

A CROSS-SECTIONAL SURVEY ON THE CURRENT STATUS OF THE RURAL DOCTOR WORKFORCE IN YUXI CITY, YUNNAN PROVINCE

Lei Yang¹, ShuQing Yuan¹, E Diao¹, ChuanZhi Xu², Ting Luo⁴, Ling Fan⁴, JunKui Li⁵, ShunXiang Li^{1,2,3*}, Yan Wang¹

¹*School of Public Health, Dali University, Dali 671000, Yunnan, China.*

²*Haiyuan College, Kunming Medical University, Kunming 650106, Yunnan, China.*

³*Yuxi Emergency Center, Yuxi 653100, Yunnan, China.*

⁴*Yuxi Center for Disease Control and Prevention, Yuxi 653100, Yunnan, China.*

⁵*School of Public Health, Qilu Medical University, Zibo 255300, Shandong, China.*

*Corresponding Author: ShunXiang Li

Abstract: Objective: This study aims to fully understand the basic status of rural doctors in Yuxi City, Yunnan Province, systematically evaluate their workforce quantity, demographic structure and service capacity, deeply analyze the major problems and restrictive factors hindering the construction of the rural doctor team, and provide scientific evidence for optimizing the composition of rural doctors, improving their service capabilities, and advancing the development of the primary medical and health service system in Yuxi City. Methods: A complete census was conducted covering all 649 village clinics across 9 counties (districts/county-level cities) of Yuxi City. A total of 99 rural doctors with ≥ 3 missing information items were excluded, and 1667 subjects were finally included for analysis. Indicators including workplace, gender, employment status, staffing category, personnel type, major, educational background and working years were analyzed. Results: Significant gender differences were observed among rural doctors in Yuxi City ($P < 0.01$), with females accounting for the majority (1188 individuals). The gender ratio was the lowest in Huaning County at 19.86% and the highest in Yuanjiang County at 102.25%. A total of 1624 rural doctors were formally staffed, accounting for 97.42% of the total participants. Secondary technical school education dominated the sample with 1131 practitioners, representing 67.85%. The number of rural doctors per 10,000 population ranged from a peak of 10.9 in Eshan County to a minimum of 5.0 in Hongta District. Rural doctors aged 41–50 years constituted the largest group (570 persons, 34.19%), while 5 practitioners aged ≥ 61 years were all rehired retirees. The largest group in terms of working years had 11–20 years of service (588 persons). Conclusion: Shortages of rural doctors exist to varying degrees in Yuxi City, which requires high attention from authorities at all levels. During the implementation of the 15th Five-Year Plan, targeted measures should be adopted to address the above-mentioned deficiencies and weaknesses, laying a solid foundation for the high-quality development of primary healthcare.

Keywords: Village doctors; Primary-level health; Human resource allocation

1 INTRODUCTION

Driven by both the "Healthy China 2030" planning outline and the rural revitalization strategy, the development of the primary healthcare service system has become a core task of public health in China. As an important force in primary healthcare services, the development of the rural doctor workforce directly affects the accessibility, equity, and effectiveness of primary healthcare services. Previous studies have shown that understanding the current status of primary healthcare institutions is an important step in evaluating rural medical services, and that village clinics serve as the foundation of the three-tier medical service system [1]. Within the three-tier medical service system, rural primary healthcare institutions remain the weakest link with the poorest foundation [2]. Through a comprehensive and systematic survey of the current status of the rural doctor workforce in Yuxi City, this study aims to provide scientific evidence for optimizing the workforce structure, improving the practice environment, promoting career development, advancing the primary healthcare service system, enhancing service capacity, and safeguarding the basic healthcare needs of rural residents.

2 MATERIALS AND METHODS

2.1 Data Source

This study investigated all 1766 rural doctors from 649 village clinics in nine counties (districts/county-level cities) of Yuxi City. Data were collected on their workplace, gender, employment status, staffing category, personnel type, specialty, highest educational attainment, and working years. The census data collected in this study only covered basic information of rural doctors, and the analysis focused on the current status of the workforce; no sensitive information was involved, and no ethical issues were implicated.

2.2 Quality Control

All investigators received unified training and passed the assessment. The questionnaire underwent a pilot survey and demonstrated good reliability, validity, and responsiveness. Two responsible and experienced personnel were assigned as quality controllers to ensure quality control.

