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RESEARCH ARTICLE **OPEN ACCESS**

Development of a Conceptual Model and Validated Tool for Assessing Hospital Readiness in Chemical Incidents

Ahmad Ameryoun[1], Naeim Shokri[2], Habibollah Hemmati[3], Alireza Shahriary[4], Mojtaba Sepandi[5] and Sayyed Morteza Hosseini Shokouh[1,*]

[1]*Health Services Management Department and Health Management Research Center, Health Faculty, Baqiyatallah university of Medical Sciences, Tehran, Iran*
[2]*Health Economics Department, Health Management Research Center, Health Faculty, Baqiyatallah university of medical sciences, Tehran, Iran*
[3]*Health Services Management Department, Health Faculty, Baqiyatallah University of Medical Sciences, Tehran, Iran*
[4]*Chemical Injuries Research Center, Systems Biology and Poisonings Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran*
[5]*Department of Epidemiology and Biostatistics, Faculty of Health, Baqiyatallah University of Medical Sciences, Tehran, Iran*

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*Address correspondence to this author at the Health Services Management Department and Health Management Research Center, Health Faculty, Baqiyatallah University of Medical Sciences, Tehran, Iran; E-mail: hosainysh.morteza@gmail.com

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Supplementary Table S1. Full list of codes extracted from interviews

Decontamination in Chemical Incidents; Necessary Actions in Decontamination; Inter-Organizational Duty Division in Chemical Incidents; Guidance and Control of Operations in the Hospital; Technical Instructions; Safety Compliance; Incident Command System; Diagnostic Tools and Equipment; Transportation; Chemical Incidents Risk Assessment; Personal Protective Equipment; High Probability of Chemical Incidents; Strategy for Treatment Centers Readiness; Chemical Emergency; Secondary Decontamination; Risk Reduction Strategy; Determination of Responsible Persons in Organizing; Access to Treatment Centers; Optimal Use of Facilities; Conceptual Model Design; Organizing Instructions and Standards; Diagnostic Instructions; Employment of Trained Personnel; Communication Instructions; Readiness Requirements; Inattention to the Probability of Chemical Incidents; New Educational Methods; Educational Requirements; Call Code and Summoning Operational Teams; Principles and Training Methods; Treatment Requirements for Injured; Pre-Hospital Management; Role of Military Hospitals; Ready-to-Use Equipment; Hospital Mission; Medical Strategy in Incidents; Contaminated Waste Disposal; Ministry of Defense Mission; Decontamination Systems; Public Education; Chemical Incidents Authority; Severity of Chemical Incidents Occurrence; General and Specialized Education; Limitation in Preparing Drugs and Equipment; Primary Decontamination; Characteristics of Chemical Incidents; Crowd Management; Introduction of Chemical Hospital Response Team; Importance of Safety for Rescue Personnel; Practice and Skill; Education and Learning; Backup Hospitals; Secondary Decontamination; Compliance with Proper Planning; Time Efficiency in Helping Chemical Injured Treatment; Mission Notification; Necessary Coordination in Support and Logistics; Technical Inspection of Readiness Equipment; Chemical Incidents Emergency Pattern; Policy Making in Treatment Centers Readiness; Importance of Educational Planning;

Re-Decontamination Method; Management of Drug and Equipment Supply; Treatment Instructions; Comprehensive Coordination in Crisis Response; Management in High Casualties; Mission of Other Treatment Centers; Responding Hospital Centers in Chemical Incidents; Decontamination Index; Chemical Injured Treatment Protocol.

Good Reporting of A Mixed Methods Study (GRAMMS) checklist.

