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Design and psychometric evaluation of the Emergency Medical Services Safe Care Scale (EMSSCS): a mixed-method study

Fateme Mohammadi[1], Rasoul Salimi[2], Mohammadreza Shokouhi[3], Salman Khazaei[3] and Mostafa Bijani[4,5*]

Abstract

Background Providing safe care by emergency medical services (EMS) personnel at the stressful scene of an incident is one of the most crucial factors influencing the preservation and enhancement of patient health. However, culture, attitudes, and social norms can influence the provision of care at the scene of an accident. Consequently, evaluating safe care practices at incident scenes is imperative and necessitates a specialized assessment tool. Presently, there is a lack of reliable and valid instruments for measuring safe care practices among EMS personnel. Therefore, this study was designed and conducted to develop and psychometrically evaluate the Emergency Medical Services Safe Care Scale (EMSSCS).

Methods This investigation employed a mixed-methods design with a sequential exploratory approach, conducted from January 2024 onwards across the southwestern, western, and southeastern regions of Iran. The study was bifurcated into two distinct phases. In the initial phase, a conventional content analysis method was employed to scrutinize the narratives elicited from 41 EMS personnel. In the subsequent phase, the instrument's validity and reliability were rigorously assessed.

Results Safe care provided by EMS personnel was defined as the management of the incident scene, efficient clinical skills, and effective interaction aimed at delivering principled and safe patient care. Subsequently, based on the derived conceptual framework, a safe care instrument was designed with 44 items across three dimensions. During the qualitative and quantitative content validity 11 items, and face validity 3 items were deleted. Exploratory and confirmatory validity of this scale was approved in three dimensions: "incident scene management" (12 items), "efficient clinical skills" (10 items), and "effective interaction" (8 items). The scale's reliability was reported at 0.95 using Cronbach's alpha method.

Conclusion The Emergency Medical Services Safe Care Scale (EMSSCS), demonstrated acceptable psychometric properties. Consequently, senior managers in pre-hospital emergency services can utilize this instrument to evaluate safe care practices among pre-hospital emergency medical technicians. They can identify the most appropriate strategies, including educational interventions, to enhance safe care provision at incident scenes when necessary.

Clinical trial number Not applicable.

*Correspondence:
Mostafa Bijani
bizhani_mostafa@yahoo.com

Full list of author information is available at the end of the article

Keywords Scale, Safety management, Pre-hospital, Eemergency medical services, Psychometric evaluation

Introduction

Pre-hospital emergency services constitute the primary and most crucial line of care in patient encounters, bearing the responsibility of delivering safe and high-quality care to preserve and enhance patient health [1]. Notably, the environment and conditions for care provision in pre-hospital emergency settings differ substantially from those in hospital environments [2]. To deliver care services to patients, pre-hospital emergency personnel operate in diverse environmental conditions, weather situations, environmental disasters, traffic incidents, and road accidents [3]. Consequently, working conditions in pre-hospital emergency services are not as stable as those experienced by other healthcare personnel [4]. This variability can significantly impact the quality of service delivery and safe care provision [5]. Safe care is defined as the application of knowledge and skills to deliver quality care that minimizes the likelihood of patient harm while addressing their care needs [6]. In the challenging and high-stress conditions of pre-hospital emergency services, factors such as clinical skill, knowledge, experience, incident scene management capability, and care team coordination can influence the delivery of quality care [7]. Therefore, it is imperative to examine and evaluate the quality of care in pre-hospital emergency services and identify the needs and challenges faced by pre-hospital emergency personnel in providing safe care [8–9]. Recent studies have focused on investigating care quality, safety in care provision, assessment of medical errors and mistakes, stressors, and factors influencing care in pre-hospital emergency settings [9–12]. In this context, Kerner et al. (2017) asserted that using safe and principled care checklists and adherence to them in care provision leads to an enhancement in safe care [10].

