

# Assessment of Intraorganizational Collaboration in the health sector during Disasters: Exploring a Valid and Reliable Assessment Tool for Disaster Risk Management

## Abstract

**Background:** Collaboration, as a key factor in disaster risk management, is a mechanism that prevents the loss of time, investment, and resources. The variety of units in the health sector has made collaboration a major challenge. The present study aimed at developing a tool for assessing collaboration in the health sector during disasters. **Methods:** In this mixed-methods study, a questionnaire was developed by integrating the findings of a systematic literature review and a qualitative study. Face and content validation were performed. The reliability of the tool was tested through a 15-day interval test–retest by Cronbach’s alpha and intraclass correlation coefficient (ICC) with 30 participants. Confirmatory factor analysis was done to test the validity and reliability of instrument using SmartPLS in a case study with 450 health sector staff. **Results:** The factors affecting intraorganizational collaboration of the health sector were identified in six categories and 19 subcategories by searching 46 articles in the systematic review and content analysis of 16 semistructured interviews with health sector staff. The results of content validity ratio (=0.81), content validity index (=0.92), Cronbach’s alpha (=0.975), and ICC (=0.970) confirmed the validity and reliability of the tool. Convergent validity, discriminant validity, and reliability were approved by AVE (average variance extracted) >0.5, Fornell and Larcker matrix, and CR (composite reliability) >0.7. According to the positive result of  $R^2$ ,  $Q^2$ , and goodness-of-fit (GOF) criteria, the model fit was confirmed. **Conclusion:** The results of validity and reliability measurements approved the proposed tool. The use of this tool is recommended for developing collaboration in the health sectors of different countries.

**Keywords:** Disaster planning, disasters, health care sector, intersectoral collaboration, natural disasters, surveys and questionnaires

## Introduction

Natural disasters have been affecting societies and causing serious damages to human life and health.<sup>[1]</sup> The frequency of natural disasters and their consequences, such as death, injuries, and financial losses has been increasing over the years.<sup>[2]</sup> After the occurrence of disasters, different services are essential for responding to the needs and compensating for the damages, and health systems play a critical role in providing services to the first and most important demands of the affected people.<sup>[1,3]</sup> Population displacement, high-density settlements, and weak response to basic health needs create a situation that endangers people’s health in disasters.<sup>[4]</sup> The health sector with the liability of the Ministry of Health and Medical Education (MOHME) takes

necessary measures to help the health system respond to disasters.<sup>[5]</sup> Therefore, all stakeholders in the health sector should be well prepared to provide compatible, integrated, accessible, and coordinated services to reduce mortality, morbidity, and injuries, and increase the number of survivors.<sup>[1,6-9]</sup>

The concept of collaboration in disasters refers to the close relationships of units whose services are required at the time of disasters so that all of them are aware of their duties and collaborate to achieve a common goal. Collaboration as a key factor of disaster risk management success,<sup>[10]</sup> is a mechanism that prevents the loss of time, investment, and resources in disasters.<sup>[8,11]</sup> The variety of different units and departments in the health sector, including the providers of prehospital

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**Website:**  
[www.ijpvmjournal.net/www.ijpvm.net](http://www.ijpvmjournal.net/www.ijpvm.net)

**DOI:**  
10.4103/ijpvm.IJPVM\_696\_20

## Quick Response Code:



**How to cite this article:** Yousefian S, Jahangiri K, Mehrabi Y, Sohrabizadeh S. Assessment of Intraorganizational Collaboration in the health sector during Disasters: Exploring a Valid and Reliable Assessment Tool for Disaster Risk Management. *Int J Prev Med* 2022;13:10.

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services, public health services, curative, and rehabilitation services, as well as information management centers, safety and security centers, and planning and policy-making centers has made collaboration more difficult especially in disasters.<sup>[7,9,12-16]</sup> Lack of collaboration as an important challenge in the health sector has resulted in the disruption of tasks and parallel work and has prevented the procurement of suitable services in disasters.<sup>[8,9,14,15,17-20]</sup> Given that the issue has been rarely studied<sup>[8,15,17-19,21-23]</sup> and the focus of studies is more on the collaboration between different responsible organizations, evaluating the collaboration function can help the health sector by identifying and eliminating obstacles and problems of partnerships and improve future collaborations in disasters.<sup>[15]</sup> Despite the difficulty of evaluation in terms of different operational measures, indicators, and accountability systems,<sup>[24,25]</sup> the use of collaboration assessment results can lead to effective disaster response through improved collaboration.<sup>[26]</sup> Therefore, when designing and developing collaboration mechanisms, evaluation of this important managerial function using suitable tool and criteria should be considered.<sup>[24,27]</sup>

Totally, a valid and reliable assessment tool can help identify deficits and the domains that need to be changed<sup>[28,29]</sup> and provide accurate data for improving policies and plans.<sup>[30]</sup> For filling this gap, the present study aimed to design and validate a tool for assessing intraorganizational collaboration of the health sector in disaster management that can lead to improving collaboration among subunits of the health sector during disasters.

## Methods

### Study Design

A mixed-methods approach was applied for conducting the study between April 2019 and September 2020 in three stages in Iran's MOHME. The study was planned in three phases – systematic review, qualitative study for designing the tool, and a quantitative study for achieving reliability and validity criteria.

#### *Designing primary tool*

#### *Systematic review*

This stage was done for identifying the factors affecting intraorganizational collaboration of health sector in disasters management. During this stage, categories, subcategories, and appropriate items were identified and generated through searching in Scopus, Web of Science, MEDLINE (PubMed), ProQuest, Google Scholar, Scientific Information Database, and key journals. To include as many studies as possible, broad search terms were used: (“coordination,” “collaboration,” “cooperation”), (“intra-agency,” “intra-organizational,” “intra-sectional,” “intra-sectoral”), (“model,” “framework,” “theoretical framework,” “model,” “conceptual

framework”), (“disasters,” “natural disaster,” “hazards”) and (“health system,” “health sector,” “public health sector,” “health service,” “healthcare service”). These groups were combined with “AND” together and were looked up in selected databases. The studies related to effective factors on health sector collaboration in disasters management were searched from January 2000 to May 2019.

