

The Competence of Village Doctors in the Diagnosis and Treatment of Heart Disease in Rural China: A Nationally Representative Assessment

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Research

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Abstract

Background

While strengthening primary care quality is key to China's health system reforms, evidence to guide this work has been limited, particularly for rural areas. This study provides the first nationally representative assessment of village doctors' competence in diagnosing and managing presumptive heart disease.

Methods

A cross-sectional study of village clinics was conducted across five provinces. We presented standardized clinical vignettes to evaluate doctors' competence in diagnosing and managing unstable angina. Enumerators accompanying mock patients documented the interaction, including questions, examinations, diagnoses, and management options provided by the doctor. We measured diagnostic process competence as degree of adherence to both "recommended" and "essential" questions and physical examinations stated in national clinical practice guidelines for patients stating typical symptoms of unstable angina. We assessed diagnostic competence according to whether doctors stated a correct or partially correct diagnosis. Finally, we assessed management as whether doctors provided correct or partially correct medication and/or referral. Management was assessed twice: following doctors' own diagnoses determined through questioning and physical examinations, and after enumerators provided doctors with the correct diagnosis.

Results

Doctors completed 26% of recommended and 39% of essential diagnostic questions and examinations; 21% of doctors arrived at a correct diagnosis. Rates of correct management were 44% following doctors' own diagnosis and 50% after being given the correct diagnosis. When we gave doctors the correct diagnosis and only asked them to provide a treatment, they prescribed 82% fewer potentially harmful medications than when they had provided their own (potentially incorrect) diagnosis.

Conclusions

The ability of village doctors to diagnose a textbook case of unstable angina is limited. Deficits in diagnostic competence led to low rates of correct management.

Background

Strong primary care systems are the foundation of high-quality, integrated healthcare systems and are vital in low- and middle-income countries (LMICs).¹ This is especially true in China, which,² like many other LMICs, faces high prevalence of both infectious and noncommunicable diseases (NCDs).³ This "dual burden" increases the necessity of a high-quality primary care system to efficiently and effectively triage and manage patients.

Over the past two decades, China has expanded coverage under public health insurance schemes and increased governmental investments in the public health system.^{2,4,5} More recently, China has focused on improving quality and efficiency, largely through strengthening the primary care system.⁵⁻⁷ There is limited evidence, however, on the quality of primary care or its determinants in China's rural areas. While a few studies have examined care quality in certain regions of rural China,⁸⁻¹⁰ no nationally representative studies have done so. To inform their efforts, policy-makers need a more comprehensive understanding of primary care quality and the barriers to its improvement.

This study provides nationally representative evidence on the quality of care in China's rural areas. A random sample of doctors were administered clinical vignettes to assess their ability to properly diagnose and manage a case of unstable angina. In China, the burden of NCDs such as angina has been increasing rapidly due to changing lifestyles and population aging.³ NCDs caused more than 9.2 million premature deaths in 2016.^{3,11} A 2013 nationally representative survey found a total diabetes prevalence of 11%, with more than 60% of cases unaware they had diabetes.¹² In rural areas, 71% of persons with diabetes were unaware, and only 25% were receiving treatment. To address the NCD health burden, primary care providers must be able to correctly diagnose and manage afflicted patients.

To assess their competence, we presented doctors with a hypothetical disease case in the form of a standardized clinical vignette. We used quantitative data collected from the vignette to assess rural village doctors' competence, defined in this study as doctors' diagnostic process quality, correct diagnosis, and correct management of a presumptive case of unstable angina.¹³

Methods

Sample and Participants

Data were collected as part of the 2016 wave of the China Rural Development Survey (CRDS), a national survey of rural households and infrastructure conducted by the Chinese Academy of Sciences and Peking University. The survey's sample includes 101 villages from 25 rural counties across Shaanxi, Sichuan, Jiangsu, Hebei, and Jilin provinces, which represent each of China's major agricultural and ecological zones. Within each province, counties were divided into five strata based on per capita income, and one county was randomly selected each stratum.¹⁴ Two townships were then randomly selected from each county, and two villages were selected from each township, for a total of 50 townships and 101 villages (one village split into two during the study). In villages with three or fewer clinics, all clinics were surveyed. If the village contained more than three clinics, three clinics were randomly selected for inclusion in the survey. All doctors working within selected clinic were surveyed. The final sample included a total of 151 doctors across 115 clinics (Fig. 1).

