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Preferences of community health workers for vaccine communication training programs in harbin, china: a discrete choice experiment

Yuwei Zhang^{1†}, Yuanheng Li^{1†}, Zhuowa Sha^{1†}, Yazhou Wang¹, Yuzhuo Xie¹, Zihua Zhao¹, Linghan Shan¹ and Mingli Jiao^{1*}

Abstract

Background Good communication skills among community health workers (CHWs) can improve public vaccination decision-making and alleviate vaccine hesitancy. However, in China, standardized training to improve the vaccine communication skills of CHWs is insufficient and underemphasized. Accordingly, this study examined the training preferences for CHWs' vaccine communication skills to meet the current needs of community-based vaccination services in China.

Methods This study employed a discrete choice experiment (DCE) design conducted at five community health service centers in Harbin, China, between April and June 2021. Data collection included in-depth interviews and face-to-face administration of questionnaires. CHWs were recruited via convenience sampling, with eligibility criteria requiring participants to: hold vaccination qualification certificates; be full-time frontline staff with ≥ 1 year of vaccination experience; have no prior formal training in vaccine communication. A total of 164 valid questionnaires were included for analysis. Preferences for training programs were evaluated using a mixed logit model. The DCE attributes comprised training period (1 day, 3 days, 7 days), main content (vaccine basics, addressing common misconceptions, communication skills), delivery methods (online lectures, on-site seminars, case simulations), training scale (< 50 , $50-100$, > 100 participants), and feedback mechanisms (none, final feedback, stage-based feedback).

Results Three attributes—training period, main content of the training, and training scale—significantly influenced CHWs' training choices. CHWs preferred programs with shorter training cycles and fewer than 50 participants to improve their ability to share basic vaccine-related knowledge and had less desire to receive communication skills training. At the same time, we found no association of training modality on CHW preferences.

Conclusions Using a DCE, this study investigated the preferences of CHWs for participating in a vaccine communication training program. CHWs preferred a one-day training cycle, training content focusing on

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vaccine basics, and a small number of people to be trained. The results of this study can inform policymakers and administrators when in China developing vaccine communication training programs for CHWs.

Keywords Vaccine communication, Training, Preference, Community health workers, Discrete choice experiment

Background

Vaccination is an important means of controlling preventable diseases, and its implementation has been recognized worldwide as one of the top 10 global public health achievements of the twentieth century, with significant economic and social benefits [1]. However, as the dissemination of adverse safety events regarding vaccines on the Internet and changing information about a wide range of new vaccines have reduced public confidence in them, people are increasingly delaying or refusing vaccinations [2, 3]. The World Health Organization (WHO) defines vaccine hesitancy as delaying or refusing vaccinations, even though they are accessible [4]. It was listed as one of the 10 threats to global health in 2019 [5]. Increasing public confidence in the safety and efficacy of vaccines is critical for the success of any vaccination program [6–8]. Relevant studies have shown that effective communication behaviours of community health workers (CHWs) [9], who are the most trusted advisors and influencers in vaccination decisions, can help reduce vaccine hesitancy among recipients [10–12]. Therefore, a communication process that builds rapport and trust between CHWs and their patients is necessary [13].

There is growing evidence that communication can help people adopt positive health behaviours and create a demand for preventive and treatment services [14]. A survey study of COVID-19 vaccine communication among Hong Kong residents suggested that verbal interventions can influence public attitudes toward vaccines and that verbal communication can be a low-cost, actionable strategy to reduce public hesitancy toward vaccines [15]. Leask et al. suggest that efficient communication by vaccinators can reduce public vaccine hesitancy and alleviate public concerns about vaccine safety and efficacy [16]. These studies suggest that communication can be an effective tool for influencing public decision-making regarding vaccination issues. CHWs' strong communication skills thus play a key role in increasing vaccination rates and reducing hesitancy. Therefore, it is critical to find ways to improve their vaccine communication skills.

Studies conducted in developed countries have found that training to improve CHWs' vaccine communication skills is effective. For example, a study of HPV vaccination in the United States suggested that the role of CHWs should be expanded to ensure optimal healthcare outcomes for patients by training them to be competent in vaccine communication and recommendations [17]. Similar to other technical skills acquired through consistent supervised practice and feedback, communication is

a skill that can be learned successfully [18]. Therefore, the Centers for Disease Control and Prevention encourages efforts to improve comprehensive communication strategies between primary care providers and other health-care professionals [19].