After removing all duplicates, the evaluation of studies was performed by the title and abstract screening and the inclusion criteria by two researchers. Finally, 46 eligible studies were included, and the full text of the selected articles was analyzed independently by two researchers considering the inclusion and exclusion criteria and standard quality assessment. In the case of disagreement in the selection of studies, a third person was the final decision maker to include them.

The data extraction sheet was designed regarding each study's information, including title, purpose, the name(s) of author(s), the year of publication, the data source, journal's name, the type of study, and study findings. And also all extracted data were evaluated by the research team to verify the accuracy and completeness.

#### *Qualitative study*

Qualitative content analysis with a deductive approach based on Bryson's model<sup>[31]</sup> was carried out to develop the model and to identify the components and factors influencing the success of intraorganizational collaboration in the context of Iran.

The participants of the qualitative stage were 16 managers and experts of MOHME and Emergency Medical Organization who had the experience of working in the field of disasters. All participants were selected by a purposive sampling method. We communicated with the units and departments of MOHME and Emergency Medical Organization to identify the participants and their experiences. Subsequently, the main criteria to choose the eligible employees included having at least 5 years of work experience in the health sector, having field-based experience in a natural disaster with a focus on earthquakes and floods, and having the willingness to participate in the interview. The number of participants was determined based on the saturation principles until no new concepts were developed.

We conducted semistructured interviews for data collection and extracting the experience of participants. The interview guide was provided with several questions and supplemented with complementary questions during interview sessions. Each interview session lasted between 20 and 60 minutes. Informed consent was obtained from the interviewees for recording the interviews. All interviews were recorded and transcribed verbatim in Persian. Data gathering and analysis were performed simultaneously such

that the retrieved information became a guide for further data collection.

The analysis took a deductive approach to discover the factors affecting health sector collaboration from the perspective of participants. All interviews were read several times to obtain a sense of the whole. The units of analysis were selected, and then meaning units were formed by extracting the text. The next step was labeling the condensed meaning units with a code. Finally, comparing the extracted codes with regard to their differences and similarities and grouping them into categories and subcategories formed the first draft of the collaboration assessment tool in disasters.

The trustworthiness of our study was assessed using four criteria.<sup>[32]</sup> Credibility was approved via the triangulation strategy. In addition to interviews, prolonged engagement with the subject provided credibility. Moreover, peer checks were conducted in research team meetings and member checks were done by providing a summary of the analyzed interviews and extracted codes to the participants. Conformability of the data was accomplished by the lead researcher. Transferability of data was confirmed by offering a comprehensive description of the subject, participants, data gathering, and data analysis. Dependency was assured through the current article, which offers detailed information for other researchers to replicate and extend the study.

### *Measuring validity and reliability*

#### *Quantitative study*

The findings of the qualitative study and the systematic review were used to design the primary tool and to remove the duplicated factors. At this stage, face validity, content validity, and reliability were measured.

**Validity:** The validity of the proposed questionnaire was assessed as follows:

- **Face validity**  
Face validity was measured by sending the questionnaire to 15 experts (including managers and experts of MOHME, universities, and Emergency Medical Organization) and receiving their overall conception in responding to all the items. For face validity, an impact score was computed through a 5-point Likert-type scale, in which the response “very important” was scored as 5 and the response “it is not important at all” was scored as 1. The impact score was obtained by multiplying the item’s frequency (the percentage of responses with the important score of 4 or 5) and item’s importance (importance of each item on a 5-point Likert-type scale). The cutoff point to select the items was calculated as 1.5, and the items with a value less than 1.5 were removed.<sup>[33,34]</sup>
- **Content validity**  
Content validity was measured through the content validity ratio (CVR) and content validity index (CVI)

criteria. In this study, 15 specialists in the field of health in disasters were selected to carry out the content validation forms. To calculate the CVR, each specialist determined the “necessity of each item” in the questionnaire by selecting one of the three options “not essential,” “useful but not essential,” or “essential,” and based on their ideas, the score of each item was determined from 1 to 3, respectively. Then using the equation related to this topic and considering the number of participants and the participants who selected the option “essential,” the CVR for each item was calculated. According to the Lawshe table that was used in this phase,<sup>[35]</sup> the acceptable CVR score was 0.49, and the items with scores less than 0.49 were removed.

The CVI was another approach for determining the content validity of the tool. So, in this stage, the questionnaire was sent to 15 experts, and all of them were requested to rate the tool items in terms of relevancy, simplicity, and clarity based on a 4-point scale and to select the score of each item from 1 to 4. For calculating the CVI, the number of experts who gave a score of 3 or 4 to each item was divided by the total number of experts. The items with scores higher than 79% were accepted, and the items with scores between 70% and 79% were revised.<sup>[36]</sup>

**Reliability:** Assessment of the external consistency of the tool was performed using test–retest method. This process was carried out with the participation of 30 health sector personnel with a 15-day interval between the two stages of test and retest. For every participant, the whole score was calculated at both the test and retest stages. Then the intraclass correlation coefficient (ICC) was calculated for the two scores to determine if there was a significant relationship between the responses in the two stages. With regard to 95% confident interval of the ICC estimation, the results of the calculation were interpreted based on the following classification: 0.0–0.2 (low), 0.21–0.40 (fair), 0.41–0.60 (moderate), 0.61–0.80 (substantial), and 0.81–1.0 (almost perfect).<sup>[33]</sup>

#### *Model evaluation*

In the final stage, a survey was conducted to generate the data for confirmatory factor analysis. The designed tool was distributed between the managers and experts of MOHME, Emergency Medical Organization, and 18 universities. The random sampling approach was used for data sampling. The acceptable sample size was estimated at 450 by considering five samples per each item.<sup>[33]</sup> After collecting the distributed tool, the data were entered into SmartPLS software. The measurement model of the study was assessed by determining its reliability and validity, and the structural model was assessed using  $Q^2$ ,  $R^2$ , and goodness of fit (GOF).