Surveys and Vignettes

Village Doctor and Facility Surveys

We administered both doctor and facility surveys (Table 1) in the selected clinics. Doctor surveys collected doctors' age, gender, years of experience, highest general and medical education level attained, qualifications, and salary. Facility surveys collected information on the annual revenue, number of doctors employed, patient volume, stock of medicines, presence of medical instruments (including those relevant for the disease case – electrocardiographs (ECGs), stethoscopes, sphygmomanometers, and thermometers), and other characteristics.

Table 1
Village Clinician Characteristics (N = 151)

| | Mean | SD | Min | Max |
|---|-------|-------|-------|--------|
| Age of village clinician (years) | 49.55 | 11.09 | 27.00 | 76.00 |
| Male (yes = 1) | 0.75 | – | – | – |
| Practicing experience (years) | 27.87 | 12.68 | 2.00 | 54.00 |
| Highest general education | | | | |
| Junior high school or less | 0.15 | – | – | – |
| Academic/vocational high school | 0.67 | – | – | – |
| Junior College degree or higher | 0.19 | – | – | – |
| Highest medical education | | | | |
| No medical education | 0.20 | – | – | – |
| Vocational medical high school | 0.62 | – | – | – |
| Junior medical college or higher | 0.18 | – | – | – |
| Type of medical education (conditional on having medical education) | | | | |
| Chinese | 0.07 | – | – | – |
| Western | 0.48 | – | – | – |
| Chinese and Western | 0.44 | – | – | – |
| Public health | 0.02 | – | – | – |
| Medical qualification | | | | |
| No formal qualification | 0.06 | – | – | – |
| Village doctor qualification ¹ | 0.65 | – | – | – |
| Associate medical practitioner | 0.19 | – | – | – |
| Medical practitioner | 0.11 | – | – | – |
| Receives basic wage from the government (yes = 1) | 0.23 | – | – | – |
| Total annual income (yuan) | 23247 | 14236 | 0 | 100000 |

Note:

¹ Village clinician qualification is not a regular certification for clinicians. Clinicians with village clinician qualification are permitted by local health authorities to work only in village clinics.

| | Mean | SD | Min | Max |
|--|------|------|------|------|
| Weekly working days | 6.26 | 1.74 | 0.00 | 7.00 |
| Note: | | | | |
| ¹ Village clinician qualification is not a regular certification for clinicians. Clinicians with village clinician qualification are permitted by local health authorities to work only in village clinics. | | | | |

Standardized Clinical Vignettes

We used standardized clinical vignettes to measure doctors' ability to correctly diagnose and manage a patient presenting with a presumptive case of unstable angina. Unstable angina was chosen as the test case for three reasons. First, heart disease comprises an increasing proportion of China's disease burden in rural as well as urban areas.¹⁵ Second, while diagnosis is not particularly complex, it requires adequate competence of subtleties of the disease presentation. Third, correct management of the disease - ultimately the most important outcome - is still possible without a specific diagnosis if providers recognize the need for higher-level care and triage appropriately. With the assistance of cardiologists from the Medical School of Peking University, we adapted the vignette script to the Chinese context from earlier studies in India.¹⁶ This script, provided in the supplementary material, includes disease symptoms, medical history, and patient background.

During the survey, two enumerators presented the vignette to doctors. One enumerator assumed the role of the "mock patient" and the other "facilitator" stated instructions to the doctor, documented the interaction, and provided additional information that the patient might not know but that the doctor would determine if she/he actively solicited it, such as the results of tests or examinations. To begin the vignette, the facilitator informed the doctor that a 45-year-old male patient was visiting the clinic. The mock patient then told the doctor about his problem with an opening statement ("Doctor, I've had chest pains recently") (Supplemental text A5). Doctors were then asked to proceed as they would with a real patient and were told that the patient would answer any questions asked and comply with any instructions given. During the interaction, the facilitator documented the doctor's questions, diagnostic examination requests, stated diagnosis, treatment prescribed (drugs or patient education/instructions), and whether the provider referred the patient to another provider.

