



## Development and psychometrical assessment of competency-based Community Health workers' Interpersonal Communication Skills Questionnaire (CHWs-ICSQ) based on intervention mapping approach: A novel Method

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### Abstract

Given the importance of communication skills and undesirable status of these skills among Community Health Workers (CHWs) and lack of a comprehensive, theory- and competency-based questionnaire in this field, the current study aimed to develop and psychometrically assess competency-based communication skills questionnaire based on Intervention Mapping Approach (IMA) for CHWs.

This methodological study was performed at 2019. Firstly, through performing a qualitative study and literature review, CHWs' competencies in regard to communication skills was determined. Then, behavioral determinants were determined based on literature review. Following primary designation of questionnaire, face and content validity was assessed, and then through fulfillment of questionnaire by 657 CHWs, construct validity was performed using Confirmatory Factor Analysis (CFA) by AMOS software. Finally, reliability of the questionnaire was assessed by determination of Cronbach's alpha coefficient and Interclass Correlation Coefficient (ICC) by SPSS software version 20.

Mean and standard deviation of age of CHWs was  $37.35 \pm 8.21$  years. CVR and CVI of items of questionnaire were between 0.8 and 1, and the impact scores ranged from 3.6 to 5. Cronbach's alpha coefficient for total questionnaire was 0.918, and Cronbach's alpha coefficient of constructs of questionnaire ranged from 0.646 (knowledge construct) to 0.937 (performance construct). ICC for constructs ranged from 0.619 (knowledge construct) to 0.926 (performance construct). Indices of model fit were at acceptable range and confirmed sufficiency of the model.

Development of the competency-based communication skills questionnaire based on IMA leads to develop a tool to evaluate communication skills with desirable indices. Therefore, it is recommended to use IMA to develop the questionnaire in context of communication skills, health education and behavioral change.

**Keywords:** Communication Skills; Community Health Workers; Intervention Mapping; Psychometry.

## Introduction

Communication skill is one of the important competencies in health professions and especially in the context of health education (1-14). Proper relationship of staffs in various health professions with patients and clients has positive effects and outcomes on health, such as improvement in vital signs, improvements in markers of disease control such as hemoglobin A1c and blood pressure, decline in pain and anxiety, better cooperation of patient in therapeutic program, increase in satisfaction of client, patient and clinician, improvement in physical health, mental and emotional health, increase in self-efficacy at health care professions, decline in aggression in patient, prevention of occupational exhaustion, prevention of complaints related to medical errors, improvement of care indices, better performance in daily activities, and improvement in quality of life in patients with cancer. On the other hand, incorrect relationship can make negative effects on health, such as incorrect diagnosis, making patients confused, decline in cooperation of patient during therapeutic programs, stress of clinicians and mental distress for patient (15-37).

Scientific evidences showed that CHWs can be effective in improvement of population health in low-, moderate- and high- income countries. Evidences showed that CHWs have critical role in population-based programs which improve health outcomes (38). CHWs are the most important ring in communication chain of primary health care programs and they need considerable skills to establish effective communication in order to make an effective role in prevention as well as promotion of society's health (39). Therefore, communication skills are among required competencies for CHWs (34, 40, 41). Their knowledge and communication skills are fundamental for success in the health system, and a continuous process should guarantee providing opportunities for health staff to make their knowledge up to date, promote their communication skills and validate their personality as a health educator (42). However,

various studies have shown that communication skills of health care providers such as CHWs, health care staffs, nurses and physicians are not desirable (43-48).

There are more than 31000 CHWs in Iran, who have important role in promotion of health in rural population (38, 49). Program of Iranian CHWs is a complete sample of comprehensive primary health care, in which they present basic health care; in addition they work with other members of the society and other sectors to addressing the social determinants of health (50). To promote communication skills among CHWs and their clients, access of a standard questionnaire to assess this communication and its determinants is necessary, since by assessment of this communication and identification of factors affecting it (determinants), promoting communicative behavior could be implemented.

Various studies (25, 51-53) performed development and psychometrically assessment of the questionnaire to assess communication skills, but questionnaires did not consider determinants of communicative behaviors in developing questionnaire. On the other hand, IMA is a comprehensive approach in precise identifying determinants of behavior. In this approach, matrices which combine performance objectives with determinants are a basis for development of the program (54). So, development of questionnaire using this approach considers behavioral determinants in questionnaire development.

