

BMJ Open Changing community health service delivery in economically less-developed rural areas in China: impact on service use and satisfaction

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ABSTRACT

Objective: To evaluate the impact of a model of rural community health service (CHS) on the use and acceptability of primary healthcare services.

Design: Quasi-experimental.

Setting: Two adjacent rural counties in China.

Participants: 5842 residents in 2009 and 3807 in 2010 from 980 households in 7 intervention townships and 49 villages; 2232 residents in 2009 and 2315 in 2010 from 628 households in 3 comparison townships and 9 villages. All residents were approached to participate, with no significant differences in age or sex between groups.

Intervention: Multilevel intervention in 2009 including training rural practitioners, encouraging clinic improvements, providing clinical guidelines, standards and subsidies.

Data collection: Surveys of community members from randomly sampled households in 2009 and 2010.

Primary outcome measures: Satisfaction with and utilisation of outpatient and public health services.

Analysis: Factor analysis confirmed two components of satisfaction. Univariate and multilevel analysis was used.

Results: Satisfaction scores for intervention county respondents increased from 21.4 (95% CI 21.1 to 21.7) to 22.1 (95% CI 21.7 to 22.4) with no change in comparison area. In multilevel analysis, satisfaction with patient-centred care was associated with chronic disease, shorter waiting times and county. Satisfaction with clinic environment and cost was associated with female gender, shorter waiting times but not county. The proportion of children receiving immunisation in intervention village clinics increased from 42.5% (95% CI 27.9% to 47.1%) to 59.2% (95% CI 53.8% to 64.6%) whereas this decreased in comparison villages (16.5%; 95% CI 10.3% to 22.7% to 6.0%; 95% CI 1.3% to 10.7%). Antenatal visits increased in intervention villages (from 69.0%, 95% CI 65.8% to 73.1% to 75.8%, 95% CI 72.2% to 79.4%) with no change in comparison villages.

Conclusions: Introduction of a CHS model adapted to economically less-developed rural areas was associated with some improvements in satisfaction with care and use of some village-based public health services. Further research is needed to determine its public health impact and application to other areas.

Strengths and limitations of this study

- There have been no previously published studies evaluating the impact of a model of community health service delivery in socioeconomically depressed rural areas in China.
- The study had a quasi-experimental design and a limited sample of townships and villages.
- The outcomes were based on self-report by participants to questions adapted from the national health survey.

INTRODUCTION

In China, due to a range of historical and economic factors, health system development in rural areas has lagged behind that of urban areas.¹ Rural doctors focus mainly on clinical care, giving less attention to public health.² In economically less developed areas, there are deficiencies in the quality and quantity of the medical workforce, especially at the village level.³ These contribute to the poor health status of rural populations.

In recent years, new rural community health services (CHS) have been established in the economically developed areas of China (eg, around Beijing, Jiangsu, Zhejiang).⁴⁻⁷ These have required significant government investment but they have achieved a significant improvement.⁸ All doctors in these services are employed by the government and thus are able to be directed to do public health. In 2010 the central government provided new funding for public health services in all rural areas. However, the amount allocated to economically less-developed rural areas (eg, ¥15 per capita in Chongyi) still lags behind the amount provided in economically developed rural areas (eg, over ¥25 per capita in Zhejiang) and the health workforce undersupply remains a challenge.

In most rural areas primary healthcare (PHC) is provided at village level by self-

employed village doctors. Many of these have received limited training. Their source of funding has been predominantly from payments by patients for clinical care and dispensed medicine. Recently, incentives (including funding to refurbish clinics, additional equipment and subsidies for public health work) have been introduced to encourage these doctors to provide more public health-care and reduce their reliance on funds from drug dispensing. There has also been funding for improvement to facilities at the village and township levels.

Until now there have been few reports of studies evaluating the impact of different models of CHS delivery in economically depressed rural areas. This paper reports on the evaluation of a model of CHS delivery adapted to the less-developed rural areas.