Many developing countries, including China, have recognized that improving the communication skills of CHWs can have a positive effect on increasing vaccination rates [20]; however, there has been little training in this area at the grassroots level. In China, some CHWs have educational backgrounds in clinical medicine and nursing, and are primarily responsible for routine childhood immunizations (e.g., measles, polio, hepatitis B vaccines) and adult vaccines (e.g., influenza, HPV vaccines). During the COVID-19 pandemic, community health service centers and designated medical institutions were also responsible for COVID-19 vaccination. To our knowledge, standardized training to improve the vaccine communication skills of CHWs in China is virtually non-existent. As China serves one-fifth of the world's primary healthcare population [21], vaccination rates in China could have a significant impact on global immunization programs. Effective communication among CHWs is recognized as a reliable means of increasing vaccination rates. Currently, China focuses on basic professional skills in most training programs for CHWs [22]. This is similar to many countries where training in communication skills is tailored to advanced degrees (e.g. physicians and nurse practitioners) or clinical provider audiences (e.g. medical assistants and nurses) [23]. According to China's 2020 National Study on Learning and Science Education Behavior of Vaccination Personnel, only 24% of vaccination personnel are very knowledgeable about the form and content of science education, whereas 76% hope that they will have more opportunities to participate in relevant training to improve their business skills [24]. Thus, China's current communication training for CHWs is insufficient and underemphasized. Accordingly, this study examined the training preferences for CHWs' vaccine communication skills to meet the current needs of community-based vaccination services in China.

Studies have shown that communication skills can be improved through curricular training [25]. However, a lack of vaccine communication training courses exists for CHWs, and neither the WHO nor many international organizations offer courses or standardized training programs [26]. In addition, limited international research has been conducted on CHWs' vaccine communication training preferences, which is currently an urgent

focus of exploration. Therefore, we aimed to investigate Chinese CHWs' communication competency training program preferences through a discrete choice experiment to provide a clear direction for the development of standardized vaccine communication training curricula in many countries (and international organizations) that need to explore it further.

Methods

DCE methodology

Discrete choice experiments (DCEs) are a quantitative research method for measuring preferences by eliciting preferences for multi-attribute solutions, where researchers simulate the design of choices for individuals to choose from to determine an individual's attribute preferences for a product or service [27]. The method combines random utility theory, consumer theory, experimental design theory, and econometric analysis, and is suitable for analysing the choice behaviour of decision-makers [28].

The DCE asks individuals to state their preferences in hypothetical scenarios. This study comprises a training on vaccine communication for CHWs, and each training option can be characterized by a set of attributes and their corresponding levels; in expressing a preference for one option, individuals weigh the different attributes and levels of the other options. The combination of these attributes mimics real-life and real-work situations. In this case, vaccine communication training for CHWs does not involve just one characteristic but a whole set of characteristics, and individuals must weigh the advantages and disadvantages of such an option and the degree of compatibility with the real work environment when choosing. Thus, under random utility theory, respondents will choose the option with the highest utility from the alternatives we provide. The DCE design and analysis was based on the checklist and reports of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) Joint Analytical Working Group [29].

Survey design

Determination of attributes and levels

In this DCE survey, respondents were asked to make a series of choices between hypothetical training programs. Each training program is defined by a set of attributes that reflect its characteristics. We followed the DCE best practice recommendations and conducted a literature review, focus groups, and interviews with key informants to establish a set of salient attributes, accompanied by a description of the level of plausible options being investigated [30], in order to ensure that the attributes and levels in the DCE would be clear, reasonable, and meaningful, and to allow respondents to make realistic trade-offs between them [31]. Some studies have shown that

the discrete selection of experimental attributes and levels should not be too numerous, as too many attributes or levels can easily cause interviewees to make difficult decisions [32]. The setting of levels is also very important, and the choice of levels should be very broad to avoid decision-makers ignoring attributes because the differences are too small. Some studies have shown that the range of levels for each attribute should be 2–4 [33]. Based on the above rules for setting attributes and levels, the process was divided into two steps.

Literature review

First, search terms were identified for the purpose of the study, and international literature on communication training and CHW training was reviewed [34]. In addition, a survey of training needs in urban community health centres in China and relevant elements of healthcare worker training curricula in the United States, United Kingdom, Canada, and other countries was conducted to determine which attributes might be relevant [22, 35–37]. The curriculum design of most studies was based on semi-structured interviews with experts and the job characteristics of CHWs to construct training programs. We also found very little literature directly from the population and topics we wished to study. According to the general training program development needs of the content, five attributes were focused on: 'training cycle', 'the main content of training', 'training mode', 'training scale', and 'training effect feedback'.

Focus-group discussions

To further define the level of attributes and learn more about what is important to train community vaccinators in when conducting vaccine communication, we conducted a second step by selecting community vaccinators for interviews and incorporating relevant expert opinions. Two focus groups were used to conduct the interviews.

In the first focus group, a purposive sampling strategy was employed to select 12 CHWs from five community health service centers in Harbin, Heilongjiang Province. Participants were selected based on predefined criteria, including: (1) having ≥ 3 years of work experience; (2) possessing a relevant educational background and having obtained a vaccination qualification certificate; (3) being affiliated with community health centers; (4) having practical experience in vaccine communication. Face-to-face in-depth interviews were conducted by two trained researchers and completed in June 2021. Data collection continued until information saturation was reached. Each interview lasted 30–40 min and was audio-recorded in full for subsequent analysis. The interview protocol encompassed the following domains:

- (1) CHWs’ daily responsibilities and communication practices in vaccination settings;
- (2) Barriers and facilitators in vaccine-related communication;
- (3) Expectations for vaccine communication training modalities;
- (4) CHWs’ perceived needs and attitudes toward communication skill enhancement.