Therefore, given lack of a theory-based tool to assess relationship between CHWs and their clients and also determinants of this relationship, the current study aimed to develop and psychometrically assess competency- and theory-based communication skills questionnaire according to IMA for CHWs.

## Methods

This methodological study was performed at 2019 as a part of a large study based on IMA. Seven steps were performed to develop communication skills questionnaire: identification of required competencies of CHWs related to communication skills, identification of

determinants of communicative behavior, development of questionnaire's items, assessment of validity of questionnaire, assessment of content validity of questionnaire, assessment of construct validity of questionnaire, and reliability assessment of questionnaire.

Each step is explained as follow:

#### *Identifying required competencies of CHWs related to communication skills*

To identify competencies of health workers in regard with health education and communications, a literature review was performed (1-14), and in addition one qualitative study was performed in content analysis approach by participation of specialists in health education and promotion (10 individuals), health experts (19 individuals), and physicians (2 individuals) at various levels of health system that were selected using purposive sampling. Data were collected using face to face interviews. Gathered data from literature review and qualitative study were integrated, and then, to achieve consensus in regard to competencies, Delphi technique was used. Researchers were Ph.D graduates and Ph.D Candidates as well as faculty members of medical university. Researchers had experience in qualitative study and health communication. Interviewers' characteristics such as reason and interests in research topic were reported to participants. The guide of questions were used for interviews, and it should be mentioned that guide of questions was tested in a pilot study. Data were collected at workplace. Audio recording was used for data collection. The duration of each interview session was approximately 40 minutes to 90 minutes. Data Saturation was done after 29<sup>st</sup> interviews but data collection continued to the 31<sup>st</sup> interview for greater confidence. Two researches coded data and themes derived from the data. Participants provide feedback on open codes. MAXQDA software was used for data management.

#### *Identification of determinants of communicative behavior*

At this stage, keywords of “communication skills”, “inter-personal skills”, “model”, and “theory” were searched at scientific databases of Google Scholar, Scopus, and Science-direct. Studies were selected based on title at first stage, based on abstract at second stage, and based on full-text at third stage, and a primary list was prepared. Inclusion criteria were as follow: publications in Persian and English language focused on determinants of communication skills. Exclusion criteria included lack of access to full-text, and not meeting study inclusion criteria. After selection of studies, determinants of communication behaviors were identified.

#### *Development of items of questionnaire*

It was developed according to the data obtained from first step (literature review and qualitative study), and second step (determinants of communication behavior), items of questionnaire were developed in domains of knowledge (16 items), skill (7 items), self-efficacy (7 items), attitude (7 items), Barriers (6 items), and subjective norms (6 items).

In addition, due to the literature review, one questionnaire to assess communicative behavior of health workers (15, 51) was previously designed and validated, and was based on the objectives of the study (after obtaining permission from developer of the questionnaire) and was used according to the opinion of research team as domain of behavior (36 items).

Knowledge scale consists of 16 items with three-option answers (correct, incorrect, I don't know). These items assess knowledge of respondents related to interpersonal communication skills.

Scale of attitude, skill, and self-efficacy consists of 7 items with five point Likert responses (strongly agree, agree, neutral, disagree, and strongly disagree), which assess positive or negative attitudes, skill and judgment of respondents in regard to their ability to apply their interpersonal communication skills, respectively.

Barriers scale consists of 6 items with five point Likert responses (strongly agree, agree, neutral, disagree, and strongly disagree). These items assess barriers on application of interpersonal communicative skills.

Subjective norms scale consists of 6 two-section items, first section of each item assesses opinion of influential individuals related to the application of interpersonal communication skills according to viewpoint of respondents through 3-choice answers (yes, approximately, and no), second section of each item assesses importance of opinion of influential individuals for respondents through 3-choice answers (yes, approximately, and no).

Performance scale consists of 36 5-option items (always, often, sometimes, rarely, and never). These items assess performance of respondents related to interpersonal communication skills.

#### *Assessment of face validity of questionnaire*

To assess face validity of questionnaire, two qualitative and quantitative methods were used; in qualitative method, in order to assess the difficulty level and the rate of relevancy and ambiguity, face-to-face interview was conducted with 15 CHWs to identify similarity of understanding of CHWs from questions with understanding of researchers.