The reliability of the measurement model was established using the composite reliability (CR), factor loading, and

Cronbach's alpha ( $\alpha$ ). Cronbach's alpha and CR values above 0.7 were considered desirable. The validity of the measurement model was determined using both convergent validity and discriminant validity. Convergent validity was determined by average variance extracted (AVE) recommended values, and an AVE value above 0.50 was accepted. The measurement model's discriminant validity was determined using the Fornell and Larcker matrix.

$R^2$  was used to assess the explanatory power of the research model, and the predictive capability of the model was evaluated using Stone-Geisser's  $Q^2$  for endogenous constructs of the study. Both the criteria and GOF values above 0 were considered desirable.<sup>[37]</sup>

### Ethical Approval and Consent to Participate

This study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran (IR.SBMU. PHNS. REC.1397.112). All participants entered the study with their own written consent, and they were allowed to leave the project at any phase of the study. Besides, the participants were informed about the confidentiality of their private information in related reports.

### Results

#### Systematic review

In the first stage of this study in which a systematic review was carried out, the full texts of 157 out of 5,889 extracted studies were examined, and 46 eligible studies were included. By analyzing the selected studies, intraorganizational collaboration of the health sector in disasters was classified into six categories: initial conditions, collaborative structures, collaborative processes, facilitating factors, conflicts and tensions, and accountabilities and outcomes, which were classified into 16 subcategories.<sup>[38]</sup>

#### Content analysis

The qualitative stage of the study was conducted with 16 participants. The participants of this stage were in the age range of 32 and 50 years. Furthermore, 69% were male and 31% were female [Table 1]. Six categories and 19 subcategories were extracted from the data at this stage [Table 2].

**Antecedent Conditions:** This category with five sections reflects various issues as the initial conditions of collaboration in any organization. These factors facilitate collaboration by influencing the collaborative processes and structures.

**Structural Factors:** The collaborative structure is another important factor influencing the success of collaboration. This category reflects the necessity of integrated structures in disaster risk management; determining the tasks, roles, and responsibilities of all stakeholders; and

**Table 1: Demographic Information of Participants (Qualitative Study)**

Demographic characteristics	Sub-Category	N	%
Gender	Female	5	69
	Male	11	31
Age groups (years)	25-35	1	6
	36-45	9	56
	46-55	6	38
Work experience (years)	5-15	2	12
	16-25	11	69
	<25	3	19
Job position	Manager	10	62
	Expert	6	38

**Table 2: Categories and Subcategories Extracted From Qualitative Data**

Category	Subcategory
Antecedent Conditions	Laws and policies
Structural Factors	Organizational culture
	History of collaboration
	Access to resources
	Initial agreement
Process Factors	Design of collaboration structures
	Coordination governance
	Planning
Facilitating Factors	Executive capacity
	Communications
	Building trust
	Leadership
Disincentives Factors	Technology
	Incentives
	Organizational tensions
Accountabilities and Outcomes	Behavioral conflict
	Monitoring and evaluation
	Accountabilities
	Outcomes

describing power and authority relationships by defining decision-making and accountability paths.

**Process Factors:** This category focuses on building trust, communication, executive capacity, and planning. Collaborative processes help partners establish collaborative structures and vice versa, so the processes and structures have to be related to fostering collaboration.

**Facilitating Factors:** The existence of facilitators or drivers is essential for the success of the collaboration. The most important facilitators are leadership and technology.

**Disincentives Factors:** Tensions and conflicts within the organization can affect collaborative processes and structures. These organizational constraints are generally influenced by organizational culture.

**Accountabilities and Outcomes:** Types of assessments in the effective management of disasters; functional accountability; and individual, organizational, and social consequences are the main subjects of this category.

### Design and validation of the tool

At the stage of designing the intraorganizational collaboration tool in disaster, all categories and subcategories extracted from the previous two stages were checked out, and 154 items were extracted. The items were reviewed by the research team, and the repetitious and overlapping items were removed. The first version of the questionnaire was developed by selecting 110 items on six dimensions.

- **Face and content validity**

To determine content validity in the first round, CVR and CVI were computed for each question as well as for the whole tool by sending the tool to 15 specialists. Based on the Lawshe table, 17 items were removed because their CVR scores were less than 0.49. The total CVR (average of CVRs of all items) for the whole tool was 0.81. In the round of calculating the CVI, no question was removed. However, some questions with scores between 70% and 79% were revised. The overall scale's content validity (S-CVI) was measured to be 0.92.

To determine face validity, the tool was given to 15 employees familiar with the topic and who held responsible positions in the secretariat of the Health Policy Council in Disaster and in the Emergency Operation Centers (which are the centers of coordination and control of response operations in MOHME and medical universities). They were asked to judge the importance of each item, and based on their opinion the impact score of the items was calculated. According to the comments received, a few items needed to be revised, and seven items with a score less than 1.5 were removed. Eventually, after assessing the face and content validity of the tool, 88 items in six dimensions remained [Table 3]. In the final tool, a 5-point Likert-type scale was used (very high = 5, high = 4, medium = 3, low = 2, and very low = 1).

- **Reliability**

The stability of the tool was computed by ICC. In this stage, the average measure ICC was 0.970 with a 95% confidence interval from 0.952 to 0.984, which indicated desirable reliability of the tool. Besides, the reliability of the tool was measured with Cronbach's alpha for all dimensions and total items. The estimated Cronbach's alpha was 0.975, which fully confirms the internal consistency of the questionnaire. Cronbach's alpha and ICC of the six dimensions and the total tool are shown in Table 4.

### Measurement model evaluation

The results of descriptive statistics showed that most of the participants were female, in the age range of 36 to 45 years, having master's degree and above, and had more than 15 years of work experience [Table 5]. The examination of factor loading showed that the values of this indicator for question No. 56 in the structural factors, question No. 63 in the process factors, and question No. 80 in the disincentives factors were lower than 0.3, and were removed<sup>[39]</sup> [Figure 1] and the final questionnaire was accepted with 85 items [appendix]. The *T*-value in all items was greater than 2.58; this indicated that all factor loadings at the 99% confidence interval level were positive and meaningful [Figure 2].