All audio recordings were transcribed verbatim and analyzed using thematic analysis. Two researchers independently coded the transcripts to identify primary and secondary themes. Through iterative discussions with the research team, key attributes and levels were systematically defined.

The second focus group discussion was not part of the qualitative data collection but constituted a critical step to refine the DCE design. This group was convened to validate and enhance the attributes and levels identified from the initial interviews with CHWs (first focus group). A panel of ten participants, including two health statisticians, four community vaccine communication specialists, and four postgraduate students, was convened to validate and prioritize the preliminary attributes and levels derived from CHW interviews and literature synthesis. During structured discussions, experts highlighted potential overlaps between the attributes “training modality flexibility” and “feedback mechanisms,” arguing that flexible training formats inherently influence feedback effectiveness. Consequently, the attribute “feedback mechanisms” was merged into the broader “training evaluation” category. Additionally, CHWs emphasized

the importance of integrating practical case studies into training content, leading to the inclusion of “scenario-based learning” as a distinct level under the “training methods” attribute. Through iterative ranking and consensus-building, five core attributes with empirically grounded levels were finalized (Table 1).

This study used a D-efficient optimal design to generate choice sets using the discrete choice experimental design software Ngenex, which resulted in 18 choice sets designed to investigate the main effects of different vaccine communication training programs on respondents’ choices. Because participation in communication training was a voluntary decision, and given the fact that too many choice sets for one respondent would create a burden and reduce the accuracy of the results, we used a two-stage response design, dividing the 18 choice sets into two versions of 9 choice sets each to maximize the information obtained from the respondents. Respondents selected a random choice set for the survey. We also considered whether to include an exit option throughout the design process, with some research suggesting that having an exit option mitigates the possible effects of high-regard attributes [38]. Therefore, this study includes an exit option in the design process. Figure 1 presents an example of the final selection set.

Study population and data collection

Pilot study implementation

To validate the effectiveness of the questionnaire instrument, the research team conducted a pilot survey in March 2020 using the convenience sampling method at two community health service centers in Harbin,

Table 1 Attributes and levels of discrete choice experiments for CHWs

Attributes	Attribute Levels	Descriptions
Training period	1 day	The number of training days available to CHWs.
	3 days	
	7 days	
Main content of the training	Vaccine Basics	Principles of vaccine production, mechanism of action, function, abnormal post-vaccination reactions, and cold chain transportation.
	Common misconceptions about vaccine safety and rationalizations	Perceived errors and reasonable explanations of vaccines or vaccinations that are common among the vaccinated.
	Communication Skills	How to communicate effectively with vaccinees.
Training Methods	Web-based Online Training	Training Models Available to CHWs.
	On-site Knowledge Seminars	
	Case Discussion and Scenario Simulation	
Scale of training	Small Scale	Less than 50 participants.
	Medium Scale	50–100 participants.
	Large Scale	More than 100 participants.
Training Effectiveness Feedback	No feedback	Feedback on the effectiveness of the training is given only at the end of the training.
	Final feedback only	
	Stage Feedback	

This section invites you to consider the vaccine communication training program you would like to receive in your work. Assuming that you are required to undergo a vaccine communication training course for community health workers, there are two options for the training program. These two training options differ only according to the characteristics outlined below. All other characteristics not mentioned are the same.

Please take a moment to read about the features of these vaccine communication training programs listed below.

You may not like any of the training programs, but we'd like you to state which one you think is better!

Training options: which training program do you prefer?			
	Training A	Training B	Training C
training period	7days	3days	None
Main content of the training	Communication skills training	Common misconceptions about vaccine safety and rationalizations	None
Training Methods	Case Discussion and Scenario Simulation	On-site Knowledge Seminars	None
Scale of training	Large scale: more than 100 participants	Medium scale: 50-100 participants in training	None
Training Effectiveness Feedback	Stage-by-stage feedback on the effectiveness of individual training	Only final feedback on the effectiveness of individual training	None
In your opinion, which of the above training programmes do you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Fig. 1 Illustration of discrete choice experiment and example of choice scenario

Heilongjiang Province, with 45 CHWs participating in the pilot study. Due to COVID-19 prevention and control policies restricting the research team's fieldwork, an online pilot experiment was implemented via the Questionnaire Star platform, and telephone interviews were conducted with pilot participants to collect feedback on the questionnaire. A total of 43 valid questionnaires were retrieved (response rate: 95.6%).

Questionnaire refinement

Based on feedback from the pilot test and expert consultations, we finalised revisions to the questionnaire to further clarify attribute definitions. Specifically: "Training scale" was explicitly defined as the number of participants, adjusted according to venue capacity and training effectiveness considerations. The specific explanation for "small-scale training" was revised to "fewer than 50 participants". To address ambiguity in the scope of "basic vaccine knowledge," the level descriptions were refined to include "vaccine action mechanisms, cold chain transportation, and management of adverse reactions" to enhance understanding. To prevent misinterpreting "stage feedback" as referring to work phases, the description was clarified to "regular feedback on training effectiveness throughout the training process." An "opt-out option" was added to simulate real-world decision-making scenarios and avoid forced-choice bias.