METHODS

The study had a quasi-experimental design comparing change in two adjacent rural areas in Jiangxi Province of China.

The intervention site, Chongyi, is a small county in a remote mountain area. It has a population of 203 438, of which 165 214 work in agriculture. The economic condition of Chongyi County is representative of economically less-developed rural areas. The fiscal revenue of the local government was ¥307 700 000 and net average income of farmers for the whole year was ¥3406 per capita in 2008, which was below the 2008 average per capita income of rural residents in China (¥4761). In 2008, infant mortality was 9.53‰. There is a fairly sound three-level health service structure (at village, township and county levels). It was one of the first counties to pilot the new rural cooperative medical system in 2003. The county government attaches great importance to the rural health services and supports health reform. If it is successful, it is expected that the pilot project will be further developed and extended to other areas.

Luxi was chosen as the comparison site. Luxi is another small county in a mountain area adjacent to Chongyi in Jiangxi province. It has a population of 286 300 and an agricultural population of 227 733. Fiscal revenue of local government was ¥378 000 000 in 2008. The per capita annual income was ¥5047 in 2008. In 2008 infant mortality was 9.17‰.

Study population and sample

Seven townships were randomly sampled as intervention sites from the 16 townships in Chongyi County. These seven townships included 49 administrative villages. Three townships were randomly selected for comparison sites from a total of 10 townships in Luxi County. In each township, three administrative villages were randomly selected—a total of nine administrative villages.

Intervention

There were four components of the intervention.

Promoting the involvement of county government in the development of PHC

Engagement of rural government officials was achieved through seminars, individual interviews, joint review of relevant documents, joint visits to examine the model of rural CHS in Zhejiang province. The local government set up a group to lead rural CHS work which included leadership from the relevant branches of health, social security, civil administration and financial administration. This has helped to integrate PHC into the work plan of the government and develop a policy to promote it.

Improving the skills of PHC practitioners

Training aimed to improve the individual skills of PHC workers. The project group conducted a 1-week training course for 40 health managers, 160 doctors and 40 nurses. This included both theoretical education and field-based training. Theoretical training included social medicine, general medicine, CHS, community nursing and health management. In addition, Chongyi County sent 20 doctors from Township hospitals in two batches to participate in transition training (6 months general practice training) held by the provincial health department. The immediate impact of the training on their knowledge, attitudes and stated practice was assessed using a questionnaire before and after the training. These were analysed to evaluate the quality of training.

Improving management processes in PHC

Chongyi County health management regulations were revised and local CHS guidelines were drafted. These were based on the CHS guidelines in urban areas and revised to adjust for conditions in economically less-developed rural areas. They were discussed and revised in three rounds with input from government officials (provincial, municipal, county and township) and the experts from Nanchang University.

Improving access to quality PHC

In order to encourage medical workers in village and township levels to carry out effective PHC, incentive policies for rural CHS were introduced in Chongyi County in 2009. These policies included funding for repair or refurbishment of the clinic premises and some additional equipment (computer, examination bed, simple test equipment). By establishing these township and village health facilities as new rural cooperative medical system appointed institutions, the rural doctors were able to access subsidies for public health service work (eg, home visits, immunisation, patient education, etc) thus improving the affordability of rural PHC services.

In the comparison sites, in Luxi County, these interventions were not provided and township and village health facilities provided usual care.