Cronbach's alpha values and CR were greater than 0.7, which indicate a high reliability of the questionnaire.

Convergent validity was measured by the average variance extracted (AVE). The results showed that the measurement model of the current study had sufficient convergent validity because AVE values for all the variables were above the recommended values of 0.50 [Table 6]. The instrument in this study had good discriminant validity because each square root of AVE is larger than the correlation of the latent variables and the factor loading is a group in the same column [Table 7].

The results of the model fit showed that  $R^2$  is acceptable and the independent variables have been able to explain the changes of the dependent variable to an acceptable level. Also, positive values of the  $Q^2$  showed that the model has the power to predict relationships and the high-degree of GOF criterion approves the fit of the model [Table 6].

### Discussion

This study developed a tool for assessing the intraorganizational collaboration function as the most important challenge of the health sector in disaster management. The current tool that is extracted from a mixed-methods study considered six dimensions, which include antecedent conditions, structural factors, process factors, facilitating factors, disincentives factors, and accountabilities and outcomes. The validity and reliability of the tool indicate that the tool is accurate enough for intraorganizational collaboration assessment in disaster management.

A systematic and comprehensive approach was considered in developing the tool. This approach could help identify, clarify, and understand the concept, antecedents, and consequences of collaboration deeply and also facilitate its improvement.<sup>[8,30,31,40-42]</sup> A deep understanding of the concept of collaboration by health care providers results in an improvement in resource allocation, quality of service delivery, and people's health situation during disasters.<sup>[9]</sup> So the present tool with 85 questions in six categories, all

**Table 3: Results of Validity and Reliability Measurements**

Items		CVR	CVI	Impact Score
<b>Antecedent Conditions</b>				
Laws and Policies	Transparency policies and strategies in DRR	0.73	0.80	4.29
	Strengthen collaboration in strategies and policies	1	0.89	2.96
	Emphasis on implementation of DRR laws and policies	0.60	0.98	3.41
	Monitoring the implementation of laws and policies	0.87	0.93	3.31
Organizational Culture	Belief in teamwork	0.60	0.78	2.58
	Belief in systematic thinking	0.60	0.78	2.71
	Professional ethics observance	0.73	0.96	3.31
History of Collaboration	Experience of previous collaborations	0.73	0.93	3.03
	Recording experiences and lessons learned	1	0.98	4.17
	Freedom to record experiences	0.60	0.82	3.36
	Exchange of experiences and lessons learned	0.60	0.96	3.70
Access to Information Resources	Accepting EOCs as information management centers	1	0.91	4.36
	Transparency process of exchanging information	1	0.93	4.04
	Access to the electronic information registration system	0.87	1	4.17
	Information sharing between departments	1	0.91	3.70
	Access to comprehensive, reliable, and timely information	0.87	1	3.63
Access to Human Resources	Access to sufficient workforce in departments	1	0.96	3.47
	Access to knowledgeable and experienced workforce	1	0.96	3.81
	Recalling personnel based on incident leveling protocol	1	0.91	3.64
	Distribution of personnel based on the regional needs	0.87	0.89	3.31
	Personnel needs supply in the field of disaster	0.60	0.87	3.76
	Emphasis on relocation of workforce	0.73	0.87	3.12
	Emphasis on increasing the readiness of managers and employees through training	0.87	0.96	3.81
	Continuation of joint exercises	1	0.96	3.98
	Emphasis on the effectiveness of exercises and training	0.87	0.87	3.15
Access to Financial Resources	Estimation of financial resources to strengthen the collaboration	1	0.96	2.53
	Allocation of sufficient funds to implement plans	1	0.82	2.93
	Monitoring spending of funds	0.73	0.93	2.57
Access to Physical Resources	Identify capacities and equipment	0.73	0.96	2.71
	Supply and distribution of equipment based on needs of the field	0.73	0.98	3.13
	Strengthening space and infrastructure of the EOC	0.87	0.93	3.76
Initial Agreement	Common belief on collaboration in disaster management	1	0.87	2.62
	Mutual agreement on goals and plans	1	0.89	2.62
	Common perception of collaboration status and challenges	0.87	0.89	2.80
	Developing collaboration agreements between departments	1	1	3.31
<b>Facilitating Factors</b>				
Leadership	Acceptance Unity of Command in ICS and NRF	1	1	3.13
	Understanding of duties and responsibilities based on NRF by commander	0.87	0.93	4.04
	Delegation of authorities to the coordination officer in NRF and ICS	0.87	0.91	3.70
	Belief in implementation of disaster management strategies and plans by managers	0.87	0.98	2.28
	Communication skills of the commander and managers	0.87	0.87	3.23
	Teamwork skills of the commander and managers	1	0.93	2.71
	Decision-making skills of the commander and managers	0.87	0.96	3.18
	Experience of commander and managers in disaster management	0.60	0.91	2.79
Technology	Access to high-tech communication equipment	1	1	3.31
	Access to early warning systems	1	0.98	3.36
	Improvement of information systems and data banks	1	1	3.52
	Establishment of an integrated information system	1	0.96	3.81

Contd...