Kosydar-Bochenek, et al. (2023) reported that participants' perception of the patient safety climate in pre-hospital care was unsatisfactory, confirming the ongoing need for developing a patient safety culture in pre-hospital emergency care [11]. Häske et al. (2022) stated that team-based and scenario-oriented training for pre-hospital emergency personnel contributes to improving the safety and quality of medical care services, emphasizing the necessity for more extensive research to enhance safe care in pre-hospital environments [12]. Some studies examined patient safety in pre-hospital settings, the impact of pre-hospital personnel's knowledge and competency development on safe care provision, and the identification of factors influencing safety and care quality in pre-hospital emergency services [11–13]. The most important tools used to assess safe care were the Emergency Medical Services-Safety Attitudes Questionnaire (EMS-SAQ) and the Assessment of Safe Nursing Care (ASNC). The Emergency Medical Services-Safety Attitudes Questionnaire (EMS-SAQ) comprises 30 main items across 6 dimensions (safety climate, teamwork climate, perceptions of management, job satisfaction, working conditions, and stress recognition), scored on a 5-point Likert scale, with higher scores indicating safer attitudes [14]. While this tool evaluates safety and safety conditions at the incident scene, a crucial factor in providing safe and quality care, it does not encompass all aspects of safe care, highlighting the need for a specialized safe care assessment instrument. Another scale is the Assessment of Safe Nursing Care (ASNC) questionnaire, which includes 32 questions across 4 domains (assessment of nursing skills, evaluation of patient psychological safety, evaluation of patient physical safety, and assessment of nurse teamwork), scored on a 5-point Likert scale. Higher scores indicate more favorable safe care [15]. Although this instrument assesses safe care, the working environment and unstable conditions in pre-hospital emergencies can alter care delivery, performance, and safety in care provision.

Consequently, considering that the tension and stress of the accident scene, cultural, social factors, and religious beliefs of individuals may influence providing safe and ethical care, as the importance of assessing safe care in pre-hospital emergency personnel, the present study aimed to design and psychometrically evaluate safe care tool in prehospital emergency medical technicians.

Methods

A mixed methods approach was used, employing a sequential exploratory design. In the initial phase, interviews were conducted with 41 emergency medical technicians to identify and analyze key themes using conventional content analysis. The second phase involved developing and refining a 53-item questionnaire with input from 15 experts. This questionnaire was pretested with 30 emergency medical technicians. Subsequently, a shorter 30-item questionnaire was created, utilizing a five-point Likert scale, and tested with a larger sample of 310 emergency medical technicians. The questionnaire's psychometric properties were assessed through factor analysis and reliability testing.

Phase I. Instrument development

Qualitative study

In this phase of the present study, the researchers aimed to define and explain the concept of safe care in emergency medical technicians. To achieve this, they utilized the qualitative content analysis method. Because

qualitative content analysis research can help explain a phenomenon in the cultural context of people's perspectives who have dealt with a phenomenon for a long time [16]. Conventional content analysis is one of the most common and important qualitative content analysis methods. It allows for a better understanding of how individuals perceive and make sense of a phenomenon by identifying commonalities and differences in their interpretations [16–17]. Also, conventional qualitative content analysis is an appropriate procedure for obtaining reliable and valid results from textual data, allowing the creation of new knowledge and innovative understanding of phenomena under investigation [16]. Therefore, a qualitative approach with conventional content analysis has been used to investigate this subject. 41 emergency medical technicians in 18 city and road emergency bases affiliated with medical universities in Iran's western and southeast regions were selected with purposeful sampling. The criteria for inclusion were being willing to participate, having at least 24 months of work experience in the city and road emergency bases, being Iranian, and having a good command of Farsi. The study utilized various methods for data collection, including face-to-face, semi-structured interviews, observation, and field notes. A total of 41 emergency medical technicians were interviewed in quiet pre-hospital settings when the participants did not have a shift. The time and location of the interviews were selected based on the participants' preferences.

The interviews were thorough and aimed to understand the participants' perspectives better. Each interview began with a few general questions, including" "Can you describe a day of your working "? and" What does safe care mean to you?", "What factors are effective in safe care in pre-hospital emergence situation?". Subsequently, based on the 'respondents' answers, follow-up questions would be asked to increase the clarity of the information—the questions included, "Can you explain further?", "What do you mean by that?" and "Can you give an example?". Based on the participant's answers, other questions were asked to further probe other aspects of ethical intelligence. The interviews were audio-recorded, and field notes were taken with the permission and awareness of the participants. Each interview lasted between 60 and 70 min. The interviews were continued until data saturation was achieved, which is indicated by the absence of new categories and the saturation of existing categories based on their characteristics and dimensions.