The intervention period was from June 2009 to June 2010. The development of the intervention and its impact on service providers has been described in a previous paper.⁹

Table 1 Rural residents' social characteristics in 2009 and 2010 (Source Household Survey)

	Chongyi		Luxi	
	2009 (n=5842)	2010 (n=3897)	2009 (n=2232)	2010 (n=2315)
Gender(male)	3045 (52.1%)	2009 (51.6%)	1140 (51.1%)	1224 (52.9%)
Age (year) (95% CI)	33.6 (33.1 to 34.1)	34.1 (33.5 to 34.7)	35.4 (34.6 to 36.2)	36.1 (35.3 to 36.9)
Per capita income (¥) (95% CI)	4788.5 (4702.9 to 4874.0)	5764.1 (5660.1 to 5868.1)*	4889.2 (4736.8 to 5031.6)	5896.1 (5722.2 to 6070.0)*
Educational attainment†				
Semiliterate	565 (8.4%)	306 (6.0%)	124 (3.2%)	121 (3.1%)
Elementary school	1411 (21.0%)	1118 (22.0%)	665 (17.3%)	703 (17.8%)
Junior high school	2051 (30.6%)	1194 (23.5%)	757 (19.7%)	902 (22.9%)
High school	362 (5.4%)	254 (5.0%)	227 (5.9%)	152 (3.9%)
Tech secondary school	166 (2.5%)	98 (1.9%)	24 (0.6%)	32 (9.8%)
College diploma or above	142 (2.1%)	110 (2.2%)	34 (0.9%)	28 (0.7%)

*Significant difference between 2009 and 2010.

†Educational attainment in people more than 15 years of age.

Data

Sampling methodology for resident survey

In each of the 49 villages in Chongyi County in the intervention townships we approached 30 households to complete the baseline resident survey (at total of 1474 households). In each of the three villages selected in the three townships in the comparison area in Luxi County, (a total of nine villages) we sampled at least 60 households (a total of 587 households). In each village we randomly sampled the first household then selected the next 59 households in order of their household registration number order (as assigned by the local government). For each sample household, all members of the family were interviewed. These baseline surveys were conducted at the same time in June 2009.

A similar sampling method was used in the villages after 12 months. In 201 020 households in each village were selected. In Chongyi County one village clinic revoked their participation and another three rural doctors left their posts long term. This left 45 villages and 980 households participating. In Luxi County one rural doctor had a serious car accident. Thus there were only eight villages participating in 2010 containing 628 households in the Luxi sample.

Data collection

The questions used in the household survey were adapted from the Questionnaire used in the fourth National Health Survey.¹⁰ The School of Public Health, Nanchang University organised and supervised the

Table 2 Patient reported outpatient and inpatient medical service use in 2009 and 2010 (Source Household Survey)

	Chongyi		Luxi	
	2009 %o (95% CI)	2010 %o (95% CI)	2009 %o (95% CI)	2010 %o (95% CI)
Number of respondents	5842	3897	2232	2315
2-week prevalence of illness (%o)	69.5 (63.0 to 76.0)	79.55 (71.1 to 88.0)	46.6 (37.8 to 55.3)	73.9 (63.2 to 84.5)*
Chronic disease prevalence (%o)	60.69 (54.5 to 66.7)	96.0 (95.4 to 96.6)*	89.2 (77.3 to 101)	123.1 (110 to 13.6)*
Outpatient attendance rates in past 2 weeks (%o)	61.3 (55.1 to 67.4)	59.5 (52.6 to 67.0)	37.6 (29.7 to 45.5)	51.4 (42.4 to 60.4)
Hospitalisation rates (%o) (At least one)†	24.8 (20.8 to 28.0)	46.5 (39.8 to 53.1)*	62.3 (52.3 to 72.3)	60.5 (50.8 to 70.2)
Hospitalisation rates (%o) (Total)‡	28.2 (24.0 to 32.5)	58.0 (50.7 to 65.3)*	79.8 (78.1 to 81.4)	87.3 (75.8 to 98.8)
No hospitalisation (%)	26.8 (22.6 to 30.9)	9.1 (6.1 to 12.0)*	17.8 (12.3 to 23.2)	8.5 (4.8 to 12.2)*

*p<0.05.

†Rate=number of patients hospitalised at least once/population.

‡Rate =number of total hospitalisations/population.