**Table 3: Contd...**

		CVR	CVI	Impact Score
<b>Items</b>				
<b>Structural Factors</b>				
Design of Collaboration Structures	Transparency organizational structure in disaster management	0.87	0.96	3.08
	Integration of disaster management structures	0.87	0.96	4.23
	The position and role of ECC in health sector	1	0.98	3.41
	Using chain of coordination in preparedness phase	0.87	0.89	2.53
	Using chain of command in response phase	0.87	0.89	3.03
	Acceptance Health Policy Council in Disaster by managers	0.73	0.89	2.24
	Transparency department's duty descriptions	1	1	2.58
	Personnel awareness on duties of departments	1	0.96	3.31
Coordination Governance	The task overlap among the departments	0.87	0.93	2.93
	Acceptance EOC as a decision-making center	1	0.93	3.99
	Decision making based on common goals and plans by commander and manager	0.87	0.91	2.71
	Delegation of authority to commander and managers based on responsibilities in the NRF	0.73	1	2.79
	Responsibility in achieving disaster management strategies and goals	0.60	0.98	3.25
<b>Process Factors</b>				
Planning	Developing and reviewing of disaster management plans with participation of stakeholders	1	0.96	3.76
	Developing disaster management plans with a single hazard approach	0.60	0.84	3.36
	Developing protocols and guidelines related to the functions	1	0.98	3.03
	Developing protocol based on needs assessment and regional capacity	0.60	0.87	3.13
Executive Capacity	Protocols and guidelines notification	0.73	0.96	2.71
	Transparency processes of the departments in disaster management	0.87	0.98	3.25
	Understanding of the common processes	0.87	0.96	2.76
	Collaboration in designing the common processes	0.87	1	3.36
	Implementation of disaster management plans (mitigation, preparedness, response and recovery plans)	0.73	1	3.52
	Monitoring in implementation of disaster management plans and protocols	0.60	1	3.47
	Modifying processes based on joint exercises	0.73	0.93	3.47
Communications	Emphasis on meetings of the Health Policy Council in Disasters	0.73	0.96	2.88
	Belief in attending Policy Council meeting and its committees	0.73	0.98	2.88
	Communication between the national and local levels	1	1	3.81
	Using the informal communication channels in disaster management	0.87	0.96	2.71
Building Trust	Emphasis on risk communication for managing rumors	0.73	0.96	4.17
	Trust in existing infrastructures and information resources	0.60	0.91	3.36
	Trust in competency of managers	0.60	0.91	3.08
<b>Disincentives Factors</b>				
Conflicts and Tensions	Fear of losing power	0.60	0.82	3.81
	Job competition	0.60	0.82	3.08
	Priority of departments specialized goals over common goals	0.60	0.89	2.76
<b>Accountabilities and Outcomes</b>				
Monitoring and Evaluation	Transparency in rapid assessment process	0.60	0.91	3.03
	Decision-making and response operations based on the results of rapid assessment	0.60	0.89	3.47
	Reform structure and process based on assessments	0.60	0.89	3.08
Accountabilities	Service compensation system based on performance accountability of workforce in disasters	0.73	0.96	2.76
Outcomes	Emphasis on organizational outcomes for improving collaboration	0.73	0.89	3.52
	Emphasis on individual outcomes for improving collaboration	0.60	0.87	3.47
	Emphasis on social outcomes for improving collaboration	0.60	0.82	2.98
Total		0.81	0.92	3.26

CVR=content validity ratio, CVI=content validity index, DRR=disaster reduction risk, EOC=Emergency Operations Center, ICS=incident command system, NRF=National Response Framework, ECC=Emergency Coordination Center

**Table 4: Cronbach's Alpha and Interclass Correlation (ICC) of Dimensions and Total Questionnaire**

Variable	Antecedent Conditions	Structural Factors	Process Factors	Facilitating Factors	Disincentives Factors	Accountabilities and Outcomes	Total
Cronbach's alpha	0.944	0.905	0.906	0.877	0.866	0.880	0.975
ICC	0.930	0.886	0.902	0.806	0.758	0.755	0.970

**Table 5: Demographic Information of Participants (Quantitative Study)**

Variable	N	%
Gender		
Female	229	51
Male	221	49
Age groups (years)		
25-35	54	12
36-45	274	61
46-50	90	20
<50	32	7
Work experience (years)		
5-15	182	41
16-25	217	48
<25	51	11
Educational level		
Bachelor of science	105	23
Master of science	238	53
Physician and PhD	107	24
Job location		
MOHME	230	51
University	190	42
Emergency Medical Organization	30	7
Job position		
Manager	159	35
Expert	291	65

MOHME=Ministry of Health and Medical Education

input, process, and output factors was considered and confirmed. The results of the calculations showed that the relationship between all six main factors with collaboration was positive and significant.

The initial conditions of collaboration can strongly affect the formation of collaborations. Having related and supportive policies and regulations; collaborative culture<sup>[11,31]</sup>; successful collaboration experiences<sup>[26]</sup>; the stakeholders' agreement on their mission, goals, policies, programs, values, problems, and their solutions<sup>[23,43,44]</sup>; and access to resources such as financial, human, physical, and information<sup>[45]</sup> are essential and preconditions of a successful collaboration.

Clarifying collaborative processes as another factor affecting collaboration requires plans and standard protocols.<sup>[46]</sup> Besides planning, communication and building trust are important factors of the collaborative process because these can reduce the complexity and transaction costs faster than other factors.<sup>[8,26,31,47-50]</sup>

Due to various times for response to different health needs of people affected by disasters, the health sector

should make clear the roles and responsibilities of each department in the various phases of disaster management.<sup>[9]</sup> The transparency in collaboration structure (horizontal and vertical) and the roles and responsibilities based on it can reduce confusion among groups involved and improve collaboration.<sup>[46,48]</sup>

Facilitating factors such as committed and powerful leaders and technology can facilitate collaboration.<sup>[31]</sup> On the other hand, tensions and conflicts can affect the collaborative process negatively and hinder the success of the partnership. Therefore, the use of appropriate conflict management methods such as regular meetings to raise and resolve problems will be helpful.<sup>[31,47]</sup>

Accountability and outcome are other factors affecting the success of the collaboration. The main subject in examining the accountability of providers and the consequences of collaboration is monitoring and evaluation, which play important role in identifying obstacles and problems, eliminating and preventing their recurrence, and increasing collaboration in future disasters.<sup>[15]</sup> Collaboration improvement using the results of collaboration assessment and outcomes like any reform effort in the health systems requires the support, participation, and commitment of all stakeholders.<sup>[30,31,42,44,45]</sup> The importance of this issue is such that its existence or nonexistence determines the success or failure of collaboration,<sup>[28]</sup> so it should be considered as a vital factor.