Doctors choose management strategies based on both their diagnostic and therapeutic competence. To determine how deficits in diagnostic competence or in competence of appropriate treatment of angina patients are independently contributing to mismanagement, following the completion of the initial vignette, doctors were asked directly to state how they would manage a patient with unstable angina. Facilitators then documented the treatment prescribed (drugs or patient education/instructions), and whether the provider referred the patient to another provider.

Quality Measures

We evaluated the doctors' competence on three domains of the clinical encounter: diagnostic process quality, diagnosis given, and case management.

We assessed diagnostic process quality by documenting the questions that doctors asked and the physical examinations they conducted in comparison with standard checklists stated in the Chinese national practice guidelines.¹⁷ For patients who present stating typical symptoms of unstable angina, these checklists contain 16 "recommended" and seven "essential" questions that doctors should ask, along with six "recommended" and two "essential" physical examinations that doctors should perform to make proper diagnoses (Supplemental Table A1 and Table A2). We scored the number and percentage of recommended and essential questions that doctors asked, along with the number and percentage of recommended and essential physical examinations that doctors performed.

We categorized diagnoses as correct if they named unstable angina, angina, or acute coronary syndrome; partially correct if they named coronary artery disease, cardiovascular disease, or a number of other cardiac ailments; or incorrect if the doctor made no mention of the correct or partially correct diagnoses (Supplemental Table A3). If the doctor did not provide any diagnosis, the vignette patient was instructed to ask for a diagnosis at the end of the interaction.

We categorized case management as "correct" if (a) the doctor did not prescribe any potentially harmful medication, which we defined operationally as an antibiotic, hormone, or analgesic, and (b) the doctor prescribed a correct medication or referred the patient to an upper level provider. We considered case management "partially correct" if the doctor (a) did prescribe an antibiotic, hormone, or analgesic, which again are potentially harmful but also (b) prescribed a right medication or referred the patient or prescribed (Supplemental Table A4). We considered case management "incorrect" if the doctor made no mention of a correct or partially correct item just named, and "potentially harmful" if the doctor prescribed any antibiotics, hormones, or analgesics.

Statistical Methods

We analyzed the quality measures in Stata (version 14.1) and report the mean in the full sample as well as standard deviations for continuous variables.

Results

Village Doctor Characteristics

Participating doctors had low levels of both general and medical education (Table 1). While 19% had a junior college degree or higher, 67% had completed only academic or vocational high school and 15% had only junior high school level or below. Similarly, while 18% had completed junior medical college or higher, 62% had completed vocational medical high school, and 20% had no medical education. Most were trained in Western medicine (48%) or a combination of Chinese and Western medicine (44%). About 11%

had the highest “Medical Practitioner” qualification, while 65% had the lowest “Village Doctor” qualification.

Clinic Characteristics

We surveyed doctors in 115 total clinics across the five sample provinces (Table 2). Around two doctors staffed each clinic, supported by one to two non-clinical staff. Clinics had a mean volume of 5,431 patients per year (around 14.8 patients per day). Clinics held an average of 194 different varieties of medicine within their inventories including 110 varieties of Western medicine and 37 varieties of Chinese medicine. Notably, some clinics only held either Western medicine or Chinese medicine. Of the four medical instruments needed for the standard recommended examinations used to diagnose unstable angina – electrocardiographs (ECGs), stethoscopes, sphygmomanometers, and thermometers – nearly every clinic had stethoscopes, sphygmomanometers, and thermometers, but only 19% had access to ECGs on site.

Table 2
Clinic Characteristics (N = 115)

| | Mean | SD | Min | Max |
|--|-------|-------|-------|--------|
| Annual net revenue (yuan) | 45175 | 43786 | -3460 | 198583 |
| Number of village doctors | 1.94 | 1.56 | 0.00 | 7.00 |
| Number of other health workers (non-clinicians) | 0.24 | 0.75 | 0.00 | 5.00 |
| Annual patient volume (visits) | 5431 | 11270 | 100 | 90000 |
| Varieties of medicine in inventory ¹ | 193.9 | 169.0 | 15 | 1020 |
| Varieties of western medicine (number) | 109.7 | 89.2 | 0 | 500 |
| Varieties of Chinese patent medicine (number) | 36.8 | 38.4 | 0 | 250 |
| Total value of medical instruments in clinic (yuan) | 15139 | 26436 | 500 | 300000 |
| Presence of medical instruments that might be used to diagnose unstable angina (Proportion) | | | | |
| Electrocardiograph | 0.19 | – | – | – |
| Stethoscope | 1.00 | – | – | – |
| Sphygmomanometer | 1.00 | – | – | – |
| Thermometer | 0.99 | – | – | – |
| Population in village clinician's catchment area for public health services (people) | 1809 | 1581 | 0 | 7900 |
| Note: | | | | |
| ¹ The number of varieties of medicine in inventory is more than the sum of varieties of western medicine and Chinese patent medicine because there were Chinese herbal medicines in some clinics. | | | | |