In addition, questionnaire was provided to 10 specialists, and they were asked to declare their opinions in this regard. Based on the results of the interview and feedbacks of participants, the required corrections were done in the questionnaire.

In quantitative method of face validity assessment of questionnaire, in order to omit inappropriate items and determine importance of each of the items, impact score method was used.

In this method, the participants were asked to score the rate of importance for each items of the scale in a five point Likert; absolutely important (score of 5), partially important (score of 4),

moderately important (score of 3), less important (score of 2), and no importance (score of 1).

Then, the score of effect was calculated through related formula separately for each item: Impact score= Frequency (%) × Importance. A criterion of appropriateness of item for later analyses is effect score of 1.5 and more (55).

#### *Assessment of content validity of questionnaire*

In order to determine content validity, two qualitative and quantitative methods were used. In qualitative method, the rate of adherence of grammar and application of appropriate terms understood by target population, proper location of items in constructs, and also the way of scoring of questionnaire were assessed by specialists. Accordingly, opinions of 10 specialists of health education and promotion and three specialists of medical education and two experts of health education at deputy of health of university were used.

Results of content qualitative assessment showed that some of the items needed correction in grammar and application of proper terms, which were corrected based on the opinion of specialists. In quantitative method, two assessment methods for content validity include CVR and CVI were used. To compute CVR, ten specialists in health education and promotion were asked to assess each item based on three-section spectrum (necessary, useful but not necessary, and no necessity). Then, based on the given answers, CVR was computed for each item based on the following equation:

$$CVR = \frac{Ne - \frac{N}{2}}{\frac{N}{2}}$$

In this equation, Ne=number of specialists who selected necessary option, and N=number of total specialists. Since ten specialists participated, based on Lawshe table (55, 56), the value more than 0.62 was considered as acceptable criterion to accept items. One item was omitted in this stage.

In order to assess CVI, opinion of ten specialists in health education and promotion was

used, and CVI was calculated based on the recommended equation of Waltz and Bausell (55, 56) presented below:

$$CVI = \frac{\text{Number of raters giving grade of 3 and 4}}{\text{Total Number of raters}}$$

Specialists were asked to identify relevance, simplicity and clarity of each item, based on content validity index of Waltz and Bausell (55, 56).

These three criteria were regulated in a four point-Likert; Relevance (absolutely relevant, relevant, approximately relevant, and not relevant), simplicity (absolutely simple, simple, approximately simple, and not simple), and clarity (absolutely clear, clear, approximately clear, and not clear).

#### *Assessment of construct validity of questionnaire*

Construct validity was used to assess the sufficiency of tool to measure the present construct. The current study used CFA to determine construct validity. By the way, specific factorial construct on items locating pattern in each factor was assessed and confirmed by CFA. The questionnaires were fulfilled by 657 CHWs that were selected by random sampling method in Khorasan Razavi province (northeast of Iran). Prior to performing CFA, sufficiency of sampling was assessed by Kaiser-Meyer-Olkin (KMO) test and Bartlett test (55, 57). Normal univariate distribution of the data was assessed based on skewness index of  $\pm 3$  and Kurtosis of  $\pm 7$  (55). Normal multivariable distribution of data was assessed based on Mardia coefficient (more than 8) (55). Multivariable outliers were assessed by Mahalanobis d-square test (55). Missed data percentage was assessed using multiple imputation, and then was substituted by mean answers of participants (55). To assess fitness of model, indices of RMSEA, RMR, AGFI, PGFI, PRATIO, PNFI, PCFI, HOELTER, CMIN/DF were used (55). Data was analyzed by software of AMOS and SPSS16.

#### *Assessment of reliability of the questionnaire*

To assess and confirm internal consistency of the questionnaire, Cronbach's alpha was determined. It should be noted that Cronbach's alpha was computed for each of the constructs separately and for total questionnaire. In addition, ICC was determined for each of the constructs, separately.

#### *Ethical considerations*

The current study was approved as a part of another larger study at ethics committee of Tehran University of Medical Sciences (IR.TUMS.SPH.REC.1397.030). Before the initiation of the study, general objectives of the study were explained for the participants, and informed consent was obtained from all of them. In addition, the participants were assured on the confidentiality of their information.

