

Review Article

Atrial Fibrillation Management of Rural Elderly Patients in China: Current Realities and Emerging Challenges

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Abstract

Background: Rural China experiences a disproportionately high burden of atrial fibrillation (AF) among the elderly, facing three major challenges in AF management: (1) inequitable distribution of medical resources, (2) limited access to healthcare, and (3) significant variability in clinical competency among village doctors. **Objective:** To evaluate current realities, systemic challenges, and evidence-based solutions for AF management in rural elderly populations, focusing on village doctors' roles and telemedicine integration. **Method:** A narrative review was conducted using PubMed, CNKI, and Wanfang Data (2000-2025), focusing on studies related to AF management, rural healthcare, and village doctors in China. Evidence was synthesized from epidemiological surveys, policy analyses, and intervention trials, including the MIRACLE-AF cluster-randomized trial which evaluated a telemedicine-assisted model involving remote monitoring, specialist consultations, and village doctor education. **Result:** Rural China exhibits low AF detection rates (4.3% in high-risk elderly) and suboptimal care due to limited resources, poor patient awareness, and significant knowledge gaps among village doctors (89.6% lacking formal medical training). The MIRACLE-AF trial demonstrated significant improvements in the intervention group: higher anticoagulation adherence (85.2% vs. 20.8%) and reduced annual cardiovascular event incidence (6.2% vs. 9.6%). Rural AF prevalence (5.4% in ≥ 75 -year-olds) correlates with aging, lifestyle factors, and healthcare disparities. Persistent urban-rural gaps exist in AF awareness (78.3% vs. 35.3%) and risk factor control. **Conclusion:** Enhancing village doctors' capabilities through telemedicine-supported training, coupled with policy reforms and infrastructure investment, is essential for equitable AF management. Integrating digital health platforms with traditional care offers a feasible approach to reduce rural-urban disparities, improve outcomes, and establish sustainable chronic disease management in resource-limited settings.

Keywords

Atrial Fibrillation, Rural Elderly, Village Doctors, Chronic Disease Management, Telemedicine

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1. Introduction

Atrial fibrillation (AF), the most prevalent sustained cardiac arrhythmia worldwide, imposes a substantial burden on healthcare systems—particularly in developing countries undergoing an epidemiological transition from infectious diseases to non-communicable conditions [1, 2]. In China, AF prevalence continues to rise, disproportionately affecting elderly populations in rural areas [3, 4]. However, rural areas confront three major AF management challenges: (1) inequitable medical resource distribution, (2) restricted healthcare access, and (3) highly variable clinical competency among village doctors.

2. Search Strategy and Selection Criteria

References for this Review were identified through searches of PubMed, CNKI, and Wanfang Data with the search terms “rural elderly China”, “atrial fibrillation management”, “AF screening”, “Age-related AF” and “health policy rural China” from January, 2000 until May, 2025. Articles were also identified through searches of the authors’ own files. Only papers published in English or Chinese were reviewed. The final reference list was generated based on originality and relevance to the broad scope of this Review, prioritizing studies conducted in mainland China. Case reports, editorials, and studies lacking primary outcome data were excluded.

This review systematically examines the current status, the

challenges, and potential solutions to AF management in rural elderly populations, focusing on the critical role of village doctors as frontline healthcare providers. We conduct an in-depth analysis of the obstacles posed by scarce medical resources, low detection rates, and suboptimal treatment outcomes, while proposing multidimensional strategies to enhance healthcare delivery for this underserved population.

3. Epidemiological Characteristics of AF in Rural China

China's demographic transition, marked by rising life expectancy and falling fertility rates, has led to rapid population aging. As of the 2020 National Population Census (Figure 1A), 17.2% of rural residents were aged ≥65 years - significantly higher than the 10.6% urban prevalence of elderly individuals [5]. This urban-rural disparity persists across healthcare indicators [6].