Village Doctor Competence

Diagnostic Questions and Examinations

On average, doctors completed only 26% of the full recommended checklist, including an average of 25% of recommended questions and 27% of recommended examinations. Doctors completed 39% of the smaller subset of essential questions and examinations items, including an average of 33% of the essential questions, and 77% of providers recommended or completed the single essential exam (ECG).

Although the average is low, we do find substantial variation across providers in checklist completion. For instance, while 60 out of 151 (40%) of providers completed less than 20% of checklist items, 38 (25%)

completed more than 30%. The inter-quartile range (IQR) is 17 percentage points for all recommended checklist items and 25 percentage points for essential items.

Table 3

Village Doctors' Competence in Process Quality, Diagnosis, and Management of Unstable Angina in Rural China

| | Mean | SD | Min | Max | IQR |
|---|------|------|------|-------|------|
| Number of doctors | 151 | | | | |
| Questions and Exams | | | | | |
| Questions | | | | | |
| 1. Number of questions asked in total | 7.85 | 4.41 | 1.00 | 23.00 | 7.00 |
| Recommended questions (16 in total) | | | | | |
| 2. Number of recommended questions asked | 4.05 | 2.37 | 0.00 | 12.00 | 4.00 |
| 3. Proportion of recommended questions asked | 0.25 | 0.15 | 0.00 | 0.75 | 0.25 |
| Essential questions (7 in total) | | | | | |
| 4. Number of essential questions asked | 2.33 | 1.60 | 0.00 | 7.00 | 2.00 |
| 5. Proportion of essential questions asked | 0.33 | 0.23 | 0.00 | 1.00 | 0.29 |
| Exams | | | | | |
| 6. Number of exams performed in total | 3.20 | 2.03 | 0.00 | 10.00 | 2.00 |
| Recommended exams (6 in total) | | | | | |
| 7. Number of recommended exams performed | 1.61 | 1.03 | 0.00 | 5.00 | 1.00 |
| 8. Proportion of recommended exams performed | 0.27 | 0.17 | 0.00 | 0.83 | 0.17 |
| Essential exams (1 in total) | | | | | |
| 9. Number of essential exams performed | 0.77 | 0.42 | 0.00 | 1.00 | 0.00 |
| 10. Proportion of essential exams performed | 0.77 | 0.42 | 0.00 | 1.00 | 0.00 |
| Questions & Exams | | | | | |
| Recommended questions & exams (22 in total) | | | | | |
| 11. Number of recommended questions asked and recommended exams performed | 5.66 | 2.87 | 1.00 | 13.00 | 4.00 |
| 12. Proportion of recommended questions asked and exams performed | 0.26 | 0.13 | 0.05 | 0.59 | 0.17 |
| Essential questions & exams (8 in total) | | | | | |
| 13. Number of essential questions asked and essential exams performed | 3.10 | 1.71 | 0.00 | 8.00 | 2.00 |

| | Mean | SD | Min | Max | IQR |
|---|------|------|------|------|------|
| 14. Proportion of essential questions asked and exams performed | 0.39 | 0.21 | 0.00 | 1.00 | 0.25 |
| Diagnosis | | | | | |
| 15. Provided a diagnosis | 0.87 | -- | -- | -- | -- |
| 16. Correct diagnosis | 0.21 | -- | -- | -- | -- |
| 17. Partially correct diagnosis | 0.36 | -- | -- | -- | -- |
| 18. Wrong diagnosis | 0.31 | -- | -- | -- | -- |

Diagnosis

All doctors either gave a diagnosis to the patient at the end of the vignette or were asked for one, but most diagnoses were inaccurate. As seen in Table 3 (Row 16), only 21% of doctors correctly diagnosed the patient with unstable angina, angina, or acute coronary syndromes. The remainder either gave a partially correct diagnosis (36%), which included mentions of cardiovascular or cardiac heart disease, heart problems, cardiac insufficiency, myocardial infarction, or myocardial ischemia; gave a wrong diagnosis (31%); or were unable to give any diagnosis (13%).