The final questionnaire underwent expert validation to ensure alignment with research objectives and

operational feasibility, qualifying it for formal implementation. To avoid memory effects and experimental contamination and ensure the independence of the formal study sample, all pilot study participants ($n = 45$) and CHWs involved in in-depth interviews ($n = 12$) were excluded from the formal experiment.

Formal survey implementation

The formal survey was conducted from April to June 2021 using convenience sampling. The research team collaborated with the Harbin Municipal Health Commission, and community health service center directors recommended institutions meeting eligibility criteria. After on-site evaluations of indicators including vaccination service volume and staffing configuration, we contacted leaders of five selected community health service centers. Researchers conducted surveys in the selected five community health service centers in groups, scheduling data collection primarily during after-hours periods to minimize disruptions. Survey locations were chosen for quiet and comfortable environments, typically staff lounges or observation rooms within the community health centers.

Inclusion criteria for CHWs were: (1) Primary job responsibility involving public vaccination services; (2) ≥ 1 year of frontline vaccination experience; (3) No prior formal vaccine communication training; (4) Full-time employment status; (5) Valid vaccination qualification certificate. Nine hypothetical training program

choice sets were pre-loaded into the Questionnaire Star app, with responses recorded via mobile phones or iPads. Also some researchers have used a paper version of the questionnaire for the survey. Researchers trained in neutral communication provided standardized explanations of the survey purpose, vaccine communication training attributes and levels, and completion instructions, followed by informed consent signature. Questionnaires began immediately after consent, with timed breaks to ensure data quality. The informed consent procedure was approved by the Research Ethics Committee of Harbin Medical University (Approval ID: HMUIRB20160014).

Data quality control

Questionnaires were excluded based on two criteria: (1) completion time less than 2 min, which was less than one-third of the median time in the pilot survey; (2) consistently selecting the same answer for each option (i.e., consistently choosing the left, right, or opt-out option).

Sample size determination

No standard method exists for determining the sample size in discrete choice experiments. However, various researchers have proposed different methods for this purpose [39]. Based on the rule of thumb suggested by Johnson and Orme, the sample size in this study was determined using the minimum-sample-size formula proposed by Orme [40]: $N > 500 c / (t \times a)$, where c represents the maximum number of attribute levels, t represents the number of choice sets, and a represents the number of options in each choice set. Therefore, the values of c , t , and a in this study were 3, 9, and 3, respectively. The necessary sample size in this study was calculated as greater than 55.6. This indicated that the sample size used in this study was sufficient for preference estimation and heterogeneity analysis.

Statistical analysis

Responses to the paper-based DCE questionnaire were entered into a database created using EpiData V.3.1 and matched with other sociodemographic characteristics obtained from the iPad for statistical analysis, using descriptive statistics to describe the study sample. Respondents were excluded from the final analysis if the number of missing DCE responses exceeded two or if most sociodemographic data were missing.

In this study, we chose the mixed logit model, which can analyse both discrete and continuous distributions and is relatively flexible, allowing for a more perfect study of heterogeneity [41]; the number of current studies that use the mixed logit model for analysis is gradually increasing. The mathematical expression for the utility of the i -th decision maker in the mixed logit model for choosing j in scenario t is as follows:

$$U_{ijt} = ASC + x_{ijt}\beta_i + \varepsilon_{ijt} = ASC + x_{ijt}(\beta + \eta_i) + \varepsilon_{ijt}$$

where ASC is the effect of the option itself on utility, x_{ijt} is a vector of attributes that can be observed, β_i is a vector of decision-maker-specific parameters, β is a vector of attribute utility homogeneity, and η_i is a vector of deviations from the mean. η_i is capable of obeying any of the distributions but is often thought of as obeying a normal distribution. A discrete choice model was built for the data using Stata 15.0 software, and the mixlogit command was applied to start the logit model estimation. The mean and standard deviation (SD) were calculated to analyse the overall preferences of CHWs for vaccine communication training and heterogeneity analysis.

Results

Sample description

We conducted a survey of health workers in five community health service organizations in Harbin City, including the basic information of the respondents, the current status of vaccine communication training, and the survey of training preferences. A total of 233 questionnaires were issued and 233 questionnaires were recovered, 37 invalid questionnaires were excluded, and 196 valid questionnaires were accepted, for a validity rate of 84.12%.

Of the 196 questionnaires, 69.39% were completed by female respondents and 30.61% by male. Most respondents (46.94%) were over 40 years old. Of the respondents, 40.10% had worked for less than 10 years, 19.80% had worked for less than 20 years, and the remainder had worked for > 20 years. Most (86.74%) of the respondents worked 6–10 h. Of the respondents, 79.59% had a bachelor's degree or college degree, 12.24% had a high school or junior college degree, 5.62% had a master's degree or higher, and 2.55% had a junior high school degree or lower, all of whom had given birth to children, and more than half (64.80%) had given birth to two children (Table 2).

>Mixed logit model results

We used Stata15.0 software to analyse the data of the 196 questionnaires, excluding the data for those always choosing option A 13, always choosing option B 9, and always choosing to withdraw the option of the data of 10, leaving 164 valid questionnaires.