The age-stratified AF prevalence demonstrates a consistent male predominance across all age groups (Figure 1C): 0.8% (male) versus 0.6% (female) aged 45-54 years, progressively increasing to 1.6% vs 1.4% (55-64 years), 3.4% vs 2.4% (65-74 years), and 5.4% vs 4.9% (≥75 years) [4]. Numerous studies have consistently documented higher AF prevalence in rural versus urban China [3, 4, 7].

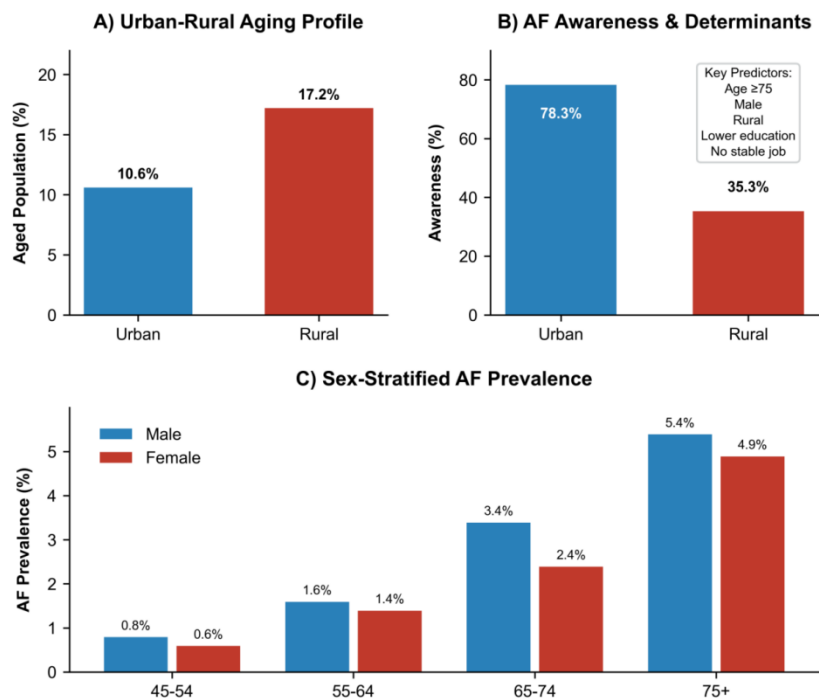


Figure 1. AF Epidemiological Characteristics Analysis.

Figure 1A Urban-Rural Aging Profile: China's aging population (≥ 65 years) reaches 13.5%, with rural areas (17.2%) experiencing significantly higher aging rates than urban regions (10.6%), reflecting healthcare and socioeconomic disparities. [5]

Figure 1B AF Awareness & Determinants: Urban AF awareness (78.3%) far exceeds rural levels (35.3%), with key predictors of low awareness being older age (≥ 75 years), male gender, rural residency, lower education, and unstable employment status. [3, 4, 7].

Figure 1C Sex-Stratified AF Prevalence: AF prevalence rises sharply with age, showing male predominance (45-54 yrs: 0.8% vs. 0.6%; 55-64 yrs: 1.6% vs. 1.4%; 65-74 yrs: 3.4% vs. 2.4%; ≥ 75 yrs: 5.4% vs. 4.9%), with rural rates exceeding urban levels (4.3% in ≥ 65 -year-olds, 7.1% in ≥ 75 -year-olds) due to aging demographics and healthcare gaps. [4, 8-10].

The Jiangsu Rural Community AF Screening Project, the largest epidemiological study of AF in rural China to date, revealed this population to be particularly vulnerable due to several factors: (a) Educational disadvantage - Among the 810 participants with AF, 91.1% had not completed middle or high school, with 51.5% lacking even primary school education. Additionally, 94.8% of the participants with AF did not own a mobile phone or had non-smartphone devices, and half of the smartphones in use were being utilized as if they were non-smartphones; (b) Limited social security coverage - Nearly half (48%) of the AF patients lacked retirement pensions and relied entirely on family support for their livelihood; (c) Poor chronic disease management - Only 17.6% of hypertensive patients maintained a resting blood pressure below 140/90 mmHg, and merely 6.0% of diabetic patients achieved fasting glucose levels ≤ 6.1 mmol/L; (d) Inadequate family support - Only 8.1% of AF patients co-resided with adult children. The study documented an age-dependent increase in AF prevalence from 4.3% among residents aged ≥ 65 years to 7.1% in those over 75 years [8].