Table 3 Total treatment satisfaction scores in outpatient clinics

	2009		2010		t'	p Value
	n	Mean (95% CI)	n	Mean (95% CI)		
Chongyi	354	21.4 (21.1 to 21.7)	232	22.1 (21.7 to 22.4)	2.754	0.006
Luxi	84	20.6 (20.1 to 21.1)	119	20.2 (19.7 to 20.8)	0.943	0.347
	t=2.847, p=0.005		t=5.573, p<0.001			

survey. County Health Bureau staff helped carry the field work. Surveyors consisted of undergraduate and graduate students from the School of Public Health, Nanchang University. Staff entered and checked the survey data. Survey data quality was assessed using the Myer's Index¹¹. This was 7.03 and 8.87 in Chongyi and Luxi, respectively, demonstrating good quality.

Analysis

SPSS V.13.0 was used for univariate statistical analysis. Statistical significance was evaluated using χ^2 , Fisher exact and the rank order test with $\alpha=0.05$. For continuous variables and scores independent t test were performed to compare 2009 and 2010 and the two counties (Chongyi and Luxi).

There were six questions about outpatient treatment satisfaction in the household survey. Each question was graded on a five-point Likert scale from very bad to very good. The six questions were highly correlated ($p<0.001$) and so factor analysis was conducted using principle component analysis. A two factor solution explained 63% of the variance (Eigen value 1.81). The first factor comprised three questions about patient centred care (clarity of explanation of illness, responsiveness to patient request for treatment and trust in doctor). We have called this 'patient centred care'. The second factor comprised those questions which were

about the quality and cost of the clinic (quality facilities and environment of clinic, satisfaction with billing and complaints). We have called this 'clinical environment and cost'.

Data were examined for the effect of clustering. This showed that there was a significant clustering of responses within households (inter cluster correlation coefficient (ICC) 0.65 for satisfaction with outpatient healthcare). Similarly there was evidence of clustering of responses at village level (ICC 0.436 for satisfaction with outpatient care). Multilevel multivariable analysis examined the association between individual, household and village level variables and the two components of outpatient patient satisfaction, using MLwiN (statistical software for multilevel models).¹² Measurement indices included outpatient satisfaction and public health services for children, women and older people.

RESULTS

Sample characteristics

In 2010 in Chongyi, 980 households with 3897 population participated. In Luxi, 628 households with 2315 population participated. There were no significant differences in the gender, age and educational attainment of participants. Per capita income increased in both Chongyi and Luxi. The mean age of participants was 1.8 years higher in Luxi in 2009 than Chongyi (table 1).

Table 4 Multilevel logistic regression models for outpatient patient satisfaction 2010 (β -Coefficients and Standard Error)

	Factor 1 Patient centred care	Factor 2 Facilities and cost
County (Chongyi=1; Luxi=2)	-0.320 (0.064)*	-0.170 (0.109)
Female (2)	-0.005 (0.036)	0.094 (0.043)*
Chronic disease	0.107 (0.038)*	0.035 (0.046)
Hospital admission in last year	0.048 (0.042)	0.013 (0.051)
Hospital admission prior to but not in last year	0.061 (0.087)	0.055 (0.103)
Reported short waiting time to see doctor	0.190 (0.076)*	0.208 (0.091)*
Income (¥3401-6700)	-0.046 (0.041)	-0.084 (0.049)
Income (>¥6700)	-0.018 (0.051)	0.008 (0.061)
Age (≤ 10)	0.001 (0.044)	0.049 (0.053)
Age (>57)	-0.027 (0.042)	0.010 (0.050)
Per cent variance explained at:		
Village level	37.5	9.5
Household level	5.9	0.0
Individual level	8.9	7.6

*Figures highlighted in bold are significant ($p<0.05$). Positive coefficient indicates an increased and negative coefficient indicates a decreased score associated with the covariate.