## **Results**

### *Results of first step: required competencies of CHWs related to communication skills*

CHWs should have required abilities in establishment of effective communication with clients, colleagues, higher level staff, and others. They should be aware of types of relationships and can use them in various situations. CHW should be able to promote interpersonal communication through management of intrapersonal communication. In addition, they should be able to use general communication skills, listening skill, empathy skill, speaking skill, observing skill, questioning skill, interpretation and clarifying skill, encouraging and appreciating skill, and feedback skill to promote communication. They should have required capability in regard with understanding and analysis of communicative models (specifically simple communicative models). They should know properties of message sender, and show capabilities of a successful sender.

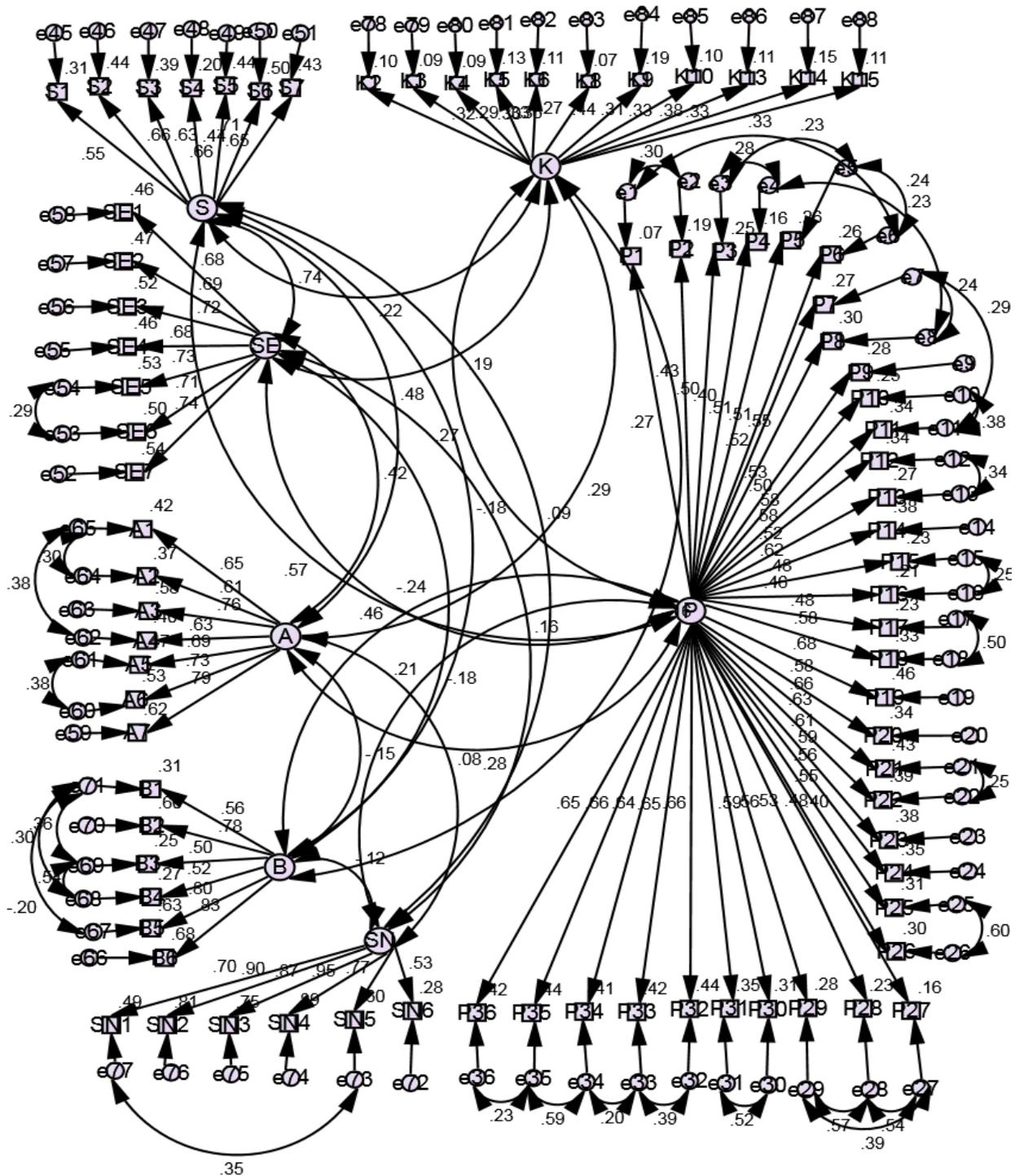


Figure 1. Community Health workers' Communication Skills Questionnaire Structure: Confirmatory Factor Analysis Model

