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Awareness, perceptions, and willingness regarding internet-based home care services and associated factors among community nurses in China

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The provision of Internet-based home care (IHC) services by community nurses has emerged as a promising strategy to enhance healthcare accessibility and efficiency, but awareness, perceptions and willingness of them to implement IHC remain under-researched. This study aimed to assess community nurses' awareness, perceptions, and willingness to IHC services in China and identify its associated factors. From May to June 2023, we conducted a convenience sampling survey of 161 eligible nurses from nine hospitals in Nanchong, Southwest China. Data were analyzed using descriptive statistics, Mann-Whitney U Test or Kruskal-Wallis H Test, and ordinal multiple logistic regression analysis. The results showed that respondents' awareness and perceived benefits for IHC services scored 3.44 and 4.06, with 120 (74.5%) willing to participate; key reasons for rejections or hesitations included medical risks, work intensity and personal safety, medical disputes, and competency. Logistic regression revealed significant associations between nurses' awareness (OR = 1.413) and competency (OR = 1.026) of IHC services and willingness. Most participants preferred providing IHC services within 2 km (71.4%) during weekdays (64.4%) and charging based on government standards (57.8%). Key service preferences included basic nursing and chronic disease management. Most participants emphasized the necessity for pre-service risk assessments (93.2%), written consent (93.8%), audio/video recordings (80.1%), accompaniment (94.4%), and insurance (93.8%). In conclusion, community nurses favor providing low-risk IHC services locally, with significant requests for support systems in place. Policymakers should enhance IHC service publicity, plan services considering nurses' and clients' needs, and create training plans to boost community nurses' competency, improving service willingness and quality.

Keywords Internet-based home care, Awareness, Perception, Willingness, Community nurses

Population aging is a major global problem and a serious challenge facing China¹. As of 2022, there are 209.78 million people aged 65 and over in China, accounting for 14.9% of the total population, of whom 150 million have chronic diseases and 44 million have disabilities or partial disabilities^{2,3}. In addition, China's "421" family structure (i.e., four older adults + a couple + one child) and the current situation of empty nests make home care or continuing care for older persons a major challenge. Internet-based home care (IHC) services are provided by registered nurses in medical institutions, relying on information technologies to achieve online applications and offline services, focusing on the care of oldest-old adults, disabled older adults, and patients with mobility difficulties at the recovery stage or the end stage³. IHC is considered to be an important complementary and effective auxiliary means of traditional nursing and transitional care, as it helps to balance the distribution of care resources⁴, reduce unnecessary hospitalization of frail individuals residing in communities^{4,5}, and save costs such as parking, transportation, and time off work required for clinic visits^{4,6}. Additionally, IHC services offer

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nurses the opportunity to augment their personal income in a flexible manner while simultaneously enhancing their professional standing and recognition⁷.

The integration of internet technology with home visiting services has experienced varying degrees of development across countries worldwide, with distinct historical trajectories and operational models. Since 2019, China has piloted the IHC services program in six provincial-level regions and then gradually expanded to other cities and regions⁸. Although the IHC services program shows promise in some areas of China, it remains in its nascent phase. It was reported that even in tertiary general hospitals, the coverage rate of IHC services was only 64.1%, and 85% of the hospitals provide IHC services less than 50 times per month⁹. Nanchong, located in southwest China, has the sixth largest proportion of people aged 65 and above in China,¹⁰ where there are a large number of oldest-old adults, disabled persons, and chronic patients, leading to a continuous increase in the demand for home care services. However, IHC service in the region is still in its infancy and is only carried out in some tertiary general hospitals. As a new health care delivery mode, the quality and effectiveness of the IHC service are heavily reliant on the active participation and cooperation of both nurses and clients. Nurses' awareness and perception of IHC services, including their perception of the benefits, demands, and competency to provide IHC services, may greatly influence their willingness and motivation to participate in the project and provide high-quality care. Additionally, the government's response to the concerns and needs of nurses will play a crucial role in determining the success of the program. Therefore, as the protagonists of this service model, nurses' views and insights on IHC services are crucial to policymakers and the effective implementation of the program.