Change in clinical service use

The prevalence of reported chronic illness increased in Chongyi and Luxi. In Chongyi, the proportion of patients attending outpatient services over the past 2 weeks did not change. However, the hospital admission rates increased. In Luxi, the outpatient attendance rates increased but hospitalisation rates did not change (table 2).

In 2010, 51.3% (95% CI 44.9% to 57.7%) of residents of Chongyi County, considered that they only had to wait a very short time to see a doctor—an increase from 20.2% (95% CI 16.0% to 24.4%) in 2009. In Luxi, 47.9% (95% CI 38.9% to 56.9%) of residents reported spending a very short time to see a doctor—also increased from 26.2% (95% CI 16.8% to 35.6%) in 2009. There were no statistically significant differences between groups.

Satisfaction with outpatient care

Table 3 shows the analysis of the summed satisfaction scores. The satisfaction scores for intervention county respondents increased from 21.4 (95% CI 21.1 to 21.7) in 2009 to 22.1 (95% CI 21.7 to 22.4) in 2010 but there was no change in the comparison area (20.6%; 95% CI 20.1% to 21.1% and 21.4%; 95% CI 19.7% to 20.8%). The total treatment satisfaction scores were higher in Chongyi than Luxi at both times.

Multilevel analysis was performed on each of the two factors for the outpatient satisfaction. There was significant variance at patient, family and village levels. Satisfaction with patient centred care (factor 1) scores were associated with living in the intervention villages in Chongyi County, suffering from a chronic disease and reporting a short waiting time to see the doctor. Satisfaction with clinic environment and cost (factor 2) was associated with female gender and reporting a shorter waiting time to see the doctor but not with the intervention (table 4).

Public health service use

In 2010 in Chongyi, there were 750 women aged 15–49 years and married who completed the survey. Of these, 518 (69.1%; 95% CI 65.1% to 73.1%) women had received a gynaecological examination, slightly more than in 2009 (63.2%; 95% CI 59.7% to 66.7%). The antenatal examination rate was 75.8% (95% CI 72.2% to 79.4%), significantly higher than in 2009 (69.0%; 95% CI 65.8% to 73.1%). There were 319 women aged 15–49 years married in the Luxi sample. Of these, 41.5% (95% CI 35.6% to 49.4%) had received a gynaecological examination in 2009 and 47.0% (95% CI 39.0% to 55.0%) in 2010. There was also no significant change in the antenatal examination rate (62.4; 95% CI 56.0 to 68.8 in 2009 and 57.6; 95% CI 50.3 to 64.9; table 5).

In Chongyi, there were 437 children under 5 years of age who received immunisations according to the Schedule in 2009 and 321 in 2010. Of these children, 90.1% received immunisations from CHS (township hospital and village clinic) in 2010. The proportion of children receiving immunisation in the Chongyi village clinics increased from

Table 5 Examination of 15–49 years old, married women during pregnancy, birth and postnatal

	Chongyi (%; 95% CI)		Luxi (%; 95% CI)		χ^2 (p)
	2009	2010	2009	2010	
In the past year					
Gynaecology check-up	737 (63.2, 59.7 to 66.7)	518 (69.1, 65.1 to 73.1)	149 (41.5, 35.6 to 49.4)	150 (47.0, 39.0 to 55.0)	1.91 (0.16)
Pregnancy	1157 (99.2, 98.7 to 99.7)	731 (97.5, 96.4 to 98.6)	354 (99.2, 98.3 to 100)	309 (96.9, 95.0 to 98.8)	4.70 (0.03)
Given birth	1155 (99.1, 98.6 to 99.6)	729 (97.2, 96.0 to 98.4)	351 (98.3, 96.9 to 99.7)	308 (96.6, 94.6 to 98.6)	2.15 (0.14)
Antenatal exam*	798 (69.0, 65.8 to 73.1)	554 (75.8, 72.2 to 79.4)	221 (62.4, 56.0 to 68.8)	178 (57.6, 50.3 to 64.9)	1.60 (0.21)
Postpartum visit†	430 (37.2, 32.6 to 41.8)	218 (29.9, 23.8 to 36.0)	84 (23.9, 14.8 to 33.0)	83 (26.9, 17.9 to 36.4)	0.78 (0.36)

*Antenatal examination rates=number of women receiving antenatal examinations/number of pregnancies.