They should have ability of identification and understanding of audience, and be able to empathy with him. They should be able to present appropriate messages according to conditions and audience. They should be familiar enough to communicative channels, and be able to select the most appropriate communicative channel (s) at each situation, and use it (them) properly. They should be aware of communicative barriers and be able to prevent occurrence of them, or resolve communicative barriers optimally in case of occurrence. They should have necessary ability to identify, develop, and provide messages using types of communicative strategies, methods and technologies. They should be able to use potential of non-verbal communication to increase efficacy of communication, and avoid non-verbal messages which lead to weakness of communication. It should be mentioned the corresponding author (Hashem Heshmati) conducted the interviews. Thirty one persons participated in the qualitative study and 1 person refused to participate in the qualitative study. There was nobody besides the participants and researchers. Participants were university professors, health experts and physicians with more than 10 years of experience.

#### *Results of second step: determinants of communicative behavior*

Determinants of communicative behavior included knowledge, attitude, skill, self-efficacy, barriers and subjective norms (58-63).

#### *Results of third step: items of questionnaire*

In total, 49 items in 6 domains of knowledge, attitude, skill, self-efficacy, barriers, and subjective norms were developed.

#### *Results of fourth and fifth steps: face and content validity of questionnaire*

Face validity of questionnaire: in assessment of face validity of questionnaire by specialists and CHWs, terms not clear sufficiently were substituted by appropriate terms, so that 18 ambiguous items or terms were determined by specialists and 5 terms or items were determined

by CHWs and were substituted by appropriate terms. Impact scores were between 3.44 and 5.

Due to the fact that the item's appropriateness criterion for subsequent analyzes is an impact score of 1.5 or more, therefore, no item was removed at this stage (Table 1).

Content validity of questionnaire: results of assessment of qualitative validity of the questionnaire showed that some of the items needed correction according to grammar and application of appropriate terms, which were corrected according to the comments of the specialists. For quantitative aspect, based on CVR index, one item was omitted due to not achieving the minimum score based on Lawshe table; CVR of the questionnaire's items was between 0.8 to 1. CVI of items was between 0.8 to 1 (Table 1).

In addition, two specialists had recommendations in addition to scoring the questions, and these recommendations were applied after assessment and confirmation by research team at section of face validity of questionnaire.

#### *Results of sixth and seventh step: construct validity and reliability of the questionnaire*

In total, 657 CHWs participated in the study which 70.9% of them were woman. In addition, 89.2% of them were married. Educational level of CHWs was a wide spectrum from elementary school to Master of Science, and most of them (61.9%) had diploma degree (Table 2). In addition, CHWs aged a wide range from 20 to 58 years old, and mean and standard deviation of their age was  $37.35 \pm 8.21$  years.

Results of the tests of Bartlett and KMO showed that there is the possibility to perform CFA on study sample (Table 3).

Four items were omitted due to low factor loading, items with factor loading close to 0.3 were preserved through cautious approach (64).

Factor loading of the questions in field of knowledge was between 0.267 and 0.436, in field of skill was between 0.443 and 0.706, in field of self-efficacy was between 0.678 and 0.737, in field of attitude was between 0.610 and