Item	Reported
Describe the justification for using a mixed methods approach to the research question	Yes. Reported in the Introduction and Methods sections. A sequential mixed-methods design was chosen because the research aimed to first explore and identify readiness dimensions qualitatively (through expert interviews and Delphi consensus), then quantitatively validate a measurement instrument derived from those dimensions. Neither method alone was sufficient to achieve both conceptual model development and psychometric validation.
Describe the design in terms of the purpose, priority and sequence of methods	Yes. Reported in the Methods section. The design is a sequential exploratory mixed-methods study. Purpose: to develop and validate a conceptual model and assessment tool. Priority: the qualitative phase had priority as it informed the quantitative instrument. Sequence: Phase 1 (qualitative) → semi-structured interviews + content analysis + Delphi consensus; Phase 2 (quantitative) → psychometric evaluation (CVR, CVI, Cronbach's alpha).
Describe each method in terms of sampling, data collection and analysis	Yes. Reported in the Methods section. Qualitative phase: purposive and snowball sampling; 15 experts in disaster management, toxicology, and healthcare; semi-structured interviews (30–60 min, audio-recorded); inductive content analysis via MAXQDA10; Delphi technique (2–3 rounds, consensus >70%). Quantitative phase: separate expert panel (10–15 members); questionnaire derived from qualitative codes; content validity (CVR, CVI) and reliability (Cronbach's alpha) assessments.
Describe where integration has occurred, how it has occurred and who has participated in it	Yes. Reported in the Methods section. Integration occurred at the point of instrument development: qualitative codes and themes extracted from expert interviews were used to generate the items of the quantitative questionnaire. The research team (academics from Baqiyatallah University of Medical Sciences) participated in integration, with expert panels involved in both phases providing continuity across the qualitative and quantitative components.
Describe any limitation of one method associated with the present of the other method	Yes. Reported in the Discussion section. The reliance on the qualitative phase for item generation means the quantitative tool is bounded by the conceptual scope identified through expert elicitation. Purposive sampling in the qualitative phase may have introduced selection bias, potentially constraining the breadth of items in the resulting questionnaire. Additionally, the psychometric phase was limited to content validity, as construct and predictive validity were not assessed, a limitation partly arising from the exploratory nature of the qualitative phase preceding it.
Describe any insights gained from mixing or integrating methods	Yes. Reported in the Results and Discussion sections. Integration of methods revealed that decontamination is a cross-cutting element that pervades all six readiness components, a finding that emerged from qualitative coding but was structurally confirmed through the quantitative distribution of items across domains. Mixing methods also allowed the study to produce both a theoretically grounded conceptual model and a practically validated psychometric tool in a single study, offering a richer output than either method alone would have permitted.

COREQ (Consolidated criteria for REporting Qualitative research) checklist.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity — Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Not reported
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Not reported
Occupation	3	What was their occupation at the time of the study?	Not reported
Gender	4	Was the researcher male or female?	Not reported
Experience and training	5	What experience or training did the researcher have?	Not reported
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	Not reported
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Not reported
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Not reported
Domain 2: Study design — Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study?	Page 3 (directed content analysis; crisis-management/HICS framework; Delphi)
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 3 (purposive and snowball sampling)
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	Not reported
Sample size	12	How many participants were in the study?	Page 3 (9 experts); Table 1, page 6

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Non-participation	13	How many people refused to participate or dropped out? Reasons?	Page 3 (20 approached; 11 declined because of limited time or insufficient familiarity with the topic)
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	Not reported (only the study site, Baqiyatallah University of Medical Sciences, is given, page 3)
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	Not reported
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Table 1, page 6 (gender, academic field, job position); date of data collection not reported
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 3 (guide developed from a systematic literature review; questions and transcripts reviewed by the research team after two interviews); formal pilot test not reported
Repeat interviews	18	Were repeat interviews carried out? If yes, how many?	Not reported
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	Page 3 (audio-recorded with consent)
Field notes	20	Were field notes made during and/or after the interview or focus group?	Not reported
Duration	21	What was the duration of the interviews or focus group?	Page 3 (36–66 minutes, mean 47 minutes)
Data saturation	22	Was data saturation discussed?	Page 3 (recruitment closed when data saturation was reached)
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	Page 3 (transcripts returned to interviewees for confirmation)
Domain 3: Analysis and findings — Data analysis			
Number of data coders	24	How many data coders coded the data?	Not reported
Description of the coding tree	25	Did authors provide a description of the coding tree?	Pages 5, 7–9 (Table 2: 6 components, 28 sub-components); page 18 (Supplementary Table S1: list of codes)
Derivation of themes	26	Were themes identified in advance or derived from the data?	Page 3 (directed content analysis; components from the literature were also reviewed in the Delphi stages)
Software	27	What software, if applicable, was used to manage the data?	Page 3 (MAXQDA10)
Participant checking	28	Did participants provide feedback on the findings?	Page 3 (extracted codes returned to interviewees for review and correction)
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Pages 7–9 (Table 2: illustrative quotations with participant numbers, e.g. P1, P4)
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Pages 5, 7–9 (component frequencies and sub-component frequencies in Table 2)
Clarity of major themes	31	Were major themes clearly presented in the findings?	Pages 4–5 and 7–9 (six components, Figure 1 and Table 2)
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Page 4 (decontamination as a cross-cutting element); page 14 (limitations)

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007; 19(6): 349–357.
Page numbers refer to the revised manuscript file. "Not reported" means the information is not given in the manuscript.

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