†Postpartum visit rates=number of women receiving postpartum visits/number of births.

Table 6 Proportion of children under 5 years receiving immunisation by site

Vaccination site	Chongyi % (95% CI)*		Luxi %, (95% CI)†	
	2009 (n=437)	2010 (n=321)	2009 (n=139)	2010 (n=100)
Centers for disease control and prevention	5.5 (3.4 to 7.6)	3.7 (1.6 to 5.8)	40.3 (32.1 to 48.5)	63.0 (53.5 to 72.5)
Township hospital	50.6 (45.9 to 56.3)	30.9 (25.8 to 36.0)	36.7 (28.7 to 44.7)	28.0 (19.2 to 36.8)
Village clinic	42.5 (37.9 to 47.1)	59.2 (53.8 to 64.6)	16.5 (10.3 to 22.7)	6.0 (1.3 to 10.7)
Other	1.4 (0.3 to 2.5)	6.2 (3.6 to 8.8)	6.5 (2.4 to 10.6)	3.0 (0 to 6.3)
Total	100.0	100.0	100.0	100.0

*Difference between 2009 and 2010 in Chongyi: $\chi^2=41.309$, $p<0.001$.

†Difference between 2009 and 2010 in Luxi: $\chi^2=14.085$, $p=0.003$.

42.5% (95% CI 27.9% to 47.1%) to 59.2% (95% CI 53.8% to 64.6%). There were 139 children under 5 years of age who received immunisation in the sample of Luxi County villages in 2009 and 100 in 2010. The proportion immunised in village clinics decreased from 16.5% (95% CI 10.3% to 22.7%) to 6.0% (95% CI 1.3% to 10.7%; table 6).

In 2010, there were 458 respondents aged 60 years or older in Chongyi. Of these 89.7% (95% CI 86.9% to 92.5%) attended township or village health services for assessments, an increase from 65.5% (95% CI 61.5% to 69.5%) in 2009. There were 222 respondents aged 60 years or older in Luxi. Of these 54.1% (95% CI 47.5% to 60.7%) attended health assessments in township or village health clinics, an increase from 38.0% (95% CI 32.4% to 43.6%) in 2009 (table 7).

DISCUSSION

The demand for and utilisation of health services is lower in rural areas such as Chongyi than in urban areas.^{13–16} Although there were changes in both sites, overall there were few differences between the responses of those residents in the intervention and control villages about their use of clinical services or the waiting times for these. In Chongyi, the reported hospitalisation rate increased significantly after the intervention, whereas in Luxi there was no significant change. However, this is likely to be related to the lower initial hospitalisation rate in Chongyi.

Although outpatient attendance rates did not change in either site, satisfaction with outpatient services especially with the quality of patient centred care (clarity of explanation of illness, responsiveness to patient request for treatment, and trust in doctor) improved in villages in Chongyi. However it declined in the sites in Luxi. Although the

difference in scores was small, in the multivariate analysis ‘county’ had the strongest association with improved satisfaction with patient centred care. In other research, factors such as age and chronic diseases have a strong influence on patient satisfaction.¹⁷ However, in this study these had much weaker associations with satisfaction than ‘county’.

There were also improvements in the use of a number of the public health programmes. Attendance for assessment of aged care improved in Chongyi but not in Luxi. Although there were improvements in antenatal assessments in Chongyi (and no change in Luxi), there was a decline in postpartum assessments bringing these closer to the rate in Luxi. Parents of children in Chongyi were most likely to report receiving their immunisation from the village or township health services and this proportion improved. By contrast they were much less likely to report this in Luxi with a higher proportion of immunisations needing to be provided by the county public health services, Centers for disease control and prevention (CDC).