The elevated rural AF prevalence shows strong correlations with three factors: (1) accelerated population aging, (2) lifestyle modifications (notably physical inactivity and high-sodium diets), and (3) limited medical resource access [9, 10]. AF awareness decreased with age and was significantly lower in rural residents (35.3% vs. 78.3%; $p < 0.001$) compared to urban residents (Figure 1B). Independent predictors of AF unawareness were advanced age (≥ 75 years), male gender, rural residence, lower educational attainment, and unemployment, while AF awareness was associated with a history of stroke [4].

Notably, rural AF patients consistently exhibit higher CHA₂DS₂-VASc scores, indicating substantially increased risk of thromboembolic events [11, 12]. This scoring system comprehensively evaluates key risk factors including age, sex, hypertension, diabetes, heart failure, and history of stroke or transient ischemic attack, serving as an essential tool for predicting thrombotic risk in AF patients. Despite

these elevated risk profiles, AF detection rates in rural areas remain markedly lower than urban counterparts, primarily attributable to rural elderly's limited awareness of AF symptoms, suboptimal healthcare-seeking behaviors, and diagnostic infrastructure limitations at primary care facilities. This urban-rural disparity extends beyond mere detection rates, profoundly reflecting systemic deficiencies in overall AF management capabilities within rural healthcare systems, thereby underscoring the critical necessity for targeted interventions to enhance rural AF management capacity [13, 14].

4. Current Status of AF Management in Rural China

The current landscape of AF management in rural China presents severe challenges across detection, diagnosis, treatment, and long-term care. Structural, socioeconomic, and technological disparities underlie these systemic deficiencies.

4.1. Detection and Diagnostic Challenges

The healthcare delivery system in rural China has a three-tiered structure: village clinics, township central hospitals, and county hospitals. As the cornerstone of rural healthcare, village clinics provide preventative and primary care [15]. However, the detection rate of AF in the elderly rural population is extremely low, with only 4.3% of high-risk individuals being identified⁸. This troubling situation stems from multiple factors.

Rural elderly patients often lack awareness of AF symptoms and consequences, leading to reduced willingness to actively seek or adhere to treatment. Primary care institutions confront severe limitations in equipment (e.g., electrocardiogram (ECG) machines) and technical capabilities, compounded by critical shortages of specialized medical personnel, particularly in remote regions [16, 17]. Compounding these issues, the absence of specialized cardiology services in rural areas forces patients to undertake arduous journeys to county hospitals or urban medical centers, with many experiencing treatment delays due to mobility limitations or transportation difficulties [18, 19].

Moreover, village doctors—serving as the sole providers of medical services in these areas—historically have lower levels of education and non-standardized medical training (see Section 5.1), further hindering effective AF management [16, 17].

4.2. Treatment and Management Deficiencies

Treatment rates and management quality for AF in rural areas trail markedly behind urban standards. Only a small fraction of patients receives standardized oral anticoagulant (OAC) therapy and limited capacity for treatment monitoring [20-22]. While smartphone applications and mobile health

technologies have demonstrated significant potential for AF management in urban communities - as evidenced by the mAFA-II study (*Mobile Health Technology for Atrial Fibrillation Screening Using Photoplethysmography-Based Smart Devices: The HUAWEI Heart study*) which utilized photoplethysmography (PPG)-based smart devices for AF screening combined with mobile apps for subsequent management [23], substantially improving AF detection and treatment rates - this model encounters multiple implementation barriers in rural settings. Over 94% of rural elderly lack smartphones or use basic models, resulted in a pronounced "digital divide," presenting substantial obstacles to implementing smart device-based AF management models in rural settings [24]. This technological gap leaves rural patients with limited avenues for self-management or access to digital health resources.