Table 1. Impact score, CVR and CVI of questionnaire Items

Items	Impact Score	CVR	CVI			Items	Impact Score	CVR	CVI		
			S-CVI	R-CVI	C-CVI				S-CVI	R-CVI	C-CVI
<b>Knowledge</b>						<b>Attitude</b>					
<b>K1</b>	4.70	1	1	1	1	<b>A1</b>	4.90	1	1	1	1
<b>K2</b>	4.23	0.8	0.9	1	0.9	<b>A2</b>	4.90	1	1	1	1
<b>K3</b>	4.32	0.8	1	1	1	<b>A3</b>	4.90	1	0.9	1	0.9
<b>K4</b>	5	1	1	1	1	<b>A4</b>	4.90	1	1	1	1
<b>K5</b>	5	1	1	1	1	<b>A5</b>	4.90	1	0.9	1	1
<b>K6</b>	4.32	0.8	1	1	1	<b>A6</b>	4.90	1	1	1	1
<b>K7</b>	4.90	1	1	1	1	<b>A7</b>	4.90	1	1	1	1
<b>K8</b>	4.90	1	1	1	1	<b>Barriers</b>					
<b>K9</b>	4.14	0.8	0.9	0.9	0.9	<b>B1</b>	5	1	0.9	1	1
<b>K10</b>	3.44	0.6(delete)	0.9	0.9	0.8	<b>B2</b>	5	1	1	1	1
<b>K11</b>	4.90	1	1	1	1	<b>B3</b>	5	1	1	1	1
<b>K12</b>	4.90	1	1	1	1	<b>B4</b>	4.23	0.8	0.9	0.9	0.9
<b>K13</b>	4.32	0.8	0.9	1	0.9	<b>B5</b>	5	1	1	1	1
<b>K14</b>	4.32	0.8	0.8	1	0.9	<b>B6</b>	5	1	1	1	1
<b>K15</b>	4.90	1	0.9	1	0.9	<b>Subjective Norms</b>					
<b>K16</b>	4.90	1	1	1	0.9	<b>Subjective Norms</b>					
<b>Skills</b>						<b>SN1</b>	5	1	0.9	1	0.9
<b>S1</b>	4.90	1	1	1	1	<b>SN2</b>	4.90	1	0.9	1	0.9
<b>S2</b>	4.90	1	1	1	1	<b>SN3</b>	4.32	0.8	0.9	1	0.9
<b>S3</b>	4.14	0.8	0.8	1	0.8	<b>SN4</b>	4.32	0.8	0.9	0.9	0.9
<b>S4</b>	4.90	1	0.9	1	1	<b>SN5</b>	4.32	0.8	0.9	0.9	0.9
<b>S5</b>	4.90	1	1	1	1	<b>SN6</b>	5	1	0.9	1	0.9
<b>S6</b>	4.80	1	1	1	1						
<b>S7</b>	4.90	1	1	1	1						
<b>Self-Efficacy</b>											
<b>SE1</b>	4.23	0.8	1	1	0.9						
<b>SE2</b>	4.23	0.8	1	1	0.9						
<b>SE3</b>	3.60	0.8	0.8	1	0.9						
<b>SE4</b>	4.23	0.8	1	1	0.9						
<b>SE5</b>	4.23	0.8	1	1	0.9						
<b>SE6</b>	4.23	0.8	1	1	0.9						
<b>SE7</b>	4.23	0.8	1	1	0.9						

Table 2. Demographics Characteristics of the assessed Samples for CFA

Variables		Number (%)
<b>Gender</b>	<b>Male</b>	167(25.4)
	<b>Female</b>	466(70.9)
	<b>No Response</b>	24(3.7)
<b>Marital Status</b>	<b>Married</b>	586(89.2)
	<b>Single</b>	37(5.6)
	<b>others</b>	34(5.2)
<b>Education level</b>	<b>Primary school</b>	8(1.2)
	<b>Secondary School</b>	72(11)

Table 2. Demographics Characteristics of the assessed Samples for CFA (continued)

Education level	Diploma	407(61.9)
	Technician	77(11.7)
	Bachelor Degree	62(9.4)
	Master of Science	3(0.5)
	No Response	28(4.3)

Table3: Result of Bartlett test و KMO

KMO(Kaiser-Meyer-Olkin Measure of Sampling Adequacy)	0.892
Bartlett's Test of Sphericity	27435.213
Df	3486
P.value	<0.0001

Table 4. Factor Loading, Cronbach's alpha and ICC of Knowledge, Skills, Self-Efficacy, Attitude, Barriers and Subjective Norms

Construct	Item	Factor Loading	Cronbach's alpha	ICC	Construct	Item	Factor Loading	Cronbach's alpha	ICC
Knowledge	K2	0.318	0.646	0.619	Attitude	A1	0.649	0.874	0.864
	K3	0.0295				A2	0.610		
	K4	0.298				A3	0.761		
	K5	0.365				A4	0.630		
	K6	0.326				A5	0.688		
	K8	0.267				A6	0.730		
	K9	0.436				A7	0.790		
	K10	0.312			Barriers	B1	0.561	0.848	0.817
	K13	0.333				B2	0.776		
	K14	0.382				B3	0.500		
Skills	K15	0.327	0.809	0.791	Subjective Norms	B4	0.516	0.913	0.903
	S1	0.554				B5	0.796		
	S2	0.664				B6	0.825		
	S3	0.628				SN1	0.698		
	S4	0.443				SN2	0.901		
	S5	0.664				SN3	0.867		
	S6	0.706			SN4	0.946			
Self-Efficacy	S7	0.653	0.875	0.866	SN5	0.772			
	SE1	0.678			SN6	0.529			
	SE2	0.688							
	SE3	0.724							
	SE4	0.680							
	SE5	0.731							
	SE6	0.708							
	SE7	0.737							