Immediately after conducting each interview, the first author listened to the recordings multiple times to gain a comprehensive understanding and to identify the key insights. The interview data underwent conventional content analysis. In the first step, each text was reviewed for immersion and acquiring insights and a deep understanding of the phenomenon under study. In step 2 meaning units were determined based on the objectives and the study questions. In step 3, important points were extracted as open codes, considering their clear and hidden meaning units. In step 4, these codes were categorized under broader titles based on their similarities and differences, and in step 5, the data analysis continued until the themes were extracted [16–18]. The interviews were continued until data saturation was achieved, which is indicated by the absence of new categories and the saturation of existing categories based on their characteristics and dimensions.To ensure the trustworthiness of the process, Guba and Lincoln criteria were used [19]. Various methods were utilized to enhance the credibility and reliability of the findings. These included a comprehensive examination of data sources such as semi-structured interviews, field notes, and prolonged engagement with the data. Additionally, member checking and peer checking were employed to validate the extracted concepts, and themes.7 participants and 3 peers were involved in this process, all of whom confirmed that the findings aligned with their understandings and interpretations. The transferability of the study was ensured through a thorough description of the participants, interviews, and analysis.

Furthermore, confirmability was achieved by accurately recording participant narratives and providing a detailed study report, facilitating the possibility of follow-up by other researchers. Finally, 1024 codes were which were categorized into 52 subcategories, 13 categories, and three main themes, which were "incident scene management" " efficient clinical skills," and "effective interaction" (Table 1). During the study phase, all participants were men, with an average age of 42.35 ± 2.73 years. Additionally, most participants held a bachelor's degree in pre-hospital medical emergencies, possessed an average work experience of 12.51 + 2.13 years.

Table 1 The main themes and subthemes of the safe care scale for EMS personnel

Incident scene management	Comprehensive scene assessment
	Scene safety evaluation
	Stress management
	Precise operational planning
Efficient clinical skills	Systematic triage
	Casualty estimation
	Initiative and prompt action
	Adherence to infection control principles
	Prevention of patient harm
Effective interaction	Dignified conduct
	Patience and forbearance
	Flexibility and composure
	Commitment to teamwork

Phase II. Psychometric properties

Questionnaire development

The assessment scale generated 43 potential items from the qualitative data, representing the main themes. Furthermore, 10 additional items were included based on the findings from the literature review, resulting in a total of 53 items. Subsequently, the research team evaluated the items and eliminated 9 redundant ones, resulting in a final count of 44 items into three dimensions: "incident scene management 20 items" efficient clinical skills 13 items" and "effective interaction 11 items".

Content validity

The content validity assessment involved consulting a panel of experts consisting of 15 professionals, including instrument-making specialists, a doctorate in nursing, and emergency medical technicians. This expert panel evaluated language, understanding, and suitability to the Iranian culture and context. Based on their evaluation, they suggested removing four items, leaving 40 questions for quantitative analysis of content validity using the content validity ratio (CVR) and content validity index (CVI) [20–23]. To accomplish this, the panel was given the instrument back, and they were requested to evaluate the items based on their relevance and importance to the study's subject matter. According to the Lawshe table, the acceptable CVR was reported as 0.49 [21–22]. However, 5 items with a CVR of 0.33 were removed from the study. The content validity index (CVI) was then evaluated for each remaining item. The revised instrument was given back to the panel, who were asked to rate each item's relevance, simplicity, and clarity on a four-point Likert scale ranging from 1 to 4. The CVI was calculated for both individual items and the entire instrument. For this study, a CVI value greater than 0.8 was deemed acceptable [23]. However, 2 items had a score below this cut-off and were also deleted.

Face validity

The revised instrument with 33 items was then given to 50 emergency medical technicians using the same inclusion criteria as for Phase 1. They were asked to assess each item regarding difficulties, relevance, grammar, vocabulary, and intelligibility. The participants declared that the items were simple, clear, and relevant to the study's topic. In addition, an impact score was calculated in which participants evaluated each item using a five-point Likert scale ranging from one (very little (to five (very much), with a score > 1.5 considered acceptable [19–20]. The impact score for 3 items was lower than 1.5. Therefore, 1 items were deleted.

Item analysis

A 30-item instrument was created based on the previous stage. Thirty eligible emergency medical technicians used a five-point Likert scale (1 = very low, 2 = low, 3 = to some extent, 4 = high, 5 = very high) to rate themselves on the 30 items. The correlation coefficients between the items ranged from 0.3 to 0.7, and the total score across all items was calculated to be greater than 0.3 [20–22]. All items met these criteria, and it was decided no further items were deleted. Finally, this scale includes "incident scene management 12 items" efficient clinical skills 10 items" and "effective interaction 8 items".