Management

Despite low rates of correct diagnosis, correct management of patients was higher as doctors may correctly refer patients even if they are unable to make a correct diagnosis (Table 4, Panel A). Following the doctor's own diagnosis (i.e. the possibly incorrect diagnosis arrived at by the doctor following questioning and examinations), 44% correctly managed the case, while 22% provided partially correct management and the remaining 34% incorrectly managed the case.

Table 4
Village Doctor Management of Unstable Angina

| | Mean | SD | Min | Max | IQR |
|---|------------------|------|------|------|------|
| Number of clinicians | 149 ¹ | | | | |
| A. Management (After Clinician's Own Diagnosis) | | | | | |
| By management | | | | | |
| 1. Correct management | 0.44 | -- | -- | -- | -- |
| Referral with no drugs | 0.40 | -- | -- | -- | -- |
| Referral with correct drugs only | 0.04 | -- | -- | -- | -- |
| 2. Partially correct management | 0.22 | -- | -- | -- | -- |
| No referral with correct drugs | 0.06 | -- | -- | -- | -- |
| Referral with any potentially harmful drugs | 0.07 | -- | -- | -- | -- |
| Referral with unnecessary drugs | 0.09 | -- | -- | -- | -- |
| 3. Incorrect management | 0.34 | -- | -- | -- | -- |
| No referral with no drugs | 0.06 | -- | -- | -- | -- |
| No referral with any potentially harmful drugs | 0.12 | -- | -- | -- | -- |
| No referral with unnecessary drugs | 0.16 | -- | -- | -- | -- |
| By components | | | | | |
| 4. Referral | 0.60 | -- | -- | -- | -- |
| 5. Gave any medications | 0.54 | -- | -- | -- | -- |
| Number of drugs prescribed | 2.51 | 1.42 | 1.00 | 8.00 | 1.00 |
| Correct medication ² | 0.19 | -- | -- | -- | -- |

Note:

¹ Two clinicians were excluded: one misses medication data and the other clinician only prescribes traditional Chinese medicine.

² Correct medication refers to prescribing one of the following: 1) Antiplatelet drugs, 2) Nitrate esters, 3) Statins, 4) β -blockers, 5) Angiotensin converting enzyme, and 6) Angiotensin converting enzyme inhibitors

³ A clinician may prescribe more than one of the three potentially harmful medicines (antibiotics, hormone, or analgesic) in one prescription.

| | Mean | SD | Min | Max | IQR |
|--|------|------|------|------|------|
| Potentially harmful medication ³ | 0.35 | -- | -- | -- | -- |
| Antibiotics prescribed | 0.19 | -- | -- | -- | -- |
| Hormone prescribed | 0.02 | -- | -- | -- | -- |
| Analgesic prescribed | 0.19 | -- | -- | -- | -- |
| B. Management (After True Diagnosis Given) | | | | | |
| By management | | | | | |
| 6. Correct management | 0.50 | -- | -- | -- | -- |
| Referral with no drugs | 0.41 | -- | -- | -- | -- |
| Referral with correct drugs only | 0.09 | -- | -- | -- | -- |
| 7. Partially correct management | 0.36 | -- | -- | -- | -- |
| No referral with correct drugs | 0.20 | -- | -- | -- | -- |
| Referral with any potentially harmful drug | 0.01 | -- | -- | -- | -- |
| Referral with unnecessary drugs | 0.15 | -- | -- | -- | -- |
| 8. Incorrect management | 0.14 | -- | -- | -- | -- |
| No referral with no drugs | 0.02 | -- | -- | -- | -- |
| No referral with any potentially harmful drugs | 0.02 | -- | -- | -- | -- |
| No referral with unnecessary drugs | 0.10 | -- | -- | -- | -- |
| By components | | | | | |
| 9. Referral | 0.67 | -- | -- | -- | -- |
| 10. Gave any medications | 0.57 | -- | -- | -- | -- |
| Number of drugs prescribed | 2.01 | 1.17 | 1.00 | 6.00 | 2.00 |

Note:

¹ Two clinicians were excluded: one misses medication data and the other clinician only prescribes traditional Chinese medicine.