Monitoring and evaluating collaboration with the use of a suitable tool can help the health sector by identifying the current situation of collaboration and the strengths and weaknesses in disaster participatory management.<sup>[26,28]</sup> The results of the collaboration assessment create an opportunity to strengthen capacities, remove barriers, and prevent recurrence of inconsistencies in future disasters.<sup>[8,15,23]</sup> In this situation, it will be possible to provide an effective response and achieve the common goals.<sup>[48,51]</sup>

The research team encountered some limitations in each stage of the study. In the qualitative stage, the experiences of the participants in natural disasters with a focus on earthquakes and floods were extracted. The current tool has been developed in the Persian language and then translated into English. Thus, translation validity should be conducted by researchers who are not Persian speaking.

## Conclusions

The results of content validity and reliability measurements show that the current tool can be applied for analyzing



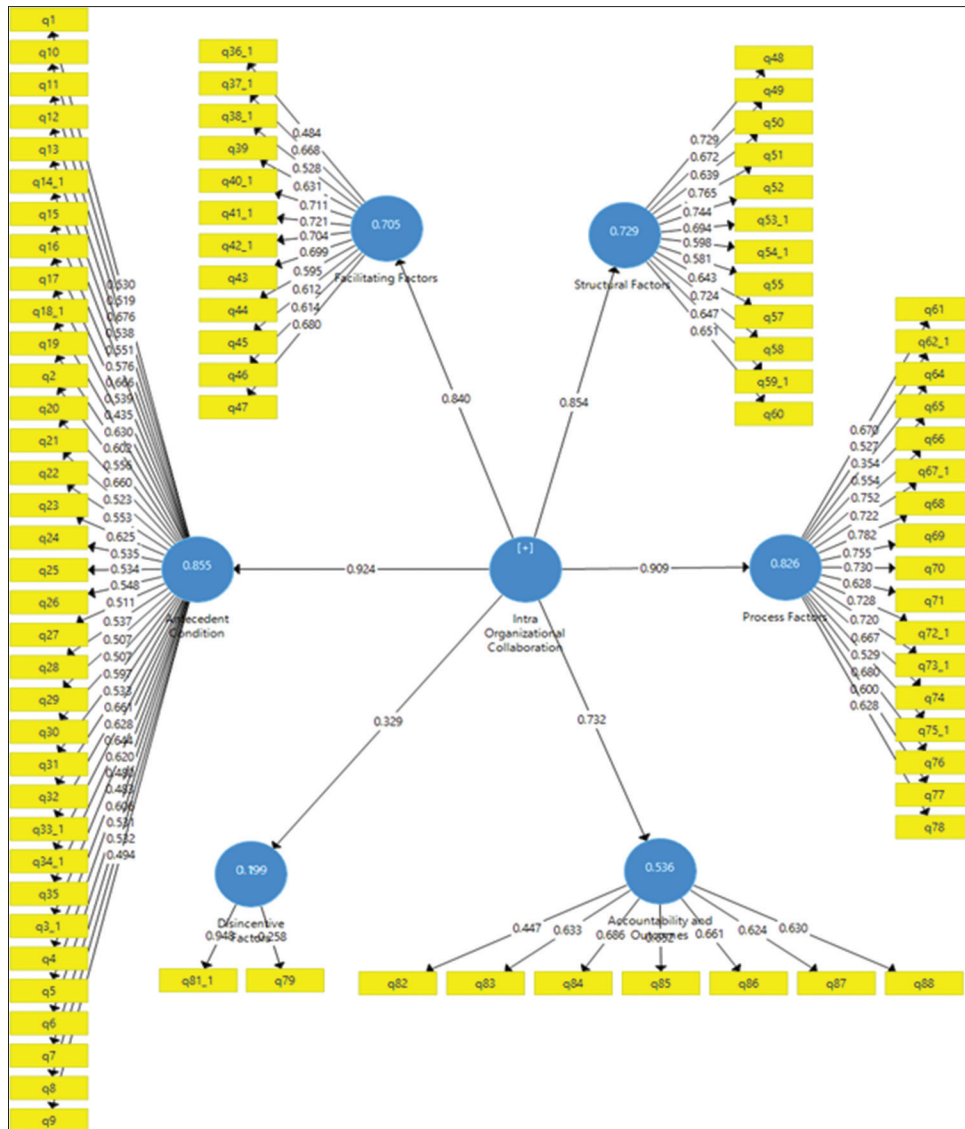


Figure 1: Variance, factor loading, and path coefficient

Table 6: Reliability, Convergent Validity, and Fitness Criterion

Variable	Cronbach's alpha	CR	AVE	R <sup>2</sup>	Q <sup>2</sup>	GOF
Antecedent Conditions	0.936	0.942	0.57	0.855	0.251	0.601
Structural Factors	0.891	0.909	0.635	0.729	0.309	
Process Factors	0.868	0.892	0.63	0.826	0.33	
Facilitating Factors	0.868	0.892	0.529	0.705	0.265	
Disincentives Factors	0.73	0.83	0.51	0.199	0.049	
Accountabilities and Outcomes	0.737	0.815	0.589	0.536	0.184	

CR=composite reliability, AVE=average variance extracted, GOF=goodness of fit

the situation of pre and post disaster collaboration in the health sector. Considering the impact of various factors on intraorganizational collaboration in disasters, a comprehensive tool with a systematic approach that can be easily applied by policymakers, managers, and health care providers was designed. Although the current tool was developed for the health sector in Iran's context, health systems in other countries with similar structure

and sociocultural context can apply this tool in disaster management. The use of the information provided by this tool is highly recommended for developing and revising policies, goals, strategies, and programs of the health sector in disaster risk management. Furthermore, the intraorganizational collaboration analysis tool can be used in all phases of disaster management, including mitigation, preparedness, and response. Further research is needed

