditions, while PHC providers barely have coordinating and gate-keeping roles.^{48 49}

Many other low-income and middle-income countries (LMIC), including India⁵⁰ and Thailand,⁵¹ share similar features with China. A recent policy analysis of strategies to strengthen referral in LMIC⁵² has summarised that 'where the quality of care is low, service delivery is weak, and access is limited, patients are likely to bypass primary care services'. Bearing in mind each country's unique contextual features, evidence on quality of PHC and policies for its improvement in China can be valuable for other LMIC facing similar challenges.

In the past few years, the Chinese government has endeavoured to improve the PHC facilities. More efforts are needed to implement the following aspects: first, to empower and encourage PHC providers to provide higher quality medical services. Second, to complete the paradigm shift from hospital-centred services to PCIC. Third, to mitigate disparity in access to high-quality services with the objective of achieving improvement in health-outcomes across provinces and social-economical classes. We underline the importance of the third aspect, since participants with lower living expenditure and those residing in rural areas were less likely to receive health education, examinations, and treatments in our study.

In line with the above, we provide several policy recommendations. First, the Chinese government should increase the fixed salary provided to PHC practitioners

to attract and retain experienced health workers. Pay for performance incentives can be considered; however, policy-makers are recommended to carefully review the evidence^{53–56} before implementation, as studies have shown uncertainty on ‘whether changes in documented quality represent true changes in patient care’.⁵⁷ Second, lessons learnt from pilots of integrated care,^{58–60} which were conducted in several municipalities during the first decade of the new health reform, should be consolidated and implemented nationally. Third, insurance policies should give higher financing priority to PHC institutions, for example, by removing barriers such as low reimbursement caps on PHC services.²⁵ Lastly, we recommend that quality of PHC in China will be routinely measured through a national quality registry,^{61 62} which is transparent, includes disparity impact assessments⁶³ and allows both policy-makers and the public to assess whether the goal of reducing health inequalities is successfully met.

CONCLUSION

China has invested heavily in improving the performance of its primary healthcare system; however, the results of this study cannot confirm that the quality of PHC has improved. Regional disparities in quality of PHC suggests that the investment in facilities and the training of service providers, particularly in West China, is far from adequate. Since current methods for measuring quality of PHC, such as hospitalisations among people with diabetes, can be influenced by additional factors, we recommend the establishment of a national quality registry for PHC in China. Areas of action also include transformation of insurance policies, so they provide higher financing priority to PHC institutions, rather than to hospitals. Lastly, an organisation structure based on PCIC is recommended for China and other developing countries who share the challenge of improving the quality of PHC.

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