Several studies have explored nurses' perceptions of and willingness to engage in the IHC services program^{11–16}. The research results consistently showed that most nurses were optimistic about the program^{11–13}, but there was a significant difference in the proportion of nurses willing to provide IHC services, ranging from 19.4% to 82.8%^{11,12,14–16}. The differences in the region and hospital level of these studies may explain this variation. The potential influencing factors for nurses' willingness to provide IHC services discussed in previous studies included gender, professional title, education level, monthly income, awareness of IHC services, etc^{11,12,15,16}. However, the findings were inconsistent, and these studies mainly focused on hospital nurses, with limited research on the willingness and demand of community nurses.

Nurses in hospitals, especially those in tertiary general hospitals, often have heavy workloads, and nurses' work role conflicts are the main obstacles to the implementation of the IHC service program¹⁷. The development prospects of the IHC service program performed by community health service centers as the main agency have been acknowledged because of their advantage of geographical location¹⁸. At the same time, community nurses are familiar with the conditions of residents in the community and have a good nurse-patient relationship foundation, which is conducive to the delivery of the service¹⁸. Therefore, this study conducted a questionnaire survey on community nurses in Nanchong to analyze their awareness, perception, and willingness to provide IHC services, and to explore associated factors with their willingness, with the aim of providing references for the comprehensive promotion and successful implementation of IHC services in Nanchong and elsewhere.

Methods

Study design, setting and participants

We conducted a multicenter cross-sectional survey in Nanchong, China. The survey settings were nine community health service centers, which were selected by randomly (using a random number table) selecting three centers from each of the main urban areas of Nanchong (Shunqing, Gaoping, and Jialing). A convenience sampling method was used to recruit registered nurses from these nine community health service centers. The inclusion criteria were as follows: (1) aged ≥ 18 years; (2) engaged in clinical nursing for ≥ 5 years; and (3) participated in the study voluntarily. Nurses who were absent from work due to reasons such as sick leave, personal leave, study abroad, etc., or who received training solely at the community health services centers surveyed were excluded.

Measurements

Sociodemographic information form

The sociodemographic information form was used to collect the basic characteristics of participants, including gender, age, educational level, working seniority, professional title, and monthly income.

IHC services awareness, perception and willingness survey questionnaire

The questionnaire on awareness, perception, and willingness to IHC service used in this study was developed according to the following steps: First, on the basis of a literature review and referring to the relevant policy documents of the National Health and Health Commission on the IHC services pilot program, we developed the initial version of the questionnaire. Second, we invited eight experts (i.e., three nurses with experience in providing IHC services, three managers in IHC services, and two researchers specializing in community care) to evaluate the importance and relevance of each item using Likert 4 scales and make revised recommendations. Third, a total of 25 community nurses participated in a pretest of the questionnaire. Based on their valuable comments, we implemented necessary revisions to refine the questionnaire, resulting in the final version consisting of three sections with a total of 25 items.

Section one measured nurses' awareness of IHC services, including seven items. Each item included two options: yes and no, with a score of 1 and 0, respectively. The total score ranged from 0 to 7 points.

Section two measured the views of nurses on IHC services, including their perception of the potential benefits of IHC services, preference for service distance, service platform, service time period, service content, and demand for service security measures. Among them, the perception of the potential benefits of IHC services consisted of five items, each of which included two options of agree and disagree, assigned a score of 1 and 0,

respectively, with a total score of 0–7 points. Participants listed the top five items successively from the service contents that have been carried out in China or supplemented by the participants themselves as their preference for service content. Eventually, we weighted and calculated the scores of the participants' preferences for service content, and the detailed method was as follows: we assigned weights based on preference ranking, ranging from 1 to 5 (with 5 being the first preference and 1 being the fifth preference), and then calculated them using the following formula: The average composite score of the options = $(\Sigma \text{ frequency} \times \text{ weight})/\text{the number of nurses}$ to answer the question.

Section three measured nurses' willingness to provide IHC services and the reasons for their unwillingness. Willingness was measured by a single-item question: if your institution piloted an IHC services program, would you be willing to participate in providing the services? Participants who were unwilling/hesitant were asked to list the top three reasons for unwillingness or hesitation from the potential reasons listed by the researchers or added by themselves. Similar to participants' preferences for service content, we weighted and calculated the scores of the reasons for their unwillingness to participate. The detailed method was as follows: we first assigned weights based on reason ranking, scoring them from 1 to 3 (with 3 being the highest ranked reason and 1 being the lowest ranked reason). We then calculated the average composite score of the options using the formula: The average composite score of the options = $(\Sigma \text{ frequency} \times \text{ weight})/\text{the number of nurses}$ to answer the question.