The mixed logit model defaults to the coefficients of the random variables being normally distributed, and it can be assumed that the regression coefficients of the respondents' preferences obey a certain distribution, which is usually assumed to obey the binomial distribution, and thus the regression results consist of the mean and the standard deviation (SD). The results of the discrete choice model regression are shown in Table 3, where the regression coefficients were used to analyse the preference analysis of vaccine training for CHW, and the

Table 2 Basic information of respondents

Relevant issues	No. of respondents	Proportion (%)
Sex		
Male	60	30.61
Female	136	69.39
Age		
≤ 30	57	29.08
31–40	47	23.98
> 40	92	46.94
Educational level		
Junior high school and below	5	2.55
High school or junior college	24	12.24
Bachelor's degree or college	156	79.59
Master's or above	11	5.62
Years of experience		
≤ 10	79	40.10
11–20	39	19.80
21–30	47	23.86
> 30	31	15.74
Working hours (hours)		
< 6	7	3.57
6–10	170	86.74
> 10	19	9.69
Birth of children		
1	61	3.12
2	127	64.80
3	8	4.08

standard deviation coefficients analysed the existence of heterogeneity in vaccine communication training preferences for CHWs.

In this study's model, we found at least one statistically significant regression coefficient value for the three attributes of training period, main content of training, and size of training, in addition to training modality and feedback on the effectiveness of training, indicating that these three attributes have a significant impact on the selection of vaccine communication training programs for CHWs and that the training modality and feedback on the effectiveness of training do not significantly influence the selection of training for CHWs.

According to the direction of the regression coefficients, it can be seen that the influence of training cycle and training content on vaccine communication training choice is negative, and the influence of training scale on vaccine communication training choice is positive. Specifically, it is found that, in terms of training cycle, relative to 1 day, CHWs do not prefer 3 or 7 days, thus preferring shorter training cycles; in terms of training content, CHWs prefer training content on vaccine basics and do not prefer training on communication skills. In terms of training size, medium-sized vaccine communication training programs were preferred over large-scale training programs by more than 50 participants. The regression coefficients for the attributes of training methods and feedback on training outcomes were not statistically significant, suggesting that the sample population

Table 3 Preference analysis results based on mixed logit model ($n = 164$)

Attribute Levels	Coefficient (Mean)	p	Coefficient (SD)	p
Training period (reference level: 1 day)				
3 days	-0.3956	0.007**	-0.0842	0.757
7 days	-0.6180	0.000**	1.2513	0.000**
Training content (reference level: vaccine basics)				
Reasonable explanation of common misconceptions about vaccine safety	0.0151	0.913	0.0033	0.990
Communication skills	-0.5640	0.000**	0.6930	0.001**
Training methods (reference level: on-site knowledge lectures)				
Web-based online training	-0.1362	0.233	-0.1809	0.626
Case discussion simulation	-0.1665	0.191	-0.4921	0.039**
Training scale (reference level: large scale: more than 100 participants)				
Small scale (less than 50 participants)	0.3701	0.010**	0.1263	0.7470
Medium scale (50–100 participants)	0.1805	0.1580	0.0645	0.8130
Feedback on training effectiveness (reference level: no feedback on training effectiveness)				
Stage feedback on the effectiveness of individual training	-0.1817	0.133	-0.4598	0.859
Only final feedback on the effectiveness of individual training	0.1019	0.422	-0.8214	0.000**
Sample size	164			
Observation size	4423			
Log likelihood	-1225.0717			
Akaike information criterion (AIC)	2494.143			
Bayesian information criterion (BIC)	2634.824			