² Correct medication refers to prescribing one of the following: 1) Antiplatelet drugs, 2) Nitrate esters, 3) Statins, 4) β -blockers, 5) Angiotensin converting enzyme, and 6) Angiotensin converting enzyme inhibitors

³ A clinician may prescribe more than one of the three potentially harmful medicines (antibiotics, hormone, or analgesic) in one prescription.

| | Mean | SD | Min | Max | IQR |
|---|------|----|-----|-----|-----|
| Correct medication ² | 0.51 | -- | -- | -- | -- |
| Potentially harmful medication ³ | 0.06 | -- | -- | -- | -- |
| Antibiotics prescribed | 0.04 | -- | -- | -- | -- |
| Hormone prescribed | 0.00 | -- | -- | -- | -- |
| Analgesic prescribed | 0.04 | -- | -- | -- | -- |
| Note: | | | | | |
| ¹ Two clinicians were excluded: one misses medication data and the other clinician only prescribes traditional Chinese medicine. | | | | | |
| ² Correct medication refers to prescribing one of the following: 1) Antiplatelet drugs, 2) Nitrate esters, 3) Statins, 4) β -blockers, 5) Angiotensin converting enzyme, and 6) Angiotensin converting enzyme inhibitors | | | | | |
| ³ A clinician may prescribe more than one of the three potentially harmful medicines (antibiotics, hormone, or analgesic) in one prescription. | | | | | |

Examining the management components individually, doctors referred the case to upper level facilities 60% of the time. Doctors prescribed drugs 54% of the time. Only 19% of drug prescriptions included drugs deemed appropriate for a patient with unstable angina and 35% included drugs deemed potentially harmful (antibiotics, hormones, or analgesics).

Doctors chose these management strategies based on both their diagnostic and therapeutic competence. To determine how deficits in diagnostic competence or in competence of appropriate treatment of angina patients are independently contributing to mismanagement, doctors were asked directly to state how they would manage a patient with unstable angina. The results of this “treatment-only vignette” are shown in panel B of Table 4. Compared to management following the doctor’s own diagnosis (panel A), rates of correct management when doctors were given the correct diagnosis were 6 percentage points higher (Row 6, 50%), partially correct management was 14 percentage points higher (Row 7, 36%) and incorrect management was 20 percentage points lower (Row 8, 14%). This increase was not primarily due to increased rates of referral, but rather to changes in drugs prescriptions. While only 19% of doctors gave correct medication based on their own diagnosis, 51% gave correct medication when told the correct diagnosis of unstable angina. There was also a significant reduction in prescription of potentially harmful medications from 35–6%, a 83% reduction.

Discussion

Our study indicates that village doctors in rural China have limited ability to correctly diagnose, treat, and manage unstable angina. On average, doctors asked and performed 26% of the recommended questions

and examinations and 39% of the questions and examinations deemed essential for correct diagnosis. Possibly due to this low adherence on diagnostic process, only 21% provided a correct diagnosis. Despite low rates of correct diagnosis, most providers indicated that they would refer patients to upper levels of care where patients are more likely to be correctly diagnosed and treated. While the proportion of cases ultimately correctly managed by doctors was higher than those correctly diagnosed our results suggest that 40% of patients presenting to village clinics with a textbook case of unstable angina would not be referred and 35% would be prescribed potentially harmful medication.

In a sense, diagnostic ability is only important because of how it contributes to better patient management. The fact that many more doctors indicated that they would refer than are able to make a correct diagnosis suggests that many doctors are aware of their lack of diagnostic skill and compensate by referring patients. This compensation is only partial, however. Although the case of angina studied here should always be referred, this may not be needed for patients with other symptoms and over-referral of such patients imposes unnecessary costs on the health system and patients. Possibly more important, we found that resolving diagnostic uncertainty by telling doctors the correct diagnosis of unstable angina led to a significant increase in correct drug prescription and reduction in the prescription of potentially harmful drugs, despite having little effect on referral rates. It is unclear why this occurs in hypothetical vignettes, but one hypothesis is that village providers are accustomed to providing some prescription for patients. Previous studies in China have shown high rates of over-prescription generally,¹⁸ possibly due to real or perceived patient demand or financial incentives due to drug sales, as this is a major source of revenue for providers.¹⁹ Given that providers face incentives to prescribe drugs, improving doctors' diagnostic ability may be important to avoid unnecessary and/or harmful treatment – independently of whether patients are referred and ultimately correctly diagnosed and treated.