2.3 Inclusion and Exclusion Criteria

Records with more than three missing information items were excluded (99 records); 1667 records with complete and intact information were included.

2.4 Statistical Analysis

Data were organized using Excel 2019. Statistical analyses were performed using SPSS 25.0, including the chi-square test, Fisher's exact test, Kruskal-Wallis test, Mann-Whitney test, Bonferroni correction, and one-sample binomial/Z test.

3 RESULTS

3.1 Staffing Category

A total of 1667 primary health personnel were included, of whom 1624 (97.42%) were formally staffed and 43 (2.58%) were non-staffed. The staffing composition by personnel type is shown in Table 1. Fisher's exact test was used to compare the staffing composition across six types of health personnel, and the overall difference was statistically significant ($P < 0.001$). Further pairwise comparisons showed that rural doctors holding only a village doctor certificate had the highest proportion of formal staffing, with a significantly lower proportion of non-staffed personnel than registered nurses ($P < 0.001$). Intern doctors were entirely non-staffed, and their staffing composition differed significantly from both rural doctors holding only a village doctor certificate and rural general practice assistant physicians (both $P < 0.0033$).

Table 1 Staffing Composition by Personnel Type

Personnel type	Staffed	Non-staffed	Total
Rural general practice assistant physician	82	1	83
Rural doctor with only a village doctor certificate	1412	3	1415
Intern doctor	0	7	7
Traditional Chinese medicine category	8	2	10
Registered nurse	120	28	148
Other health technical personnel	2	2	4
Total	1624	43	1667

3.2 Gender Distribution

Among the 1667 rural doctors in Yuxi City, 479 (28.73%) were male and 1188 (71.27%) were female. Pearson's chi-square test revealed a highly significant difference in gender composition, with the proportion of females significantly higher than that of males ($\chi^2 = 301.55$, $P < 0.001$). The gender composition of rural doctors varied considerably across counties (districts/county-level cities). The proportions of females were highest in Huaning County and Hongta District (83.43% and 81.78%), with male-to-female ratios of only 19.86% and 22.28%, respectively. Yuanjiang County was the only county where males outnumbered females (50.56%), with a male-to-female ratio as high as 102.25%. Pearson's chi-square test showed a statistically significant difference in gender composition among the nine counties of Yuxi City ($\chi^2 = 81.83$, $P < 0.001$). Using the city-wide male proportion of 28.73% as reference, one-sample binomial tests showed that the male proportions in Yuanjiang County (50.56%, $Z = 6.48$, $P < 0.001$) and Eshan County (38.24%, $Z = 2.76$, $P = 0.006$) were significantly higher than the city average, whereas those in Huaning County (16.57%, $Z = -3.56$, $P < 0.001$) and Hongta District (18.22%, $Z = -3.87$, $P < 0.001$) were significantly lower. The remaining counties showed no statistically significant difference from the city average (all $P > 0.05$) (Table 2).

Table 2 Gender Distribution of Rural Doctors by County (District/County-Level City)

County/District	Male	Female	Total	Male-to-female ratio (%)	Rank
Hongta District	43	193	236	22.28	8
Jiangchuan District	53	183	236	28.96	7
Xinping County	85	179	264	47.49	3
Yuanjiang County	91	89	180	102.25	1
Eshan County	65	105	170	61.90	2
Huaning County	29	146	175	19.86	9
Tonghai County	49	120	169	40.83	5
Yimen County	42	102	144	41.18	4
Chengjiang City	22	71	93	30.99	6
Total	479	1188	1667	40.32	—

Note: *Male-to-female ratio = male population ÷ female population × 100.

3.3 Educational Background Distribution

Regarding the educational background of the 1667 rural doctors, secondary technical school education predominated (1131, 67.85%), followed by junior college (445, 26.69%). Only 50 held a bachelor's degree or above (3.00%), 21 held a senior high school (vocational high school) diploma (1.26%), and 20 had junior high school education or below (1.20%). By region, Hongta District and Jiangchuan District had relatively high proportions of personnel with junior college or above and no personnel with junior high school education or below. Yuanjiang Hani, Yi, and Dai Autonomous County had the highest proportion of personnel with junior high school education or below, indicating an overall lower educational level. The Kruskal-Wallis H test showed a statistically significant difference in overall educational level among primary health personnel across the nine counties/districts ($P < 0.001$), suggesting that the distribution of educational attainment varied by county. Fisher's exact test confirmed the difference in educational composition, yielding a consistent conclusion ($P < 0.001$). Post hoc pairwise comparisons showed that the overall educational level in Hongta District and Jiangchuan District was significantly higher than that in some remote counties such as Yuanjiang Hani, Yi, and Dai Autonomous County (adjusted $P < 0.05$).