Equally concerning is the inadequate management of AF-related risk factors such as hypertension and diabetes in rural areas. Despite their well-established roles as major AF risk factors, control rates for these conditions remain substantially lower in rural compared to urban areas, primarily due to constrained medical resources and poor patient adherence. This management deficiency further elevates cardiovascular risk among rural AF patients.

AF management in rural China urgently requires multidimensional strategies including enhanced training for primary care providers, public health campaigns, and context-sensitive integration of digital technologies - all essential for elevating AF treatment standards and quality of life for rural patients.

5. The Critical Role and Existing Limitations of Village Doctors

As the foundational component of China's rural healthcare system, village doctors occupy an irreplaceable position in AF management [16, 25]. Confronted with the dual challenges of scarce medical resources and insufficient professional healthcare personnel in rural areas, village doctors serve as the most accessible medical resource for rural elderly populations, especially serving as health guardians for residents in remote and transport-isolated regions. However, there is a significant disparity between the importance of village doctors in managing AF and their actual capabilities, with their potential being constrained by systemic and operational challenges.

5.1. The Pivotal Role of Village Doctors

In contrast to urban areas with specialized cardiology teams, rural regions rely overwhelmingly on village doctors for primary care. Beyond preliminary diagnosis, they perform critical functions such as health education, regular follow-ups, and complication monitoring [26-28]. For instance, structured interventions by village doctors have been shown

to improve medication adherence and reduce stroke incidence among AF patients [28]. Their deep community integration also enables culturally tailored health campaigns, raising awareness of AF symptoms and preventive measures.

Despite the theoretical promise of smart device-based models, rural implementation faces insurmountable hurdles, including low digital literacy and infrastructure gaps [24]. Consequently, village doctors remain the most viable bridge to equitable care in these underserved populations.

5.2. Capacity Gaps and Pathways for Improvement

Despite their vital role in rural AF management, village doctors' knowledge and skill levels require substantial improvement, with numerous deficiencies apparent in actual management practices.

Strikingly, 89.6% of village doctors lack formal medical training meeting primary college standards, while 75.4% receive ≤ 2 annual training sessions [15, 29]. Many village doctors lack specialized training in AF diagnosis and management, resulting in high rates of misdiagnosis and missed diagnoses, along with suboptimal treatment outcomes. Their knowledge of AF is often limited to outdated practices, with inadequate knowledge about modern diagnostic technologies and treatment methods.

Rural areas face constraints in medical facilities and technical capabilities, making it difficult to meet comprehensive AF management needs. Village doctors encounter numerous obstacles in obtaining necessary diagnostic equipment and treatment options, further restricting the quality of AF management. Additionally, as previously discussed, inherent limitations among rural elderly AF populations increase the difficulty of AF management by village doctors.

Addressing these gaps requires targeted interventions. Telemedicine platforms could empower village doctors through real-time specialist consultations and continuous education, while policy reforms—such as integrating AF management into performance metrics and subsidizing essential equipment—could incentivize quality improvement [25]. By strengthening both individual competencies and systemic support, rural China could transform village doctors into effective stewards of AF care.

6. Chinese Innovate AF Management in Rural Elderly Patients

Telemedicine offers a promising approach to address rural medical resource shortages and enhance the quality of AF management [30, 31]. Studies like the MIRACLE-AF trial (*Telemedicine-based integrated management of atrial fibrillation in village clinics: a cluster randomized trial*) have shown that telemedicine-assisted integrated care frameworks—combining remote monitoring, specialist consulta-

tions, and continuing medical education—can significantly improve village doctors' capabilities and patient care standards [32].

The MIRACLE-AF trial, a cluster-randomized controlled study involving 30 village clinics and 1,039 AF patients aged 65 and older in Jiangsu Province, with a 36-month follow-up, demonstrated the effectiveness of a village doctor-led, specialist-supported approach. This model not only improved detection and treatment rates, but also enhanced the quality of life for AF patients while exploring a sustainable and rep-

licable management framework for rural chronic diseases.