The questionnaire possesses good content validity, as confirmed by expert review, with an item-level content validity index (I-CVI) for the entire instrument ranging from 0.832 to 1.000. To further establish the psychometric properties of the questionnaire, we performed additional analyses tailored to the distinct nature of each section. Internal consistency for the dichotomous Awareness and Perception of Benefits sections was assessed using the Kuder-Richardson 20 (KR-20) formula, yielding coefficients of 0.741 and 0.763, respectively. The structural validity of the Awareness and Perception of Benefits sections was examined through separate Exploratory Factor Analyses (EFA) conducted in Mplus, using the Weighted Least Squares Mean and Variance Adjusted (WLSMV) estimator appropriate for categorical data. The results supported a unidimensional structure for both sections: the one-factor model for Awareness showed good fit to the data ($\chi^2 = 127.734$, $df = 113$, $P = 0.162$), and the model for Perception of Benefits also demonstrated good fit ($\chi^2 = 13.542$, $df = 17$, $P = 0.699$). All items loaded significantly on their respective single factors. Thus, the empirical evidence supported the predefined, unidimensional theoretical dimensions for both sections. The validity of the single-item Willingness measure was supported by its significant relationships with other key variables in the regression analysis.

IHC services competency scale

The IHC Services Competency Scale was developed by Zhou¹⁹ and consisted of four dimensions: theoretical knowledge, skill practice, door-to-door service ability, characteristics and quality, with 48 items. Participants rated each item on a Likert 5-scale from very poor to very good, resulting in a total score range of 48 to 240. A higher score indicated a higher level of self-perceived IHC service competency. Previous studies showed that the scale had good reliability and validity, with a Cronbach coefficient of 0.984 and an I-CVI of 0.88–1.00.¹⁹ In this study, the Cronbach coefficient of the scale was 0.896.

Data collection

From May to June 2023, with the consent of the selected community health service centers, an online questionnaire was sent to the head nurses of each center, and then the head nurses sent the online questionnaire and the filling instructions to the community nurses through the Wechat working group. On the homepage of the online questionnaire, we set some questions based on inclusion and exclusion criteria to filter out ineligible respondents. To prevent duplication, we only allowed the same IP address or WeChat account to be submitted once. Additionally, participants were unable to submit the questionnaire if any item was missing, ensuring data integrity.

Ethical considerations

The Medical Ethics Committee of the affiliated Hospital of North Sichuan Medical College approved this study (approval number: 2023ER205-1), and all procedures were in accordance with the Helsinki Declaration. The willingness to participate was determined upon receipt of the complete questionnaire and thus provided informed consent.

Statistical analysis

Descriptive statistics were used to describe the sociodemographic characteristics of respondents and their answers to questions about awareness, perception, and willingness to IHC services. Categorical data were expressed as frequency (count) and percentage (%), and continuous data were described by mean and standard deviation ($M \pm SD$). To analyze associated factors of willingness, an ordinal multiple logistic regression analysis was performed using statistically significant independent variables identified by univariate analyses (Mann-Whitney U Test or Kruskal-Wallis H Test). For this analysis, the willingness variable was coded as an ordinal variable with three levels: 'unwilling' (lowest), 'hesitant', and 'willing' (highest). Consequently, an odds ratio (OR) greater than 1 indicates a higher likelihood of being in a category of greater willingness (i.e., a more positive attitude towards providing IHC services) for every one-unit increase in the predictor variable. The significance level of all tests was set at $P \leq 0.05$ (2-sided). The SPSS 27.0 version (IBM Corp.) was used for data analysis.

Results

Participants' sociodemographic characteristics

A total of 161 nurses completed the survey. The majority were women (98.1%) and aged 26–35 years (59.0%). Approximately half of the participants (54.0%) had a college degree or above. Most of them had nursing

experience for 5 to 10 years (62.7%), had a junior profession title (75.8%), and had a monthly income ranging from 3000 to 5000 yuan (64.6%). (Table 1).