Participants and data collection

310 emergency medical technicians were recruited using convenience sampling from 18 city and road emergency bases in Iran. The inclusion criteria were having at least 24 months of work experience in the city and road emergency bases, being Iranian, having a good command of Farsi, and willingness to participate in the study. The participants' socio-demographics were also collected. Data were analyzed using descriptive and inferential statistics via the SPSS software, v. 19 (SPSS Inc, Chicago, Illinois, USA). The mean participant's age was 42.35 ± 2.73, ranging from 23 to 54 years. Most participating in this phase were married (87.09%), had a bachelor's degree (90.96%), and the mean participant's work experience was 12.51 + 2.13 years.

Construct validity (Exploratory factor analysis, Confirmatory Factor Analysis)

Construct validity helped ensure that the instrument measured what it intended to measure [23–24]. Exploratory factor analysis using the varimax rotation was used in this study. To achieve the most appropriate structure, eigenvalues higher than 1.0, factor loadings higher than 0.50, and the so-called 'elbow criterion' regarding the eigenvalues were considered [24]. The Kaiser–Meyer–Olkin (KMO) and Bartlett's tests were performed to evaluate sample adequacy. For exploratory factor analysis, the closer the KMO index is to 1, the more it indicates the adequacy of sampling, and the Bartlett test should be less than 0.5.

Confirmatory factor analysis

Confirmatory Factor Analysis was carried out utilizing AMOS 22 software, and several indices were employed to evaluate the model's effectiveness. To ascertain the adequacy of the model, it was imperative to adhere to the following stringent criteria: goodness of fit index (GFI) exceeding 0.90, a root mean square error of approximation (RMSEA) below the acceptable threshold of 0.08, a Tucker Lewis Index (TLI) surpassing the minimum acceptable level of 0.90, and a comparative fit index (CFI)

exceeding the requisite threshold of 0.90, as per established conventions [24].

Reliability

To ensure the validity of this instrument, both Cronbach's alpha coefficient and test-retest reliability analysis were utilized. The internal consistency reliability was evaluated by calculating Cronbach's alpha coefficient with a sample size of 310 participants. The acceptable Cronbach's alpha coefficient was determined to be above 0.7. Fort test-retest reliability, the intra-class correlation (ICC) was calculated by collecting data from 100 participants at two weeks [25].

Results

Construct validity (Exploratory factor analysis, Confirmatory Factor Analysis)

Exploratory factor analysis using the varimax rotation identified three main factors, as shown in Table 2, which explained 72.48% of the observed variance together. The items' factor loadings ranged from 0.67 to 0.92. The three included factors were "incident scene management 12 items" efficient clinical skills 10 items," and "effective interaction 8 items", which broadly confirmed the main themes identified in the qualitative data in Table 1.

Confirmatory factor analysis

The result of confirmatory factor analysis indicated one model with three factors: "incident scene management 12 items" efficient clinical skills 10 items" and "effective interaction 8 items". Incident scene management showed a 0.90 correlation, efficient clinical skills showed 0.92, and effective interaction showed a 0.90 correlation with a total score of safe care in pre-hospital. Also, there was a correlation between two factors, incident scene management, and efficient clinical skills 0.91, and between incident scene management and effective interaction 0. 92. Also, there was a correlation between efficient clinical skills and effective interaction 0.90. The chi-square of 548.21 (df = 83, $P = 0.031$) showed good fitness. In

Table 2 Varimax factor loadings of the items of the Emergency Medical Services Safe Care Scale (EMSSCS)