While the rural doctors in both sites were able to access subsidies for public health service work (eg, home visits, immunisations, patient education, etc), those in the intervention sites were able to take these up to a greater extent because of greater support (funding for repair or refurbishment of the clinic premises and some additional equipment including computer, examination bed and simple test equipment). By accrediting these township and village health facilities as new rural cooperative medical care appointed institutions they were also eligible to claim payments from these insurance funds.

There have been very few studies evaluating health service use and satisfaction in economically less-

Table 7 Respondents 60 years and older receiving assessments

	2009			2010			χ^2	p Value
	Total	Attended assessment	Per cent	Total	Attended assessment	Per cent		
Chongyi	542	355	65.5 (61.5 to 69.5)	458	411	89.7 (86.9 to 92.5)	81.37	<0.001
Luxi	292	111	38.0 (32.4 to 43.6)	222	120	54.1 (47.5 to 60.7)	13.11	<0.001
	$\chi^2=58.142$, $p<0.001$			$\chi^2=111.274$, $p<0.001$				

developed rural areas in China. A sample survey in Qingzhou of Shandong province showed that the physical environment and medical services in CHS were better than in rural areas that had not implemented the CHS model.¹⁸ Further research is needed to explore the contribution that models of CHS delivery can make to improving rural health service quality.

This study suggests that the adapted CHS model had an impact both on the receipt of public health services by rural residents and their satisfaction with care received from the doctors in these services. This was independent of their overall use of services, cost or quality of facilities. Although most village doctors are not employed by government they can be influenced to provide public health services and increase the population coverage of their services at low cost to the government.

This model is suitable for economically less-developed rural areas in China. County governments can introduce this model by modifying the existing system with limited funding. The rural population accepts the role of village and township doctors in providing public health services. This can complement their role in providing sick care. At baseline the admission rates in Chongyi were lower than in Luxi. This was despite the National Rural Cooperative Medical System being introduced in 2003 in both areas. In association with the intervention, admission rates in Chongyi increased to be similar to other rural areas.¹⁹

There are a number of limitations to this study. It was conducted in rural areas in one province and the application of the findings to other areas needs to be made with caution. The design was quasi-experimental and it is possible that differences between the study sites may be explained by other factors not adjusted for in the analysis. Fewer townships and villages were sampled in Luxi than Chongyi at baseline, four villages in Chongyi and one in Luxi had to be withdrawn from the study and follow-up surveys were not conducted in these villages. The sample responding to the surveys was not the same in 2009 and 2010 and this may have introduced some bias. Although there were no significant differences in the characteristics of these respondents, there were unexplained differences in rates of hospitalisation and some assessments between the sampled villages in Chongyi and Luxi at baseline. These limitations need to be considered when interpreting the findings and generalising them to other rural areas in China.

CONCLUSION

The introduction of a model of CHS which was adapted to rural health services in economically less-developed areas was associated with improvements in the acceptability of township and village health services and the level of use of some public health services at the village level. This may be explained by improved health workers' capacities and service models implemented in rural CHS in Chongyi. However, the design and other unmeasured factors may

also have contributed to the differences observed. A similar approach should be evaluated in other economically less-developed rural areas in China.

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Contributors YZ was responsible for the project, including project design, site implementation and supervision. Liu Yong, Liu Yuxi and UJJ were involved in the implementation of the study, the evaluation, data collection and analysis and critically reviewed and commented on the draft paper. Liu Yong was in charge of the draft of the paper. MFH was advisor to the project during the design, implementation and evaluation stages. He visited Chongyi and provided comment and advice and during visits of the researchers to Australia discussed the analysis and writing. He reviewed and edited the paper.

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Competing interests None.

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