Participants' awareness of IHC services

Respondents demonstrated a low-to-moderate awareness of IHC services, with a mean score of 3.44 ($SD = 2.03$) out of 7. This was further supported by the fact that 77.0% scored below 75% of the total marks, and 5.6% scored zero. Moreover, awareness of the following specific aspects was notably limited: development status (33.5%), staff qualifications (39.8%), rules and regulations (39.1%), dispute settlement mechanisms (31.1%), and potential risks and preventive measures (42.9%). Detailed data are available in Supplementary Table S1.

Participants' perceptions on IHC services

The overall score of respondents' perceived benefits for IHC services was 4.06 ($SD + 1.39$) and ranged from 0 to 5 points. The proportion of nurses who scored zero on perceived benefits questions and scored less than 75% of the total score was 2.5% and 27.3%, respectively. The majority of respondents agreed on the potential benefits of IHC services. For the answers to each item, see supplementary Table S2. As shown in Table 2, more than 70% of participants expected the distance of IHC services to be ≤ 2 km from the departure place, and 64.6% of respondents preferred to provide services during the working day. As for the calculation method of single services salary, most nurses tend to be uniformly formulated by the government. In terms of service security, most nurses expressed the need for pre-services risk assessment (93.2%), written informed consent (93.8%), audio and video recordings of the service process (80.1%), accompaniment of at least two persons during the service (94.4%), and the purchase of related insurance (93.8%) for HIC services providers.

The weighted calculation of participants' reported preference for IHC service content showed that the top five services were basic nursing, health guidance, vital sign monitoring, blood glucose monitoring, and case management of chronic disease. See Table 3 for details.

Participants' willingness to provide IHC services and associated factors

Of the 161 respondents, 120 (74.5%) were willing to participate in IHC services. The weighted calculation of participants' reported reasons for being unwilling/hesitant showed that the top five reasons were concerns

Variables	n (%)/ $M \pm SD$	Willingness			P
		Unwilling n (%)	Hesitant n (%)	Willing n (%)	
Gender					
Female	158 (98.1)	7 (4.4)	33 (20.9)	118 (74.7)	0.559
Male	3 (1.9)	1 (33.3)	0 (0)	2 (66.7)	
Age (years)					
≤ 25	32 (19.9)	2 (6.2)	11 (34.4)	19 (59.4)	0.126
26–35	95 (59.0)	5 (5.3)	18 (18.9)	72 (75.8)	
36–45	21 (13.0)	0 (0)	3 (14.3)	18 (85.7)	
>45	13 (8.1)	1 (7.7)	1 (7.7)	11 (84.6)	
Working seniority (years)					
5–10	101 (62.7)	5 (4.9)	23 (22.8)	73 (72.3)	0.626
11–15	34 (21.1)	2 (5.9)	7 (20.6)	25 (73.5)	
16–20	9 (5.6)	0 (0)	1 (11.1)	8 (88.9)	
>20	17 (10.6)	1 (5.9)	2 (11.8)	14 (82.3)	
Professional title					
Junior	122 (75.8)	7 (5.8)	27 (22.1)	88 (72.1)	0.325
Intermediate	28 (17.4)	1 (3.6)	5 (17.8)	22 (78.6)	
Senior	11 (6.8)	0 (0)	1 (9.1)	10 (90.9)	
Education level					
College degree below	74 (46.0)	4 (5.4)	19 (25.7)	51 (68.9)	0.147
College degree or above	87 (54.0)	4 (4.6)	14 (16.1)	69 (79.3)	
Monthly income (¥)					
<3000	23 (14.3)	3 (13.1)	5 (21.7)	15 (65.2)	0.430
3000–5000	104 (64.6)	5 (4.8)	20 (19.2)	79 (76.0)	
>5000	34 (21.1)	0 (0)	8 (23.5)	26 (76.5)	
Overall score of awareness of IHC services	3.44 ± 2.03	2.25 ± 1.39	2.61 ± 1.52	3.75 ± 2.09	0.007
Overall score of perceived benefits for IHC services	4.06 ± 1.39	3.88 ± 1.36	4.24 ± 1.39	4.03 ± 1.39	0.458
Overall score of IHC services competency	171.4 \pm 29.59	155.75 \pm 20.93	157.88 \pm 20.01	176.17 \pm 30.89	<0.001

Table 1. Characteristics of participants and their willingness to provide IHC services ($N = 161$).