0.790, in field of obstacles was between 0.500 and 0.825, and factor loading of questions in field of performance was between 0.254 and 0.676. Therefore, factors are able to predict all the

observed variables (questions). Cronbach's alpha for total questionnaire was 0.918, and Cronbach's alpha for constructs of questionnaire was between 0.646 (knowledge construct) and 0.937

**Table 5. Factor Loading, Cronbach's alpha and ICC of Practice**

	Item	Factor Loading	Item	Factor Loading	Cronbach's alpha	ICC
	P1	0.267	P19	0.676	0.937	0.926
	P2	0.430	P20	0.585		
	P3	0.502	P21	0.659		
	P4	0.405	P22	0.627		
	P5	0.509	P23	0.614		
	P6	0.508	P24	0.588		
	P7	0.518	P25	0.561		
	P8	0.548	P26	0.546		
	P9	0.532	P27	0.399		
	P10	0.500	P28	0.483		
	P11	0.580	P29	0.529		
	P12	0.585	P30	0.560		
	P13	0.519	P31	0.595		
	P14	0.615	P32	0.665		
	P15	0.476	P33	0.647		
	P16	0.458	P34	0.640		
	P17	0.482	P35	0.661		
	P18	0.577	P36	0.651		

**Table 6. Pearson correlation coefficient among questionnaire constructs**

variables	Knowledge	Skills	Self-Efficacy	Attitude	Barriers	Subjective Norms
Knowledge	1					
Skills	0.168**	1				
Self-Efficacy	0.153**	0.643**	1			
Attitude	0.202**	0.408**	0.364**	1		
Barriers	-0.089*	-0.129**	-0.135**	-0.111**	1	
Subjective Norms	0.140**	0.141**	0.172**	0.111**	-0.222**	1
Practice	0.224**	0.498**	0.410**	0.233**	-0.181**	0.207**

\*\*P<0.001

(performance construct). ICC of constructs was between 0.619 (knowledge construct) and 0.926 (performance construct) (Tables 4, 5 and figure 1).

Pearson correlation coefficient showed a significant correlation between all the constructs of questionnaire, so that there was a significant positive correlation between constructs of knowledge, skill, self-efficacy, attitude, subjective norms, and performance, and there is a significant negative correlation between barriers and other constructs of questionnaire ( $P<0.001$ ) (Table 6).

Indices of model fitness were at acceptable range, and confirmed model efficiency. Therefore, the results of factor analysis showed that domains of communication skills questionnaire had acceptable construct validity (Table 7).

### Discussion

The current questionnaire was developed and psychometrically assessed using a

**Table7: Fit Indices Obtained in the CFA**

Fitness indices		Acceptable Range	The calculated value of indices	Result
<b>RMSEA</b>		< 0.08	0.048	Model verification
<b>RMR</b>		< 0.05	0.031	Model verification
<b>AGFI</b>		> 0.8	0.743	Close to nominal value
<b>PGFI</b>		> 0.5	0.711	Model verification
<b>PRATIO</b>		> 0.5	0.959	Model verification
<b>PNFI</b>		> 0.5	0.702	Model verification
<b>PCFI</b>		> 0.5	0.785	Model verification
<b>HOELTER</b>		> 200	275	Model verification
<b>CMIN/Df</b>		< 5	2.49	Model verification

comprehensive approach based on evidences, model and theory, and competencies extracted from qualitative study and also wide involving of stakeholders and accurate refinement of items, therefore, not only a comprehensive questionnaire was developed in this field, but also a comprehensive novel method based on the evidences is provided.

Six constructs with desirable psychometric properties were developed, which these constructs (58-63) predict communicative behavior of CHWs. According to the properties of this questionnaire, it can be concluded that this questionnaire is able to assess communicative behavior and its determinants among CHWs in Persian-speaking countries.