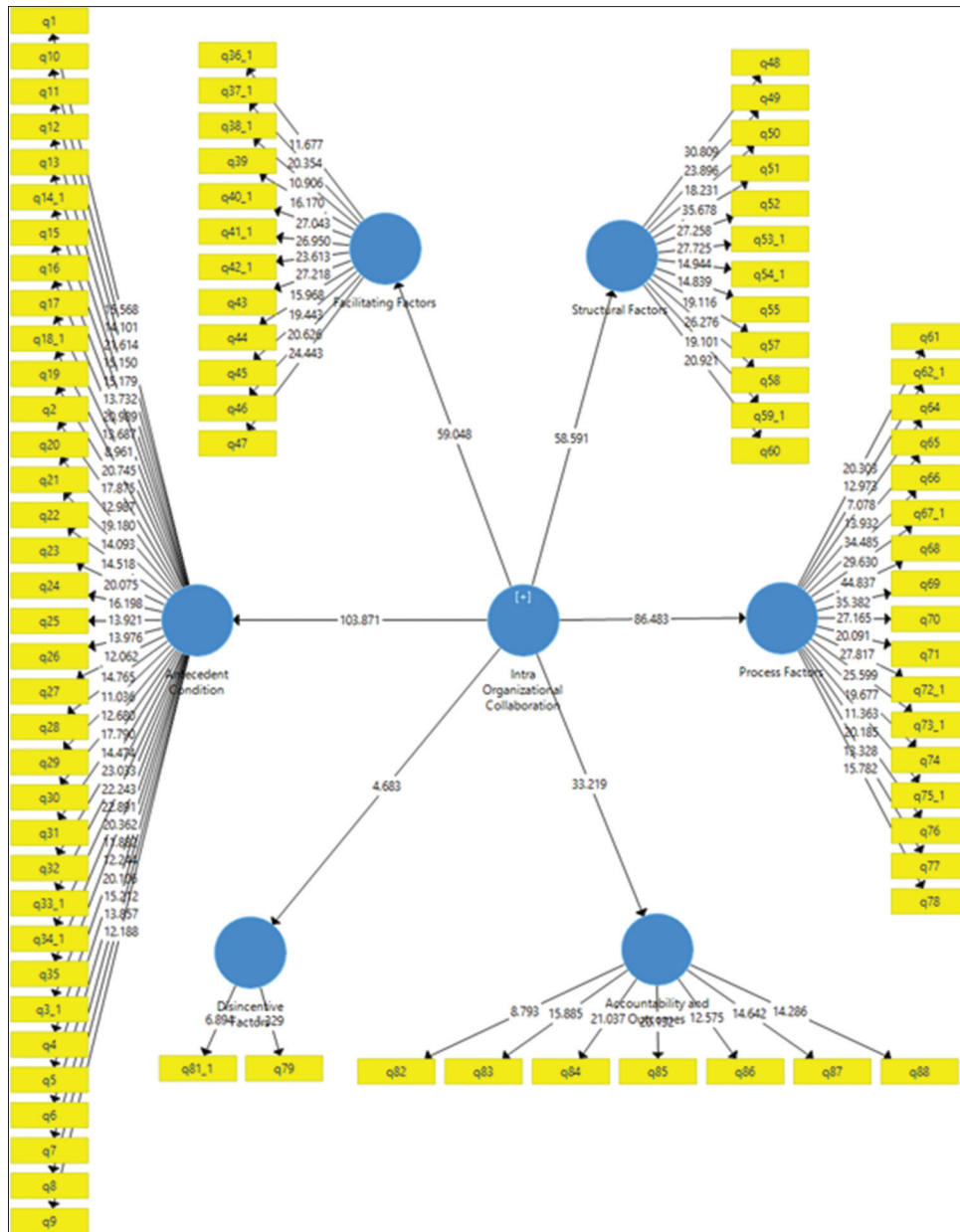


Figure 2: T-statistics by executing a bootstrapping procedure

**Table 7: Discriminant Validity of Measurement Model: Fornell and Larcker Criterion**

Variable	Accountabilities and Outcomes	Antecedent Conditions	Disincentives Factors	Facilitating Factors	Process Factors	Structural Factors
Accountabilities and Outcomes	0.767					
Antecedent Conditions	0.638	0.755				
Disincentives Factors	0.187	0.223	0.714			
Facilitating Factors	0.635	0.725	0.193	0.727		
Process Factors	0.634	0.742	0.429	0.705	0.793	
Structural Factors	0.541	0.695	0.286	0.65	0.788	0.797

to identify the associations between factors affecting the success of intraorganizational collaboration and to modify the current tool.

**Acknowledgments**

The authors thank all the participants of this study for their genuine cooperation.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

**Received:** 16 Dec 20 **Accepted:** 24 May 21

**Published:** 19 Jan 22

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## Appendix: Questionnaire

Items		Very high	High	Medium	Low	Very low
<b>Antecedent Conditions</b>						
Laws and Policies	How transparent are health sector policies and strategies in disaster risk management?					
	How much attention has been paid to the strengthening collaboration in making national health sector strategies?					
	How much emphasis has been placed on implementation of disaster risk reduction laws and policies?					
	What is the level of monitoring the implementation of disaster risk management laws and policies?					
Organizational Culture	How acceptable is the belief in team-working as an organizational value?					
	How acceptable is systematic thinking as an organizational value?					
	How acceptable is the observance of professional ethics as an organizational value?					
History of Collaboration	How successful have the previous collaborations in disaster risk management been?					
	How much attention is paid to recording experiences and lessons learned in disasters?					
	What is the level of freedom to record successful and unsuccessful experiences?					
	How much emphasis is given to the exchange of and learning from experiences and lessons learned?					
Access to information resources	How acceptable is the position of the EOC as an information management center by top-level managers?					
	How transparent is the process of exchanging information (including collecting, recording, organizing, analyzing and disseminating information) within the departments?					
	How much attention is paid to the electronic information registration system to be based on specific forms?					
	What is the status of information sharing between departments responsible in disaster management?					
Access to Human Resources	What is the status of timely access to comprehensive and reliable information?					
	What is the status of access to sufficient workforce in departments responsible in disaster management?					
	What is the status of access to knowledgeable and experienced workforce in disaster management in departments?					
	How well the recalls of personnel match the incident leveling protocol?					
	How much attention is paid to distribution of personnel based on the regional need?					
	How much attention is paid to the supply the needs of the personnel in the field of disaster?					
	How much emphasis is placed to the relocation of workforce to prevent burnout?					
	How much attention is paid to increasing the readiness of managers and employees through needs assessment and continuous training in crises management?					
How much attention is devoted to the continuous exercises between departments?						
	How effective have the trainings and exercises been in improving the collaboration between departments?					