Table 3 Educational Background Distribution of Rural Doctors by County (District/County-Level City)

County/District	Bachelor	Junior college	Senior high (vocational)	Secondary technical	Junior high or below	Total
Hongta District	13	80	2	141	0	236
Jiangchuan District	13	62	2	159	0	236
Xinping Yi and Dai Autonomous County	7	40	1	215	1	264
Yuanjiang Hani, Yi, and Dai Autonomous County	2	19	4	142	13	180
Eshan Yi Autonomous County	3	44	5	114	4	170
Huaning County	4	62	3	106	0	175
Tonghai County	4	61	2	100	2	169
Yimen County	3	48	1	92	0	144
Chengjiang City	1	29	1	62	0	93
Total	50	445	21	1131	20	1667

Pearson's chi-square test was used to compare the educational composition between males and females, while the Mann-Whitney U test was used to compare their overall educational levels given the ordinal nature of education. Pearson's chi-square test revealed a highly significant difference in educational composition between male and female health personnel ($\chi^2 = 51.88$, $df = 5$, $P < 0.001$). The Mann-Whitney U test showed that the overall educational level of female health personnel was significantly higher than that of males ($Z = -5.49$, $P < 0.001$).

3.4 Age Distribution

Table 4 shows the age distribution of rural doctors by county (district/county-level city) in Yuxi City. The oldest rural doctor was 75 years old and the youngest 21 years, with a mean age of 42.57 (± 9.81) years. Five rural doctors aged ≥ 61 years were all rehired retirees (Table 4). The 1667 rural doctors from nine counties (districts/county-level cities) were divided into five ordered age groups (≤ 30 , 31–40, 41–50, 51–60, and ≥ 61 years). Because the ≥ 61 -year group contained only five cases and thus had excessively small expected frequencies, the 51–60 and ≥ 61 -year groups were merged into a ≥ 51 -year group to construct a 9×4 contingency table. Pearson's chi-square test was used to compare age composition across counties, and the Kruskal-Wallis H test was used to analyze the overall difference in ordered age levels. When the overall test was significant, Bonferroni-adjusted pairwise comparisons were performed. The results showed that rural doctors aged 41–50 years predominated (34.19%), while those aged ≤ 30 years accounted for only 14.82%, indicating insufficient recruitment of young practitioners and a high proportion of personnel approaching retirement. Pearson's chi-square test yielded $\chi^2 = 90.25$, $df = 24$, $P < 0.001$, and the Kruskal-Wallis H test yielded $H = 78.62$, $df = 8$, $P < 0.001$, indicating highly significant differences in both age composition and overall age level among the nine counties. Pairwise comparisons revealed significant differences in age structure between Tonghai County and Yimen County, Tonghai County and Hongta District, and Yuanjiang County and Huaning County (all $P < 0.00139$). Tonghai County had the weakest reserve of young rural doctors, while aging was most prominent in Yuanjiang County and Hongta District. No statistically significant differences were found between Hongta District and Jiangchuan District or between Eshan County and Yuanjiang County.

Table 4 Age Distribution of Rural Doctors by County (District/County-Level City)

County (District/City)	≤ 30	31–40	41–50	51–60	≥ 61	Total
Hongta District	46	54	59	77	0	236
Jiangchuan District	45	63	68	58	2	236
Xinping Yi and Dai Autonomous County	43	53	102	66	0	264
Yuanjiang Hani, Yi, and Dai Autonomous County	18	32	70	60	0	180
Eshan Yi Autonomous County	18	43	55	54	0	170
Huaning County	23	53	74	25	0	175

County (District/City)	≤30	31–40	41–50	51–60	≥61	Total
Tonghai County	6	62	69	32	0	169
Yimen County	30	35	41	36	2	144
Chengjiang City	18	23	32	19	1	93
Total	247	418	570	427	5	1667

Note: *Age was recorded in whole years, with incomplete years rounded up to the next integer.