Note: ** $p < 0.05$

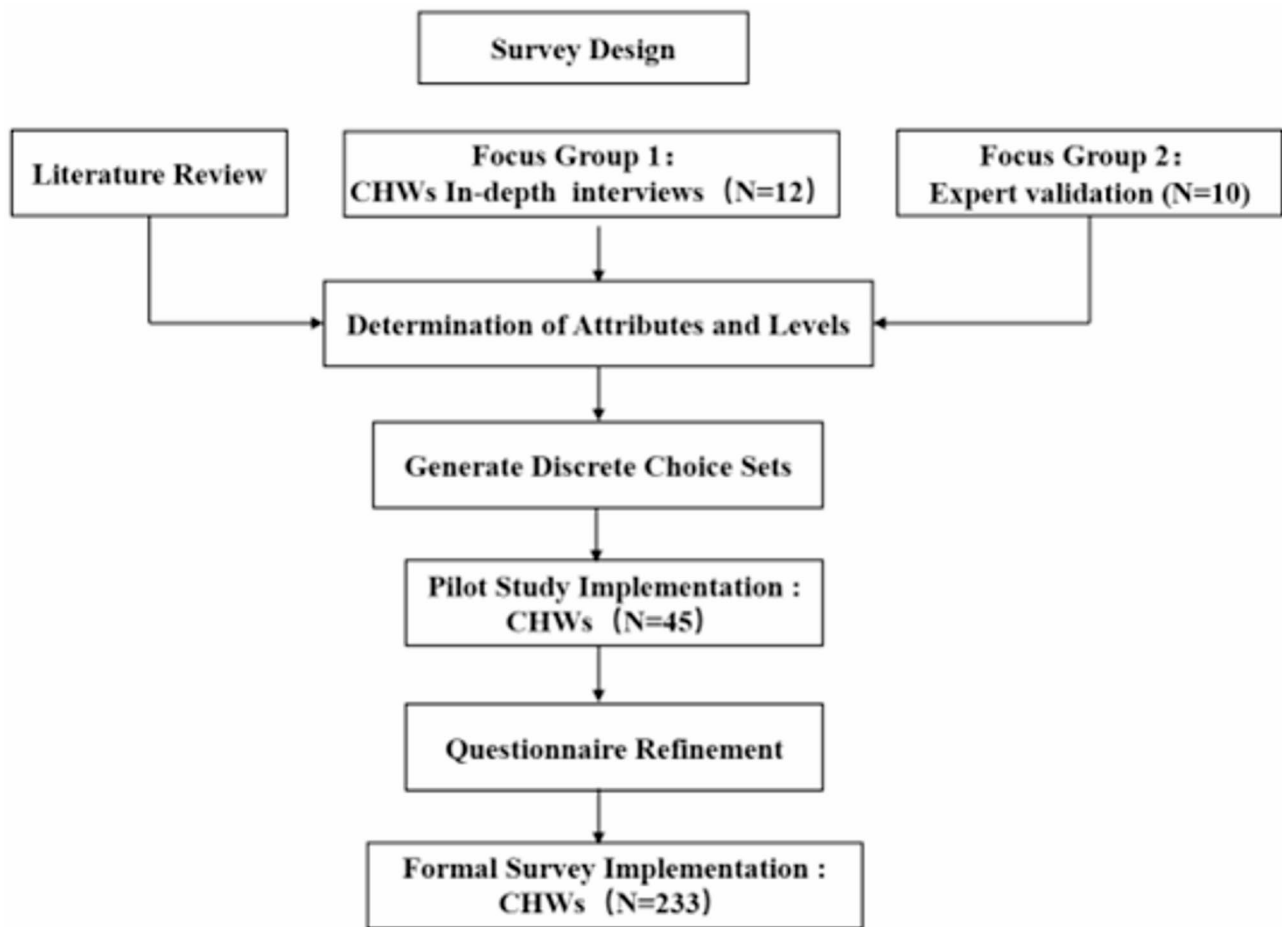


Fig. 2 Survey design process of the discrete choice experiment for vaccine communication training of community health workers

was not concerned with how the training was conducted or whether there was staged or summarized feedback on the training results. Typically, there are two reasons why an attribute is not statistically significant: Either the surveyors did not estimate the model parameters efficiently or the attribute was sufficiently heterogeneous in terms of population preferences.

The number of standard deviations indicates the heterogeneity of decision makers' preferences for specific attributes and levels of each option. As can be seen in Table 3, there is a statistically significant difference in the distribution of standard deviation in the training period of 7 days, training content of communication skills, training method of case discussion and simulation, and feedback on training effectiveness of final feedback, which indicates heterogeneity in the preference of community-based vaccinators for the said levels.

Therefore, when constructing a training program on communication skills for community vaccination personnel, emphasis should be placed on choosing a short training cycle, focusing on emphasizing the basics of vaccines,

and ideally keeping the number of participants at less than 50.

Discussion

To date, the DCE has been used to study healthcare workforce issues in medically related fields, but minimally in the field of continuing medical education [42]. Unlike most studies of topics related to continuing medical education, we addressed the topic of vaccine communication competency training for CHWs, which is currently less studied; traditional structured questionnaires and interview surveys were not used in this study of their training preferences. To the best of our knowledge, this is the first study to use a discrete choice experiment to explore the preferences for vaccine communication training programs among Chinese CHWs. We identified the basic attributes of communication training preferences of CHWs through qualitative interviews and literature review by combining the corresponding attributes into a choice set for subjects to select through discrete choice experiments to simulate possible scenarios of programs for real vaccine communication training, obtain the

communication training preferences of CHWs, and propose a communication training program for CHWs.

Our results indicate that the CHWs prefer programs with shorter training cycles. This is consistent with the findings of many communication training studies conducted in healthcare organizations, where the benefits of reduced training duration included lower delivery costs and less disruption to health services, allowing CHWs to spend less time away from their work roles [43, 44]. The heavy workload of CHWs may be the main reason why learners prefer more targeted and practical short-term training. A survey of communication training workshops developed for clinicians and nurse practitioners revealed that most learners prefer short workshops because of their busy day-to-day work [45]. Simultaneously, short-term communication training can be easily integrated into the work schedule of CHWs, improve the knowledge and skills of participants in a short period of time, and have the same long-term impact in the actual workplace [46, 47]. During the study period, the prevention and control of novel coronaviruses in China entered a normalized phase, in which CHWs played an important role. The strict normalized prevention and control policy placed a heavy burden on primary healthcare professionals. For example, during the period of closure and control of the epidemic, the population generated numerous shortfalls of various types of vaccines, which led to CHWs being in a constant state of overload [48, 49]. Due to their heavy workload, CHWs prefer short-term training to improve themselves without affecting their regular work.