*Contd...*

Items		Very high	High	Medium	Low	Very low
<b>Antecedent Conditions</b>						
Access to Financial resources	How much attention is paid to estimating financial resources to strengthen the collaboration in disaster management plans?					
	How much emphasis is placed to the allocating sufficient funds to implement disaster risk management strategies?					
	What is the status of monitoring the spending of funds to implement disaster risk management strategies?					
Access to Physical resources	How much attention is paid to identifying capacities and equipment before disasters?					
	To what extent the status of supply and distribution of equipment has been based on needs of the region?					
	How much attention is paid to strengthening space and infrastructure of the EOC?					
Initial Agreement	What is the level of common belief on collaboration in disaster risk management?					
	What is the level of mutual agreement among managers on goals and plans of disaster management?					
	What is the level of common perception of collaboration status and challenges among managers?					
	How much attention is paid to the developing of collaboration agreements between departments?					
<b>Structural Factors</b>						
Design of collaboration Structures	How transparent is the organizational structure of the health sector in disaster management?					
	How much consideration has been placed to the integration of disaster management structures?					
	How much attention has been paid to the position and role of Emergency Coordination Center (ECC) in health sector?					
	How much emphasis is placed to the chain of coordination with a decentralized approach for preparation at national level?					
	How much attention is paid to the chain of command with a centralized approach for disaster response at local and operational level?					
	How acceptable is the Health Policy Council in Disaster by top-level managers?					
	How transparent is the department's duty descriptions in disaster risk management (according to preparedness, response and recovery plans)?					
Coordination Governance	What is the level of awareness of personnel about the duties of their departments and partners?					
	How acceptable is EOC position as a decision-making center by top level managers?					
	To what extent the commander and manager's decisions have been based on common goals and plans in response phase?					
	How well the delegation of authority to the commander and managers fit the responsibilities set out in NRF?					
	How responsible are the managers and employees in achieving disaster risk management strategies and goals?					

Contd...

Items		Very high	High	Medium	Low	Very low
<b>Process Factors</b>						
Planning	How much attention is paid to developing and reviewing of disaster management plans with participation of stakeholders? How much attention is paid to the development of disaster management plans with a single hazard approach at the local level? To what extent the development of protocols have been based on needs assessment and regional capacity? What is the status of communication of protocols on the disaster management?					
Executive Capacity	How transparent are the processes of the departments in the response and recovery phases? How well the personnel understanding of the common processes in disaster management phase? What is the level of department's collaboration in designing the common processes of disaster management phase? How well the preparedness, response and recovery plans are implemented? What is the level of monitoring disaster risk management plans and protocols implementation? How much attention is paid to modifying processes based on joint exercises?					
Communications	How much emphasis has been placed to meetings of the Health Policy Council in Disasters? How much do the managers believe in attending Policy Council meetings and its committees? How well is the communication between the national and local levels? How much attention is paid to the use of informal communication channels (social networks, etc.) in disaster risk management? What is the level of risk communication in order to manage rumors?					
Building Trust	What is the level of trust in existing infrastructures and information resources? What is the level of trust in competence of the managers?					
<b>Facilitating Factors</b>						
Leadership	How acceptable is the Unity of Command in the Incident Command System (ICS) and the National Response Framework (NRF) by top level managers? What is the Commander's understanding of his duties and responsibilities and of others in National Response Framework (NRF)? How effective has the delegation of authorities to the coordination officer in NRF been in coordinating the departments? How much do the top level managers believe in the implementation of disaster risk management strategies and plans? What is the level of communication skills of the commander and managers within National Response Framework (NRF)?					

Contd...

<b>Items</b>		<b>Very high</b>	<b>High</b>	<b>Medium</b>	<b>Low</b>	<b>Very low</b>
Leadership	What is the level of teamwork skills of the Commander and Managers within National Response Framework (NRF)? What is the level of decision-making skills of the commander and managers within the National Response Framework (NRF)? How experienced are the managers in the field of disaster management?					
Technology	How accessible are high-tech communication equipment in disasters? How accessible are early warning systems? How much attention is paid to the improvement of information systems and databases in the field of disaster management? How much attention has been devoted to the establishment of an integrated information system in the field of disaster management?					
<b>Disincentives Factors</b>						
Conflicts and Tensions	How much has the fear of losing power restricted the collaboration? How much has the priority of department specialized goals over common goals created restriction for collaboration?					
<b>Accountabilities and Outcomes</b>						
Monitoring and Evaluation	How transparent is the rapid assessment process for assessment teams? How much has the decision-makings and response operation design been based on the results of rapid assessment? How well has the structural and process reform been based on the results of disaster management assessment?					
Accountabilities	How much attention is paid to the service compensation system based on performance and accountability of managers and employees in disasters?					
Outcomes	How much emphasis has been placed to the organizational outcomes of collaboration (such as improving response operations, reducing waste of resources and chaos, and etc.), for improving intra-sectoral collaboration? How much attention has been paid to the individual outcomes of collaboration (Physical and mental health, learning, promotion and job satisfaction of service providers, etc.), for improving intra-sectoral collaboration? How much consideration has been paid to the social outcomes of collaboration (Maintaining and promoting public health, increasing public trust, reducing dissatisfaction and protests of affected people, etc.) for improving intra-sectoral collaboration?					

EOC=Emergency Operations Center, NRF=National Response Framework