Variables	n (%) / M ± SD
Overall score of perceived benefits for IHC services	4.06 ± 1.39
Preference for services distance	
≤ 2 km from the departure location	115 (71.4)
> 2 km from the departure location	46 (28.6)
Preference for services time period	
8 AM to 6 PM on rest days	57 (35.4)
8 AM to 6 PM on work days	104 (64.6)
Preference for the calculation method of single services salary	
Similar to the price of similar service content in hospitals	17 (10.6)
Higher than 10%-20% of the price of similar service content in hospitals	35 (21.7)
Government unifies the price list according to the content of the service	93 (57.8)
Charge according to market rules	16 (9.9)
Pre-services risk assessment	
Unnecessary	11 (6.8)
Necessary	150 (93.2)
Written informed consent	
Unnecessary	10 (6.2)
Necessary	151 (93.8)
Audio and video recording of the service process	
Unnecessary	32 (19.9)
Necessary	129 (80.1)
Accompaniment of at least two persons during the service	
Unnecessary	9 (5.6)
Necessary	83 (51.5)
Decision based on the patient's condition and the risk of service	69 (42.9)
Purchase of related insurance for IHC services providers	
Unnecessary	10 (6.2)
Necessary	151 (93.8)

Table 2. Perceptions on IHC services of the participants (N=161).

about medical risks, the intensity of daily work, personal safety, medical disputes, and insufficient personal competency. See Table 4 for details.

As shown in Table 1, there were statistically significant differences among the three groups in the overall score of awareness about IHC services and IHC services competency (all $P < 0.05$), while there was no statistically significant difference in other factors (all $P > 0.05$). Given these preliminary findings, the significant variables (awareness and competency) were selected for further investigation in the multivariate ordinal regression model to identify independent predictors of willingness (with the outcome ordered as: unwilling -> hesitant -> willing). The result showed that for every 1 point increase in the total score of nurses' IHC service awareness and competency, the likelihood of their willingness to improve one level was 1.413 times (95%CI:1.148–1.739, $P = 0.001$) and 1.026 times (95%CI:1.011–1.043, $P < 0.001$), respectively.

Discussion

This study examined community nurses' awareness, perceptions, and willingness to participate in IHC services, crucial for policymakers and the program's effective implementation, especially in the context that IHC services have not been widely carried out in community health service centers.

We found that 77% of participants scored below 75% of the total score in IHC services awareness, indicating a generally limited understanding among community health nurses. This is similar to the findings of Ma and colleagues¹⁴, likely attributable to the relatively recent introduction of IHC services in China and insufficient dissemination of related information in community health service centers³. However, home visits should be part of community family support services²⁰. A lack of understanding of relevant policies may lead to derivative problems during pilot implementation. In fact, China's healthcare system also emphasizes the core role of community healthcare nurses in primary healthcare and home visit services^{21,22}. Therefore, it is necessary to increase the publicity of the IHC services program in community health service centers, with particular emphasis on areas where awareness were not well known to the most participants in our study: development status, staff qualification requirements, rules and regulations, dispute resolution mechanism, potential risks and preventive measures of IHC services.

Consistent with earlier research on the perception of IHC services among hospital nurses^{11–13}, we found that most community nurses were optimistic about the benefits of IHC services. Our study revealed that most participants preferred to offer IHC services within a small radius of less than 2 km and during weekdays.

Variables	Weighted score
Basic nursing	2.90
Health guidance	2.11
Vital sign monitoring	1.87
Blood glucose monitoring	1.59
Case management of chronic disease	1.53
Nasal feeding	0.97
Subcutaneous injection	0.93
Intramuscular injection	0.64
Indwelling urinary catheter care	0.41
Maternal-infant nursing	0.39
Venous blood collection	0.32
Ostomy Care	0.27
Wound care	0.20
Care of intravenous indwelling catheters (such as PICC)	0.17
Intravenous drip infusion	0.17
Tracheotomy nursing	0.10
Traditional Chinese medicine nursing	0.08
Abdominal dialysis tube maintenance	0.07
Sputum suction nursing	0.06
Arterial blood collection	0.04
Hospice care	0.03
Coloclyster	0.02

Table 3. Ranking of IHC service content preferences of the participants (N=161).