3.5 Distribution of Years of Service

According to Table 5, the longest duration of service among rural doctors in Yuxi City was 55 years and the shortest less than one year, with a mean of 17.17 (± 10.56) years. Years of service were classified into five levels: ≤ 10 , 11–20, 21–30, 31–40, and ≥ 41 years. Among all subjects, 491 (29.45%) had ≤ 10 years of service, 588 (35.27%) had 11–20 years, 340 (20.40%) had 21–30 years, 235 (14.10%) had 31–40 years, and 13 (0.78%) had ≥ 41 years. By region, Hongta District, Jiangchuan District, and Xinping Yi and Dai Autonomous County had relatively large samples (all >230 cases). In Tonghai County, Eshan Yi Autonomous County, and Huaning County, the 11–20-year service group accounted for the highest proportion. Hongta District had the highest proportion of long-serving personnel, while Yimen County and Chengjiang City had higher proportions of short-serving personnel, indicating an overall shorter service duration. Because the " ≥ 41 years" group contained few cases and several cells had expected frequencies <5 , the application conditions for Pearson's chi-square test were not met. Based on professional considerations, the "31–40 years" and " ≥ 41 years" groups were merged into a " ≥ 31 years" group, after which all expected frequencies were >5 and the total sample was >40 , satisfying the test conditions. Pearson's chi-square test was used to compare the composition of years of service across counties (districts/county-level cities), with the significance level set at $\alpha=0.05$. The results showed a statistically significant difference in the composition of years of service across counties ($\chi^2=153.82$, $df=24$, $P<0.001$), indicating heterogeneity in the service-duration structure among regions. Pairwise comparisons were performed using the Wilcoxon rank-sum test for two independent samples, with the significance level adjusted by the Bonferroni method. Pairwise comparisons showed that the overall service duration in Hongta District was significantly higher than that in Huaning County ($Z=4.45$, $P<0.001$) and Yimen County ($Z=3.92$, $P<0.001$); Tonghai County was significantly higher than Huaning County ($Z=3.58$, $P<0.001$); and Jiangchuan District was significantly higher than Huaning County ($Z=3.31$, $P=0.001$). The adjusted P values for all other pairwise comparisons were >0.0014 , with no statistically significant differences.

Table 5 Distribution of Years of Service of Rural Doctors by County (District/County-Level City)

County (District/City)	≤10	11–20	21–30	31–40	≥41	Total
Hongta District	67	56	47	65	1	236
Jiangchuan District	68	69	53	45	1	236
Xinping Yi and Dai Autonomous County	87	80	60	35	2	264
Yuanjiang Hani, Yi, and Dai Autonomous County	61	51	41	25	2	180
Eshan Yi Autonomous County	43	85	22	16	4	170
Huaning County	58	80	26	11	0	175
Tonghai County	19	95	36	16	3	169
Yimen County	63	31	37	13	0	144
Chengjiang City	25	41	18	9	0	93
Total	491	588	340	235	13	1667

Note: *Duration of service was recorded in whole years, with incomplete years rounded up to the next integer.

3.6 Comparison of Rural Doctor Allocation against Standards by County (District/County-Level City)

According to Table 6, among the counties (districts/county-level cities) of Yuxi City, Xinping County had the largest number of rural doctors (264, 16%), followed by Hongta District and Jiangchuan District (both 236, 14%), while Chengjiang City had the fewest (93, 6%), followed by Yimen County (144, 9%). Compared with the standard of 10 rural doctors per 10,000 population stipulated in the "Guiding Opinions of the General Office of the State Council on Further Strengthening the Development of the Rural Doctor Workforce" (Guobanfa [2011] No. 31), only Eshan County met the requirement, while all other counties (districts/county-level cities) fell short [3].

Table 6 Rural Doctor Allocation by County (District/County-Level City)

County/District	Chengjiang City	Eshan County	Hongta District	Huaning County	Jiangchuan District	Tonghai County	Xinping County	Yimen County	Yuanjiang County
Number of rural doctors	93	170	236	175	236	169	264	144	180
Total population (10,000)	14.92	15.57	47.23	21.3	28.78	29.24	27.9	16.37	21.12
Rural doctors per 10,000 population	6.2	10.9	5.0	8.2	8.2	5.8	9.5	8.8	8.5

4 DISCUSSION

This survey was conducted against the backdrop of the completed pre-hospital emergency care system in Yuxi City, comprehensively investigating 1667 rural doctors across 649 village clinics. It systematically evaluated their quantity, structure, and service capacity, deeply analyzed the main problems and constraining factors facing the workforce, and explored ways to optimize its structure and enhance service capability, with the ultimate goal of maximizing the protection of the life and health of the grassroots population.