The preference for short-term training of CHWs corresponds with the future needs of developing countries regarding vaccine communication policies. The acute shortage of trained CHWs in developing countries is a common significant problem for healthcare systems. A shorter training period facilitates the community's ability to train more CHWs, which can increase the capacity of the health system's CHWs in the short term and the health system's capacity to serve the community [34]. We found that the one-day training cycle is consistent with the results of most CHWs' training preferences in vaccine communication skills and can serve as an effective reference for the future development of vaccine communication training or even other training by government agencies or community-based organizations in developing countries. In China, health workers also receive financial subsidies and credits for participating in training. For example, external training may provide accommodation and meal subsidies, which are regarded as institutional benefits. Continuing education credit allocation is also typically linked to training duration. This may offset community health workers' preference for short-term training. Therefore, external incentives can be incorporated

into the implementation of training, linking participation in vaccine communication training to substantial benefits to improve community health workers' acceptance.

In terms of the choice of training content, CHWs were more willing to improve their ability to accumulate basic vaccine-related knowledge through training. The results of our in-depth interviews with CHWs also verified that they were willing to learn more about basic vaccine-related knowledge and organically translate that knowledge into practice. Basic knowledge of vaccines is particularly important for health workers working with vaccines, and a survey conducted in Canada showed that 95% of residents strongly agreed that basic knowledge of vaccines was important for their careers [50]. Similarly, 96% of U.S. paediatric residents believed that they would benefit from more information about vaccine-preventable diseases [51].

Vaccine-related knowledge is dynamic and requires continuous learning by practitioners such as CHWs. The half-life of medical knowledge is 7–10 years. In the face of changing knowledge related to vaccination, the ability to learn on one's own is important for CHWs' professional behaviours [52]. However, the long-standing educational trend of passive learning for post-continuing education has made CHWs less aware of their learning needs to acquire and master basic knowledge related to vaccines. Some scholars have found that although health workers may have a strong desire to learn and be able to identify their learning needs, they may face challenges in identifying relevant resources and managing their time and strategies [53]. Consequently, CHWs were more likely to acquire knowledge about vaccines through passive training and learning in their training choices.

The practicality of vaccine-related knowledge may be the main reason for CHWs' preference. Vaccine-related knowledge, such as knowledge of vaccination and precautions, was the most frequently used content by CHWs in their daily work, and the practicality of the training program was the most important factor that participants were concerned about, as they hoped that the content of the training could be effectively linked to reality and promote their work in their daily lives [54–56].

It is also worth noting that the desire of CHWs to receive communication skills training in the training content is low and that CHWs do not seem to pay much attention to communication skills. This phenomenon also occurs with other health workers; although most of them desire to be good communicators and need to practice communication skills, they prefer to focus on their daily work and practical tasks [57]. The lower preference for communication skills training among CHWs may stem from their perception of immediate needs. Interview data revealed that vaccine-related issues (e.g., vaccine safety, contraindications) dominated their

interactions with vaccine recipients, necessitating proficiency in technical knowledge. As one CHW stated: “If we can answer questions clearly, the public will trust us more—this is more urgent than communication styles.”. Although all interviewees acknowledged occasional communication challenges, most perceived these burdens as manageable, particularly when interacting with populations with higher health literacy (e.g., educated parents). For instance, one participant remarked: “Communication difficulties do exist, but they are infrequent. I believe I can explain patiently; the issue might lie in how I present the information.” Furthermore, our interviews identified that some CHWs viewed communication as having limited impact on deep-seated vaccine hesitancy, advocating for broader public education beyond clinical interactions. For example: “Accurate vaccination awareness requires long-term campaigns, not one-time communication during immunization. When Chinese scholars surveyed the training needs of community health service organizations, they found that the training of primary healthcare workers was mainly based on job skills training, and there was very little training in communication [58]. Basic knowledge of vaccines is the main component of communication between CHWs and vaccinators, and good communication skills are the medium of effective communication that helps vaccinators understand and make the best vaccination decisions, both of which are indispensable. Therefore, future vaccine communication training programs should be developed to understand CHWs’ basic knowledge of vaccines, ensure that CHWs are proficient in vaccine-related knowledge, and increase communication skills training.

The CHWs preferred smaller training sessions with fewer than 50 participants. Among the many factors that affect the quality of teaching and learning, class size is important [59, 60]. Smaller training sizes facilitate deeper learning; develop communication, problem-solving, and thinking skills; and improve the effectiveness of training. Developing these skills is difficult in traditional large classroom environments dominated by lectures [61]. Smaller training classes based on application, discussion, and problem solving, in which learners are motivated to engage in more in-depth reading, open discussion, and active participation, have been found in similar studies to be successful in improving communication, critical thinking, and problem-solving skills in medical students [62]. Some researchers have determined the exact number of people required for small-scale lectures, and their results indicate that the number of lectures in medical training should ideally be limited to approximately 30 [63]. This is consistent with our finding that such higher-order learning is more likely to occur in small-group settings than in large-group settings if learners are engaged in problem solving rather than simply receiving

information [64, 65]. The class size of less than 50 people was preferred because, due to the relatively small number of trainees, training experts in the training classroom can better communicate with the learners and pay attention to each learner. This enables them to understand the learner’s knowledge, skills mastery, and timely access to the training effect of feedback, so as to improve the quality of training [66]. Therefore, small-scale training could be the primary form of training for the future development of vaccine communication programs for CHWs.