Variables	Weighted score
Worried about medical risks	1.73
High intensity of daily work	1.32
Worried about personal safety	0.95
Worried about medical disputes	0.78
Perceived personal inadequacy	0.39
Worried about personal information leakage	0.37
Worried about income being disproportionate to effort	0.29

Table 4. Reasons for participants' reluctance/hesitation to provide HIC services (N=41).

This preference aligns with practical considerations for work-life balance and personal safety. Unlike in many developed countries, where home visiting nurses work for specialized institutions, nurses providing IHC services in China are registered nurses affiliated with approved medical institutions, tasked with both primary health care and public health services. Their preference for weekday services likely stems from the desire to maintain clear boundaries between professional and personal time^{12,23}, while a smaller service radius can better ensure their safety^{24,25}. Therefore, it is recommended to institute a flexible working system that prioritizes IHC services by community nurses who have completed their duties or have no urgent tasks on weekdays, while also considering commuting time and safety.

Notably, participants expressed a strong demand for specific safety measures, including pre-service risk assessment, written informed consent, audio/video recordings, accompaniment, and insurance. This demand directly mirrors their concerns regarding medical risks, personal safety, and medical disputes, which were also the top-cited reasons for unwillingness or hesitation. This is consistent with the findings of Guo²⁶ showing that over half of nurses view IHC services as medium to high risk. Indeed, home visiting nurses do encounter unique and complex risks²⁷⁻²⁹. Therefore, it is essential for policymakers and institutional managers to establish a systematic risk assessment mechanism, strengthen the informed consent process, implement audio and video recording of services (while balancing patient privacy³⁰, and provide auxiliary equipment such as one-touch emergency calls to ensure quick access to help in emergencies³¹.

Regarding the calculation method of single services salaries, most nurses prefer that the government establish uniform rates. Setting reasonable IHC service charge standards is essential for both service providers and recipients. Previous studies indicated that effective provision and pricing of online medical services can improve patient usage and satisfaction^{32,33}. However, there currently are no established IHC charging standards, and medical insurance support is lacking. Nurses feel that actual costs exceed current standards, while service

recipients find charges excessive and many items uncovered by insurance, posing affordability issues for some families¹⁷. Therefore, we recommend that the government create a unified charging standard and implement mechanisms for pricing and payment guarantees to protect the rights of nurses and patients, and to reduce disputes. most nurses preferred basic nursing services, health guidance, vital sign monitoring, blood glucose monitoring, and chronic disease management—operations that are easier and have lower perceived risks. This preference likely stems from their familiarity with these daily nursing tasks and a lower perception of risk involved. It also highlights the limited competencies of community nurses in IHC services. However, the complex and evolving medical environment and the increasing demand from community residents, community nurses must develop more comprehensive professional skills to meet diverse health needs. We suggest that community health service centers initiate IHC services with familiar, low-risk daily nursing tasks and then gradually introduce more complex services through targeted training, potentially in collaboration with tertiary hospitals.

Our study found that 74.5% of community nurses were willing to provide IHC services, and this number is likely to rise, as 20.5% were hesitant, indicating potential interest in IHC services. Key reasons for hesitation or unwillingness to participate in IHC services included medical risks, high daily workload, personal safety, medical disputes, and perceived personal inadequacy. This was consistent with their preferences for IHC service content, distance, timing, and security measures, reflecting worries about service quality and personal safety. Regression analysis confirmed that nurses' awareness (OR = 1.413, 95% CI: 1.148–1.739) and competence (OR = 1.026, 95% CI: 1.011–1.042) regarding IHC services were significant factors in their willingness to participate. Critically, beyond influencing willingness, these factors are fundamental to ensuring the quality and safety of the services delivered. In our study, the overall scores for awareness and competency in IHC services were below 50% and 75% of the total possible scores, respectively, indicating a substantive gap and an identifiable need for targeted interventions. This is consistent with previous research underscoring the importance of well-planned pre-service and in-service training for home visiting personnel³⁴. Adopting established models, such as the structured training programs in Japan³⁵ or the safety-focused checklist intervention by Gershon et al.³⁶, may offer a viable strategy.

This study has two limitations. First, we conducted a cross-sectional survey in nine community health service centers in Nanchong City, involving nurses who meet the Chinese government's minimum requirements for IHC service qualifications. As a result, the study participants were more accurate, but it also limited the number of participants, which may affect the generalizability of our findings. Future research can consider expanding the survey scope to include more diverse regions and institutions, as well as increasing the sample size for better representation. Second, we focused solely on nurses' perspectives without gathering data from clients and their families. It is essential for future research to include the views of these groups.