In terms of allocation, according to the standard of 10 rural doctors per 10,000 population in the "Guiding Opinions of the General Office of the State Council on Further Strengthening the Development of the Rural Doctor Workforce" (Guobanfa [2011] No. 31), Yuxi City, with 2.23 million permanent residents, requires 2230 rural doctors but currently has only 1667, a shortfall of 563. By county (district/county-level city), only Eshan County met the national allocation requirement, while the remaining eight fell short. It is therefore urgent to expand the rural doctor workforce by increasing staffing quotas and intensifying recruitment efforts.

Structurally, the main problems are as follows:

First, the gender ratio is severely imbalanced. In this study, there were 1188 female primary healthcare workers (71.2%) and 479 males (28.8%). This contrasts with the findings of Tian Jiang and Zhang Guangpeng et al., who reported that males accounted for 72.1% and females 27.9% of rural doctors, and with the 2015 study by Qi Huiying and Li Ruifeng et al., in which 148 of 225 rural doctors were male (65.78%) and 77 female (34.22%), a male-to-female ratio of approximately 2:1 [4-5]. It also differs from the census by Shen Fengming and Yuan Zhaokang in 2007 of 26,645 village clinics in Jiangxi Province, which found that male and female rural doctors accounted for 88% and 12%, respectively, with males far outnumbering females [6]. Moreover, marked regional differences exist. The proportion of male rural doctors in ethnic autonomous counties was significantly higher than that in non-ethnic areas, with Yuanjiang County showing a nearly balanced gender composition, whereas rural doctor teams in central urban districts and economically developed surrounding counties were more feminized. This distribution pattern may be related to regional economic development levels, occupational attractiveness, and ethnic cultural customs. The significant gender imbalance may also be associated with the nature of primary healthcare positions, occupational attractiveness, and women's preference for careers in nursing and public health. Except for Yuanjiang County, female rural doctors predominated across all counties (districts/county-level cities) of Yuxi City, with female proportions as high as 81% in Hongta District and Huaning County, reflecting a severe gender imbalance. From the demand side, primary healthcare mostly involves common rural diseases, chronic diseases, basic conditions, and maternal care, for which female doctors have advantages in the meticulousness and continuity of preventive care and health education. In the context of pre-hospital emergency care, frontline workers are predominantly male, and male workers report higher satisfaction than females [7]. Additionally, men predominantly engage in migrant work, which reduces their availability for rural practice. Therefore, greater attention should be paid to appropriately increasing the recruitment of male doctors in future hiring and selection, so as to gradually address the gender imbalance among rural doctors.

Second, the educational level needs improvement. This survey showed that the educational attainment of rural doctors in Yuxi City exceeded the standard set by the "Decision of the Central Committee of the Communist Party of China and the State Council on Health Reform and Development," which required that 80% of rural doctors nationwide reach the secondary technical school level by 2010, indicating that certain progress has been made in workforce development. However, the results indicate that the overall educational level of primary health personnel in Yuxi City is low and regionally uneven. Educational levels are higher in central urban districts and surrounding counties (Hongta District, Tonghai County, and Huaning County) but significantly lower in ethnic autonomous counties (Xinping County and Yuanjiang County), with highly educated talent concentrated in economically developed areas. These findings suggest that future development of the primary health workforce should prioritize ethnic minority areas, strengthen training for less-educated personnel, and formulate preferential policies to attract highly educated talent to grassroots and ethnic minority areas. Meanwhile, a severe shortage of high-level talent persists, with only 50 personnel city-wide holding a bachelor's degree or above (3.00%) and 495 rural doctors holding a junior college degree or above (29.69%). By county (district/county-level city), educational levels are highly uneven. The proportion of rural doctors with junior college or above was highest in Hongta District (39.41%), followed by Tonghai County (38.46%) and Huaning County (37.71%), and lowest in Yuanjiang County (11.67%), with Xinping County at 17.80% and Eshan County at 27.65%. Overall, rural doctors in plain (bazi) areas had higher educational levels, whereas those in mountainous areas had lower levels.