Choosing an appropriate training method according to the target and content of training is conducive to improving its effectiveness. However, it is worth noting that our findings indicate that training modality does not have a significant effect on the training choices of CHWs, which is inconsistent with some earlier training surveys. With the advent of digitization, online distance training has become the preferred method for in-service training of CHWs [67]. However, this study describes mostly rural CHWs. For some remote and economically underdeveloped areas, online training for CHWs can reduce the training cost, thereby reducing the contradiction between learning and working. CHWs in urban and economically developed areas attended more CDC meetings and training programs, and spent less time and money for transportation [58]. The staff of the community health service centres in Harbin City investigated in this study had the convenience of both on-site conference training and online remote training, thus, there was no significant effect of the type of training mode available to them. Simultaneously, we found that some participants in the training conducted in healthcare organizations preferred a hybrid training mode that combined online and offline training [68, 69]. This type of training is personalized and can serve as a good reference for future vaccine communication training methods.

This study was conducted in five community health service centres in Harbin City, Heilongjiang Province, as a preference survey for communication skills training based on a discrete choice experiment. The results of our study on preferences for vaccine communication training were adopted by the Heilongjiang Provincial Health Commission in 2022, with curriculum design for vaccine communication training developed based on the study’s findings. The training targets general practitioners and general nurses in primary healthcare institutions, and two rounds of training have been conducted to date. This initiative highlights the translational value of preference-based training design, ensuring alignment with frontline needs. These positive effects can be further accelerated through training; however, no training program is appropriate for all training situations. To summarize this study, we recommend that policymakers and administrators design vaccine communication training for CHWs to be

short, small-scale, and vaccine-based and to last about one day, and that specific training methods be chosen for their appropriateness, considering the venue of the training and the specific audience involved.

This study has several limitations. First, only a few community health service centre staff members in one city were selected for the survey, which limits the generalizability of the findings. However, given the lack of studies on vaccine communication training for health-care workers at the grassroots level in China, this study is both exploratory and pioneering. Second, although the attributes included in our study were identified and selected based on previous literature, expert interviews, and focus group discussions, we could not guarantee that all attributes related to the choice of vaccine communication training desired by CHWs were included. Third, the finding that the training modality and feedback did not have an impact on CHWs' preference for vaccine communication training differs from our initial hypotheses as well as findings from previous literature. This result warrants a more in-depth follow-up study. The routinised pandemic control policies during the study period placed significant demands on CHWs, potentially reinforcing their preference for time-efficient training formats. Future studies should explore training preferences under non-pandemic conditions to validate generalizability.

Conclusions

Good communication is essential for high-quality, effective, and safe medical practice. Positive vaccine recommendations by health workers increase public confidence in vaccines, and good communication behaviours positively affect recipients' willingness to be vaccinated. Although communication skills can be effectively improved through training, currently, minimal relevant training is available for CHWs. Using a discrete choice experiment (DCE), this study investigated the preferences of CHWs for participating in a vaccine communication training program. The DCE-based study showed that of the five attributes considered, training cycle, training content, and training size had a significant effect on the choice of communication skills training programs for community vaccination workers, with CHWs preferring a one-day training cycle, training content focusing on vaccine basics, and a small number of people to be trained. The results of this study can inform policymakers and administrators when developing vaccine communication training programs for CHWs.

Abbreviations

AIC	Akaike information criterion
BIC	Bayesian information criterion
CHWs	Community Healthcare Workers
DCE	Discreet Choice Experiment
ISPOR	International Society for Pharmacoeconomics and Outcomes Research

SD Standard deviation

Supplementary Information

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Supplementary Material 1

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Author contributions

Y.Z., Y.L. and M.J. conceived the study idea and designed the study proposal. Y.Z. and Z.S. design questionnaires, collect data, review records, and analyze and interpret results. Y.X. and Y.W. contributed to the conception and design of the study, Y.Z., Z.S. and Y.W. did the statistical analysis and drafted the original manuscript. Y.Z., Y.L. and Z.S. contributed to the analysis, interpretation of data and revising it. L.S. and Z.Z. contributed to the revision of manuscript. Y.Z., Y.L. and Z.S. contributed equally. M.J. is the guarantor of this study. All authors contributed to data interpretation and rewriting the paper.

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Data availability

We are willing to share the data should anyone ask you for it, and are prepared to work with any interested researches on the re-analysis of the data particularly if for a systematic review using participant level data. Please contact Ms. Zhang at zhangyuweizyw1999@163.com for approval if necessary.

Declarations

Ethics approval and consent to participate

Informed consent was obtained from all participants (all participants are older than 16), which was in the form of questionnaires. The informed consent form described the purpose and method of data collection and ensured that the data would be kept confidential. The Research Ethics Committee of Harbin Medical University approved the procedure for obtaining informed consent(number/ID: HMUIRB20160014). All the methods included in this study are in accordance with the declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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