In the intervention group, village doctors used smart devices to upload patient data to a telemedicine platform (figure 2), which employed AI algorithms to generate preliminary diagnostic reports. These reports were reviewed online by specialists from tertiary hospitals, who provided feedback on treatment plans. This collaborative mechanism between village doctors, specialists and patients improved the standardization and timeliness of AF management.

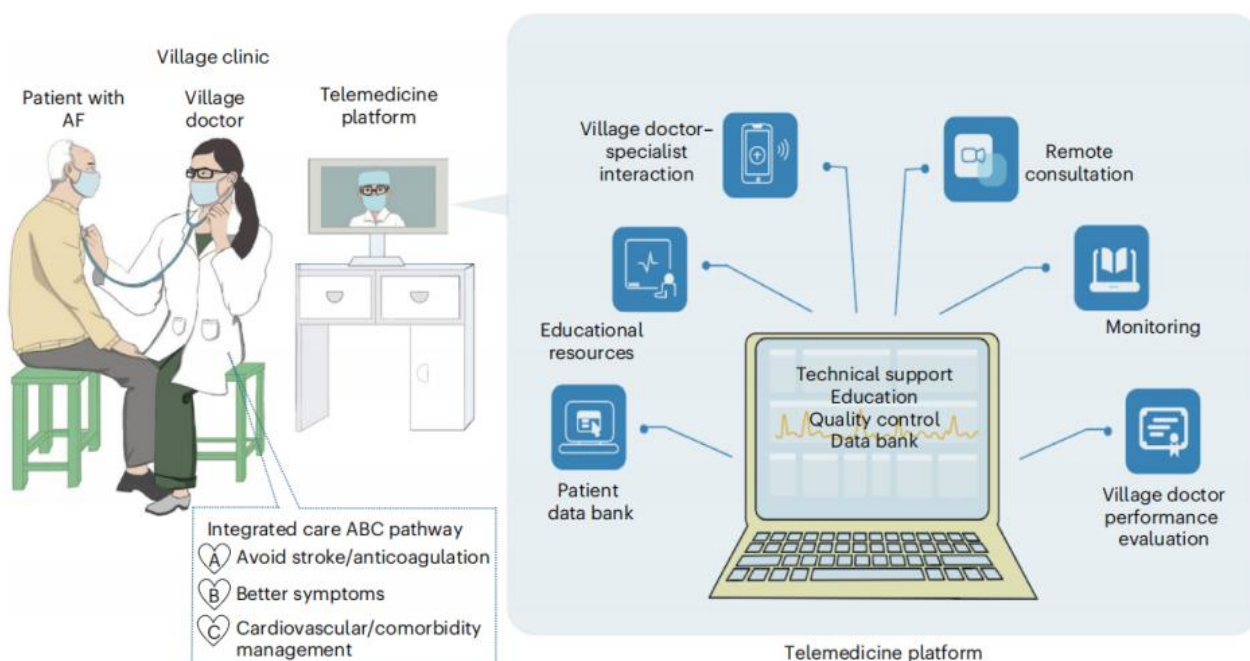


Figure 2. Illustration of the MIRACLE-AF platform.

The MIRACLE-AF telemedicine platform mainly offered the following: (1) technical support platform—realtime access to experts for consultation and support; (2) education platform—continuous education and training for village doctors; (3) quality control platform—monitoring the quality of care delivered, ensuring that village doctors adhere to evidence-based guidelines; and (4) data bank—a centralized data repository enabling more efficient patient tracking and management. Through this platform, the interaction between village doctors and AF specialists was strengthened, and the connection of patients with AF in rural areas to their village doctors was tightened. [32]

Notably, the telemedicine platform further operated as an integrated hub for capacity strengthening and quality assurance by incorporating multipurpose learning modules aligned with World Health Organization (WHO) guidelines on digital health workforce development [33]. This multifunctional platform empowered village doctors to obtain national AF protocol updates through curated digital content while enabling direct teleconsultation with specialists. Meanwhile,

dedicated quality assurance teams established continuous monitoring of evidence-based performance metrics, including adherence rates to ABC pathway (Anticoagulation therapy, Better symptom management, and Cardiovascular and comorbidity risk factor control) and achievement of therapeutic targets. Expert panels provided dynamic feedback loops to village doctors based on these quantifiable quality indicators. Government bodies established a composite assessment framework unifying these quality indicators, learning feedback dynamics, and longitudinal patient outcome data, thereby constructing a closed-loop system for continuous quality improvement that aligns with WHO's living guidelines methodology.