Although various studies have developed and psychometrically assessed questionnaire of communicative skills (25, 52, 53), the determinants of communicative behavior are not considered. The study by Ghafari far (60) assessed only two determinants of knowledge and self-efficacy. Therefore, it seems that despite important determinants to change and improve communicative behavior and specifically communicative behavior of health professionals, this issue is neglected in the development of questionnaires; therefore, it is recommended that with application evidence-based approaches such as IMA, determinants of behavior should be considered in the development of questionnaires.

Based on the results of the study, content validity of questionnaire is at a desirable level. Desirable content validity of the current questionnaire (55) showed high efficacy and accuracy of the IMA to develop questionnaire.

The results of the study showed that the current questionnaire has acceptable construct validity. However, indices of fitness model (55) represent the desirability of construct validity for the current questionnaire, but index of AGFI is close to nominal value. It seems tha, since CHWs are a heterogenic group, therefore highly desirable indices are not logically expected. On the other hand, according to the references, whenever the three indices have acceptable values, it can be claimed that fitness of model is reasonable (55).

Findings of this study showed that there is a significant correlation between all the constructs of questionnaire, however, correlation coefficient for some of the constructs is weak, but this weak correlation is theoretically logical, because most of the constructs determine performance independently. On the other hand, there was a significant negative correlation between barrier construct and other constructs of questionnaires; this issue is theoretically logical, since the more barriers, the lower desirable performance (65). In the current study, skill and self-efficacy had highest correlation coefficient with performance, respectively; in the study by Ghafari far (63) self-

efficacy was also determined as a predictor of communication behavior of interns. Due to high correlation between skill and self-efficacy and also high correlation between these two constructs with communication behavior, it seems that promotion of these two determinants has a very desirable effect on the performance of CHWs related to communication skills.

According to results of the current study, this questionnaire has desirable reliability (55). Desirable reliability of the questionnaire also represents high efficacy and accuracy of the IMA for the development of the questionnaire.

Strengths of the study, communication skills questionnaire for CHWs, resolve the lack of a theory-based tool to assess relationship between CHWs and their clients, and also determinants of this relationship. Due to systematic and evidence-based approach to provide this questionnaire, the current questionnaire has unique scientific properties in this context. In addition, the method of development of this questionnaire is a comprehensive and novel method for development of questionnaire for researchers.

One of the limitations of the current study is some subjective concepts, which was inevitable due to the subject of the study; therefore, researcher provides necessary explanations for fulfillment of items. As another limitation of the current study was high diversity among CHWs in regard to educational level, age, habitat, and their culture, therefore, it was tried to use a completely diverse combination of CHWs in assessment of face validity of questionnaire to increase face validity of questionnaire.

### **Conclusion**

Development of the competency and theory based questionnaire of communication skills based on IMA leads to design and development of a very desirable assessment tool of communication skills. Indices related to validity and reliability of the questionnaire were desirable. Therefore, it is recommended to use IMA to provide questionnaire in the contexts of communication skills, health education and behavioral change.

### **Abbreviations**

CHWs: Community Health workers; CHWs-ICSQ: Community Health workers' Interpersonal Communication Skills Questionnaire; IMA: Intervention Mapping Approach; CFA: Confirmatory Factor Analysis; ICC: Interclass Correlation Coefficient; CVI: Content Validity Index, CVR: Content Validity Ratio; KMO: Kaiser-Meyer-Olkin.

### **Ethics approval and consent to participate**

This research is part of the dissertation of the PhD thesis in Health Education and Health Promotion of Tehran University of Medical Sciences, approved by the National Committee on Ethics in Biomedical Researches (IR.TUMS.SPH.REC.1397.030). Ethics and trustworthiness were observed in the use of resources and data collection. The research units participated in the study with full and informed consent. After obtaining informed and verbal consent, participants were given written consent form to sign.

### **Consent for publication**

All authors agree to publish.

### **Availability of data and materials**

Data will not be shared because in the informed consent form, participants were assured that the data would not be shared.

### **Competing interests**

In the present study, the authors have no competing interests.

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### Authors' contributions

RS, HH, SMH, ESH, ARF and MMV were responsible for designing the study. HH was responsible for data collection. HH and ARF were responsible for data analysis. All authors read and approved the manuscript.

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