Third, there is a gap in the professional qualifications of rural doctors. According to the "Opinions on Further Deepening Reform to Promote the Healthy Development of the Rural Medical and Health Service System" issued by the General Office of the CPC Central Committee and the General Office of the State Council, the proportion of rural doctors with a licensed (assistant) physician qualification should reach about 45% by 2025. However, there are only 83 rural general practice assistant physicians in Yuxi City (4.9%), which is close to Tang Hongri's finding of a generally low certification rate (village doctor certificate holding rate of 55.9% and licensed assistant physician certificate holding rate of 56.5%), and falls far short of the national planning target [8]. A total of 1599 persons held certificates (including the village doctor certificate), yielding a certification rate of 95.92%.

Fourth, the aging of the rural doctor workforce and long service duration exist to varying degrees. In terms of age structure, the mean age of rural doctors in Yuxi was 42.57 (± 9.81) years; 247 (14.82%) were under 30 years old, and 427 (25.61%) were over 50 years old, including 5 over 60 years old who were all rehired after reaching retirement age. This suggests that rural doctors in Yuxi City are generally older, and there is a need to further optimize the age structure, implement

retirement and pension mechanisms for rural doctors, smooth their exit channels, and strengthen the influx of new talent. In terms of service duration, the mean was 17.17 (± 10.56) years, with the longest being 55 years. Previous studies have suggested two reasons for these problems: (1) rural doctors past retirement age continue working because they have no pension security after leaving their posts; and (2) no new rural doctors are recruited in a timely manner, forcing older rural doctors to remain at their posts after reaching retirement age [9]. The current rural doctor workforce is aging, structurally old, and unstable. Compared with urban areas, rural economic development lags behind, some excellent young doctors migrate to large cities, rural doctor positions are less attractive, and imperfect assessment, salary distribution, and promotion systems hinder the enthusiasm of medical personnel [10]. Similar situations exist in Yuxi. Moreover, rural doctors beyond retirement age and some older rural doctors find it difficult to provide standardized and effective medical services in pre-hospital emergency operations (in terms of training, we found that older rural doctors struggled to meet the required compression rate and depth during cardiopulmonary resuscitation). The state should further leverage policy guidance to encourage medical school graduates to join the rural doctor workforce and provide them with necessary career development opportunities, thereby addressing both the employment of graduates and the succession gap among rural doctors.

This study showed that 1624 rural doctors in Yuxi (97.42%) were formally staffed, while 43 (2.58%) were non-staffed. Rural doctors holding only a village doctor certificate were the most stable group in terms of staffing, with over 84.70% formally staffed, which is related to the long-standing preferential staffing policies for the rural doctor workforce. Characteristics of non-staffed employment: non-staffed personnel were mainly registered nurses (65.11%), which may be related to the long-standing ambiguity of the "status" of nurses in village clinics. Compared with licensed (assistant) physicians, nurses have a later start in career development paths and staffing guarantees in village clinics. For a long time, policy priorities in workforce development have focused on the training and formal staffing of physicians (especially general practitioners), whereas nurses have often been regarded as auxiliary roles, resulting in a relatively delayed process of "county recruitment and village employment" or formal staffing for nurses. The contributions of Chinese rural doctors were once widely recognized worldwide. In the 1970s, the rural doctor workforce, the cooperative medical system, and the three-tier rural health service network were known as the "three magic weapons," yet the remuneration of rural doctors did not match their contributions [11]. Service delivery models should be promoted that suit the needs of local residents and the skills of rural doctors, so as to enhance residents' sense of gain and satisfaction [12]. Because pension issues seriously affect the stability of the rural doctor workforce, health authorities may purchase medical liability insurance for local rural doctors on a unified basis, and, on the basis of improving pension security and medical liability insurance policies, establish a sound retirement system to safeguard the living rights of rural doctors and promote succession within the workforce [12].

The quantity and quality of the rural doctor workforce directly affect the functioning of the primary healthcare system in Yuxi City. Continuously optimizing the structure and improving the competence of rural doctors is an urgent and systematic undertaking. Promoting service delivery models suited to local residents' needs and rural doctors' skills and enhancing residents' sense of gain and satisfaction require the attention of Party committees and governments, coordination among departments, and, above all, the concern and support of society as a whole [13].

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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