Despite these limitations, our research contributes to the field by focusing on community nurses, who are pivotal yet understudied in this context. Second, unlike prior studies that used a single-item question, we developed a multi-item questionnaire, allowing for a more nuanced assessment of awareness and providing specific targets for training. Third, we quantitatively established IHC service competency as a key factor influencing willingness, thereby addressing a gap in the literature and providing empirical support for the development of competency-based training programs.

Conclusions

Community nurses favor providing low-risk IHC services locally, with significant requests for support systems in place. Policymakers and relevant institutions should enhance IHC service publicity, plan services considering nurses' and clients' needs, and develop targeted training plans to enhance community nurses' competency, improving service willingness and quality.

Data availability

The datasets used and analyzed in the study are available from the corresponding author upon reasonable request.

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References

1. World Population Prospects. : Summary of Results. *United Nations, Department of Economic and Social Affairs, Population Division* https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/wpp2022_summary_of_results.pdf (2022).
2. China Statistical Yearbook. *National Bureau of Statistics of China* (2023). <https://www.stats.gov.cn/sj/ndsj/2023/indexch.htm> (2023).
3. Wei, J. & Wang, Y. Healthcare plan launches in six pilot areas. *China Daily* <https://www.chinaservicesinfo.com/s/201902/13/WS5c64c164498e27e33803847f/healthcare-plan-launches-in-six-pilot-areas.html> (2019).
4. Internet-plus nursing program offers convenience to patients. *Xinhua Net* http://www.xinhuanet.com/english/2019-03/20/c_137909959.htm (2019).
5. Di Pollina, L. et al. Integrated care at home reduces unnecessary hospitalizations of community-dwelling frail older adults: a prospective controlled trial. *BMC Geriatr.* **17**, 53 (2017).
6. Gehring, N. D. et al. Families' perceived benefits of home visits for managing paediatric obesity outweigh the potential costs and barriers. *Acta Paediatr.* **107**, 315–321 (2018).
7. Wolff-Baker, D. & Ordonea, R. B. The expanding role of nurse practitioners in home-based primary care: opportunities and challenges. *J. Gerontol. Nurs.* **45**, 9–14 (2019).
8. China pilots Internet plus nursing program. *Xinhua Net* http://www.xinhuanet.com/english/2019-02/13/c_137818622.htm (2019).
9. Cao, Z., Yue, L., Peng, H., Li, B. & Peng, B. The Management of nurses in internet-based home care in tertiary general hospitals in China: mixed methods study. <https://www.researchsquare.com/article/rs-4910340/v1> (2024).