The low level of competence that we found is consistent with findings of regional studies with comparable methodology performed in China and elsewhere.^{20–22} Deficits in competence as measured with vignettes are particularly concerning as the care that patients actually receive are most likely worse. Studies have consistently shown large 'know-do' gaps, or provider underperformance relative to their competence of appropriate care.^{8,20,22,23} Although know-do gaps may be due to other factors such as lack of access to equipment or medication, prior studies consistently indicate that weak or misaligned incentives facing providers is a primary cause as significant gaps exist even in well-stocked settings.²⁴

China's difficulty in recruiting primary providers for rural areas may contribute to low provider performance. Public sector salaries are insufficient to attract highly-trained and skilled providers to serve in rural areas. More than three quarters of doctors in our sample had less than post-secondary general education and over 20% had no medical education of any kind. Although local governments have recently increased subsidies to rural providers, the compensation offered by these programs remains too low to incentivize highly-skilled doctors to locate in rural areas.²⁵

Strengths and Limitations

To our knowledge, this study is the first nationally representative assessment of rural doctor competence and care quality in China. One limitation is that providers' ability to diagnose and treat unstable angina may not be representative of other conditions. Second, the cost of surveying providers across a wide geographic area constrained our sample size and consequently the precision of our estimates. Third, our study assessed doctors' competence in response to a vignette without additional assessment of doctors' actual practice. A provider's competence as measured in vignettes acts as the upper bound on how providers may perform in treating actual patients. Providers are restricted by their competence and skills and, aside from guessing correctly, cannot perform better than what their training allows. As mentioned, previous studies have documented how the competence know-do gap contributes to the provision of low quality care in developing settings.²²

Policy Implications

Our study affirms the importance of improving the quality of care in China's rural areas. It suggests that although China has increased healthcare utilization and expenditure in its rural regions, doctor competence is still inadequate to address the patient needs.

China could improve the quality of its rural primary care by recruiting more highly qualified providers to serve in rural areas or by improving the performance of existing providers. Policy efforts along these lines are underway.²⁶ Recruiting or subsidizing providers for rural areas may prove costly, however, if providers require substantial compensation to live outside of urban areas. A more feasible option may be programs requiring a period of rural service in return for public educational subsidies.²⁷ Interventions to improve existing providers' competence may include training programs. A recent randomized trial in India, for instance, found that a multi-topic training for informal providers increased rates of correct case management by 8%.²⁸ Nevertheless, training alone is unlikely to substantially improve provider performance.²⁹ More effective strategies combine training with other approaches such as supervision and other management techniques.²⁹ As China upgrades its digital infrastructure, mobile technologies and diagnostic machines may enable access to urban providers or provide diagnostic and management support to rural doctors.³⁰

Conclusions

Using a nationally representative sample of village doctors, this study shows that rural providers have low levels of competence to diagnose and manage patients presenting with symptoms of angina. Although China has expanded rural primary care access, quality deficits remain. Further research is needed to identify cost-effective policy interventions to improve quality of care in rural China.

Abbreviations

LMIC

low- and middle-income country

NCD
noncommunicable disease
CRDS
the China Rural Development Survey
ECGs
electrocardiograph

Declarations

Ethics approval and consent to participate

Institutional Review Board approval was obtained during the primary data collection process through Stanford University. Institutional Review Board exemption was obtained at the University of North Carolina at Chapel Hill for this study.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Role of the funding source

The funder had no role in study design, data collection, and analysis, decision to publish, or preparation of the manuscript. of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Data Sharing

The dataset used during the current study are available from the corresponding author on reasonable request.