At 12 months, adherence to the ABC pathway increased significantly in the intervention group, with 33.1% of patients meeting all three criteria compared to 8.7% in the control group, with a group difference of 24.4% (95% confidence interval (CI), 18.3–30.5%; $p < 0.001$). Notably, a higher proportion of patients in the intervention arm (85.2%) than in the control arm (20.8%) met the 'A' criterion at 12

months (between-group difference, 64.4% (95% CI, 55.4–73.3%); $p < 0.001$).

Over 36 months, the intervention group (6.2% per year) showed a lower incidence of cardiovascular events, including cardiovascular mortality, stroke, and hospitalizations for heart failure or acute coronary syndrome than in the control group (9.6% per year; hazard ratio (HR), 0.64 (95% CI, 0.50–0.82), $p < 0.001$). Long-term adherence to the ABC pathway also remained significantly higher in the intervention group (41.8%) than in the control group (10.3%) at 36 months, with a group difference of 31.2% (95% CI, 22.4–39.9%; $p < 0.001$). These results underscore telemedicine's potential to overcome rural healthcare challenges and improve AF management.

In summary, the MIRACLE-AF trial highlights how telemedicine can transform rural AF care by empowering village doctors and integrating technology with traditional healthcare delivery. Future efforts should focus on policy support, technological integration, and community resource mobilization to establish comprehensive rural AF management systems that ensure equitable and high-quality care for elderly patients.

7. Limitations

While this review provides a comprehensive analysis of

AF management challenges in rural China, several limitations should be acknowledged. (1). Most cited studies (e.g., Jiangsu screening project) are region-specific, potentially limiting generalizability to other rural areas with distinct socioeconomic contexts. National-level longitudinal data are needed to validate these findings. (2). Although telemedicine shows promise, our review could not quantify infrastructure gaps (e.g., internet coverage in remote villages) or elderly patients' digital literacy—critical factors for implementation success. (3). Existing studies on training interventions (e.g., MIRACLE-AF trial) lack long-term follow-up, making it difficult to assess sustained competency improvement or patient outcome durability. These limitations highlight the need for mixed-methods research integrating quantitative health outcomes with qualitative insights from frontline providers and patients.

8. Conclusion

AF management for elderly populations in rural China faces prominent challenges. However, AF management efficiency can be significantly improved by enhancing village doctors' professional capabilities, promoting telemedicine collaboration models, and supplementing with policy support and infrastructure improvements.

Abbreviations

ABC Pathway	Anticoagulation Therapy, Better Symptom Management, Cardiovascular and Comorbidity Risk Factor Control
AF	Atrial Fibrillation
CHA ₂ DS ₂ -VASc	Cardiac Failure, Hypertension, Age ≥ 75 (2 points), Diabetes, Stroke (2 points), Vascular Disease, Age 65–74, Sex Category (Female)
CI	Confidence Interval
ECG	Electrocardiogram
HR	Hazard Ratio
mAFA-II study	Mobile Health Technology for Atrial Fibrillation Screening Using Photoplethysmography-Based Smart Devices: The HUAWEI Heart Study
MIRACLE-AF trial	Telemedicine-Based Integrated Management of Atrial Fibrillation in Village Clinics: a Cluster Randomized Trial
OAC	Oral Anticoagulant
PPG	Photoplethysmography
WHO	World Health Organization

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Li Zhang: Formal Analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing

Hongwu Chen: Conceptualization, Formal Analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing

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Conflicts of Interest

The authors report no relationships that could be construed as a conflict of interest.

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