10. China's big data on urban aging. 149 cities located in these provinces have entered deep aging. *China Bus. Network* <https://www.yicai.com/news/101164016.html> (2021).
11. Zhang, J. et al. Nurses' willingness and demand for internet + home care services and the associated factors in municipal hospitals in china: cross-sectional survey. *J. Med. Internet Res.* **25**, e45602 (2023).
12. Huang, R. et al. Internet-based sharing nurse program and nurses' perceptions in china: cross-sectional survey. *J. Med. Internet Res.* **22**, e16644 (2020).
13. Zhao, B. et al. Nurses' perceptions of engaging in internet-based nursing services: A qualitative study based on three hospitals in China. *Nurs. Open.* **10**, 6856–6865 (2023).
14. Ma, G. et al. Nurses' willingness and demand for internet + home care services and its influencing factors in different levels of hospitals in China - a nationwide survey. *Risk Manag Healthc. Policy.* **15**, 1395–1405 (2022).
15. Tian, F. et al. Investigation on nurses' willingness to internet + nursing service and analysis of influencing factors. *J. Multidiscip Healthc.* **16**, 251–260 (2023).
16. Sheng, Z. et al. Nurses' attitudes toward internet-based home care: a survey study. *Comput. Inf. Nurs.* **39**, 97–104 (2020).
17. Yu, H. Y. et al. Nurses' perceptions regarding barriers to implementing the internet plus nursing service programme: A qualitative study. *J. Nurs. Manag.* **30**, 511–520 (2022).
18. Han, Y., Qian, Y., Zhang, L. & Zhu, Q. Qualitative research on operation management experience of internet + nursing service by nursing managers (in Chinese). *J. Nurs. Sci.* **35**, 52–56 (2020).
19. Zhou, Y. Construction of competency index system of online contract nurses under the background of internet + nursing service (in Chinese)[D]. *Yunnan Univ. Traditional Chin. Medicine* (2022).
20. Gomby, D. S., Culross, P. L. & Behrman, R. E. Home visiting: recent program evaluations—analysis and recommendations. *Future Child.* **9**, 4–26 (1999).
21. Chen, Z. Launch of the health-care reform plan in China. *Lancet* **373**, 1322–1324 (2009).
22. Ge, Y., Wang, L., Zhang, J., Yu, D. & Feng, W. Focus on key issues to deepen the reform of the medical and health system. *Development Research Center of the State Council of the People's Republic of China* (2016). http://www.chinadaily.com.cn/m/drc/2016-08/25/content_26596782.htm
23. Kowitlawkul, Y. et al. Investigating nurses' quality of life and work-life balance statuses in Singapore. *Int. Nurs. Rev.* **66**, 61–69 (2019).
24. Johannessen, T., Ree, E., Aase, I., Bal, R. & Wiig, S. Exploring challenges in quality and safety work in nursing homes and home care - a case study as basis for theory development. *BMC Health Serv. Res.* **20**, 277 (2020).
25. Smith, A. F. & Plunkett, E. People, systems and safety: resilience and excellence in healthcare practice. *Anaesthesia* **74**, 508–517 (2019).
26. Guo, P. et al. Construction and evaluation of a predictive model for grassroots nurses' risk perception of internet + nursing services: A multicenter cross-sectional study. *J. Multidiscip Healthc.* **17**, 4493–4506 (2024).
27. Kim, E., Choi, H. & Yoon, J. Y. Who cares for visiting nurses? Workplace violence against home visiting nurses from public health centers in Korea. *Int. J. Environ. Res. Public. Health.* **17**, 4222 (2020).
28. Byon, H. D., Lee, M., Choi, M., Sagherian, K. & Lipscomb, J. A. Prevalence of type II workplace violence among home healthcare workers: A meta-analysis. *Am. J. Ind. Med.* **63**, 442–455 (2020).
29. Ellenbecker, C. H., Samia, L., Cushman, M. J. & Porell, F. W. Employer retention strategies and their effect on nurses' job satisfaction and intent to stay. *Home Health Care Serv. Q.* **26**, 43–58 (2007).
30. Dostálová, V., Bártová, A., Bláhová, H. & Holmerová, I. The needs of older people receiving home care: a scoping review. *Aging Clin. Exp. Res.* **33**, 495–504 (2021).
31. Tourangeau, A. E., Patterson, E., Saari, M., Thomson, H. & Cranley, L. Work-related factors influencing home care nurse intent to remain employed. *Health Care Manage. Rev.* **42**, 87–97 (2017).
32. Wu, H. & Lu, N. Service provision, pricing, and patient satisfaction in online health communities. *Int. J. Med. Inf.* **110**, 77–89 (2018).
33. Xie, C., Jia, S. & He, C. An empirical study on the factors affecting elderly users' continuance intention of shared nurses. *Risk Manag Healthc. Policy.* **13**, 1849–1860 (2020).
34. Zeanah, P. D., Larrieu, J. A., Boris, N. W. & Nagle, G. A. Nurse home visiting: perspectives from nurses. *Infant Ment Health J.* **27**, 41–54 (2006).
35. Morioka, N., Okubo, S., Yumoto, Y. & Ogata, Y. Training opportunities and the increase in the number of nurses in home-visit nursing agencies in japan: a panel data analysis. *BMC Health Serv. Res.* **19**, 398 (2019).
36. Gershon, R. R. et al. Safety in the home healthcare sector: development of a new household safety checklist. *J. Patient Saf.* **8**, 51–59 (2012).

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Author contributions

X.S. and W.L. wrote the manuscript; X.X. revised the manuscript; X.S., W.L. and X.X. conceived and designed the study; X.S., W.L., C.H. and P.Y. performed the study and collected the data; X.S., W.L. and X.X. analyzed the data. All authors reviewed the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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