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Authors' Contributions

WG, XZ and HY had full access to all of the data in the study and takes responsibility for the integrity and the accuracy of the analysis. HY and SS designed the study. HY and XZ collected the data. WG, XZ, and YC cleaned and analyzed the data under the guidance of SS, KU, and HY. WG drafted the manuscript. SS, HY and WG interpreted the data. KU and SS made critical revisions on the manuscript. All authors read and authorized the final manuscript before submission.

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Not applicable

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Figures

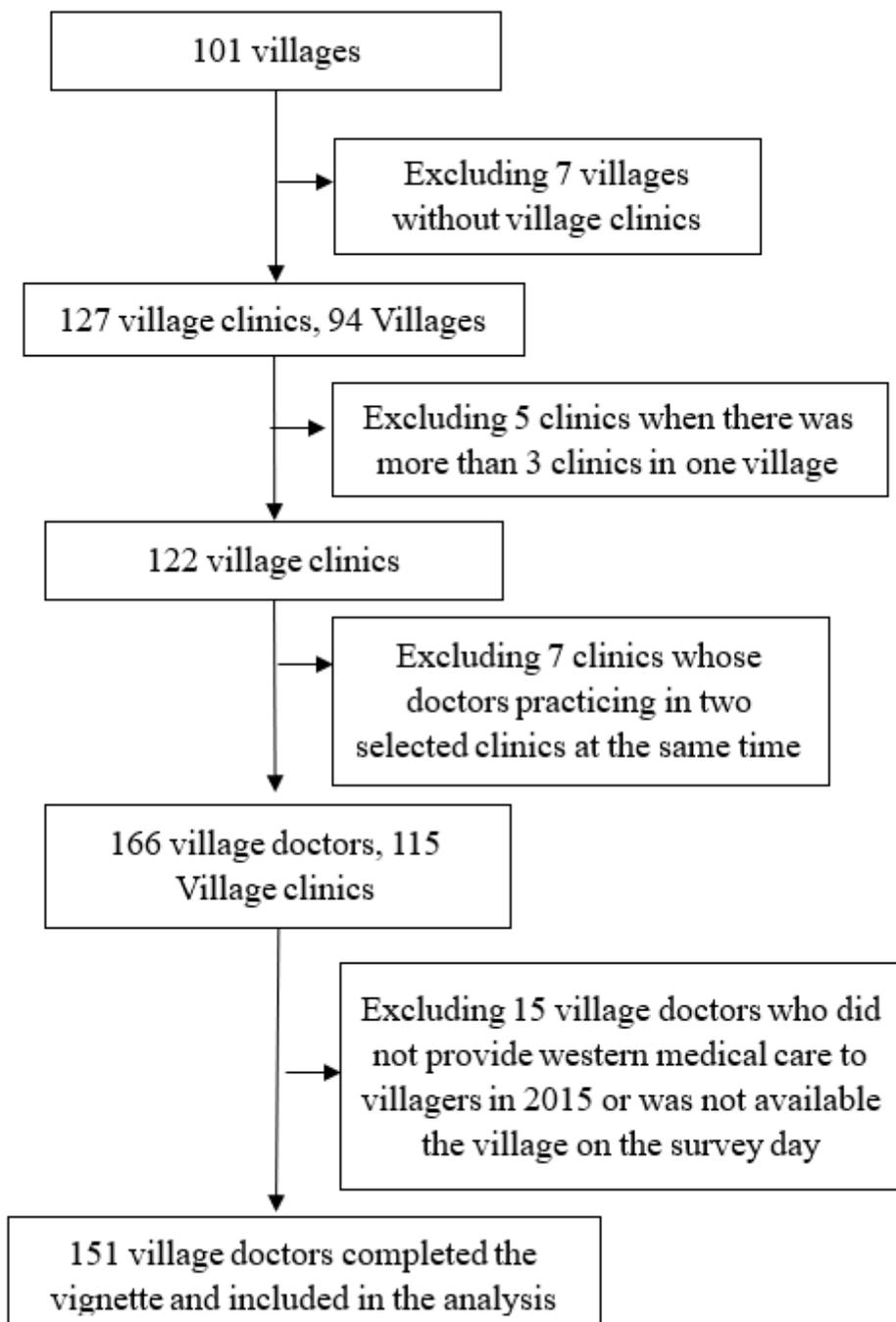


Figure 1

Selection of Village Doctors

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