Factors' names	Item	Factor loading
Factor 1: Incident scene management	1. I meticulously observe and assess the incident scene as the initial step.	0.92
	2. Prior to entering the incident scene, I evaluate any potential hazards, including fire, explosions, electrical risks, and other dangers.	0.91
	3. I pay particular attention to patient safety principles at the incident scene.	0.89
	4. I encourage bystanders to maintain distance from the incident scene.	0.88
	5. I invite the companions of the injured to remain calm.	0.87
	6. I evaluate my own performance and that of my colleagues at the scene.	0.85
	7. I execute my duties at the incident scene to the best of my ability.	0.81
	8. I supervise the performance of other members of the care team at the incident scene.	0.79
	9. I manage stress, fear, and apprehension at the incident scene.	0.74
	10. I transfer the patient to the medical center while maintaining safety principles and a calm demeanor.	0.70
	11. I encourage the patient and their companions to maintain composure and tranquility.	0.69
Factor 2: Efficient clinical skills	12. I conduct patient and casualty triage with precision and acumen in the shortest possible time.	0.91
	13. I thoroughly examine and assess patients' conditions.	0.89
	14. I perform patient mobilization and immobilization with careful adherence to safety principles.	0.88
	15. I strive to avoid causing harm to the patient when performing invasive procedures.	0.86
	16. I utilize the latest guidelines and evidence-based nursing practices in patient care.	0.85
	17. I am proficient in the scientific and proper use of medical equipment.	0.85
	18. I am skilled in performing emergency interventions in high-risk situations.	0.81
	19. I employ critical thinking and clinical reasoning skills in the provision of care.	0.79
	20. I endeavor to develop and enhance my clinical skills.	0.74
	21. I utilize the clinical experiences of my colleagues to strengthen my own clinical skills.	0.70
	22. I conduct patient triage without discrimination and in adherence to principles of equity.	0.67
Factor 3: Effective interaction	23. I pay attention to patient privacy and confidentiality in the provision of care.	0.90
	24. I interact with patients and their companions with patience.	0.86
	25. I have the ability to manage and lead a team.	0.84
	26. I treat my colleagues with respect.	0.79
	27. I am committed to the principles of teamwork and interdisciplinary collaboration.	0.73
	28. I maintain patience in my interactions with colleagues.	0.71
	29. I preserve the dignity and respect of the patient and their companions.	0.70
	30. I accept responsibility for my behavior and performance and will be accountable.	0.69

Table 3 Cronbach's alpha of subscales Emergency Medical Services Safe Care Scale (EMSSCS)

Factors	Subscale	Items	Cronbach's alpha
1	Incident scene management	12	0.98
2	Efficient clinical skills	10	0.96
3	Effective interaction	8	0.93
Entire Questionnaire		30	0.95

Table 4 Mean (standard deviation) and intra-class correlation coefficient (ICC) values for the domains of the Emergency Medical Services Safe Care Scale (EMSSCS)

Factor	Dimensions	Mean ± SD	ICC	Confidence interval
1	Incident scene management	51.23(2.17)	0.92	0.52–0.95
2	Efficient clinical skills	39.89(2.24)	0.90	0.48–0.92
3	Effective interaction	31.14(2.12)	0.92	0.49–0.93
Total		122.26(2.17)	0.91	0.51–0.92

addition, the GFI in the current study was 0.91, which showed a good fitting with the uni-dimensional model of the PTES construct. Further indices were tested in this model: RMSEA = 0.043, CFI = 0.91, NFI = 0.92, and TLI = 0.90. The reported indices indicated that the extracted model fit the ethical intelligence scale well.

Reliability

The reliability of the questionnaire was assessed using Cronbach's alpha coefficient and test-retest reliability. The Cronbach's alpha coefficient of internal consistency across the 30-item instrument was 0.95, and for the three subscales of incident scene management, efficient clinical skills, and effective interaction were 0.98, 0.96, and 0.93, respectively (Table 3). The test-retest reliability of the questionnaire was calculated by inviting 100 emergency medical technicians to complete the questionnaire again after a two-week interval. The test-retest showed no statistically significant difference between pre-and post-test scores ($p < 0.05$). The correlations between the scores on the incident scene management of the questionnaire between test-retest were 0.92, the correlations between the scores on efficient clinical skills of the questionnaire between test-retest were 0.90, and the correlations between the scores on the effective interaction of the questionnaire between the test-retest were 0.92. Finally, the correlation coefficient of the test-retest is 0.91. Table 4.

Finally, an instrument with 30 items was developed that includes "incident scene management 12 items" efficient clinical skills 10 items" and "effective interaction 8 items". All items were scored based on a five-point Likert scale (1 = very low to 5 = very high); the scale was designed to be completed within 25 min. The total score range is from 30 to 150. Higher scores indicate more safe care. Also, the range of scores shows 30–70 (low safe care), 71–110 (moderate safe care), and 111–150 (high safe care). The Emergency Medical Services Safe Care Scale (EMSSCS) is shown in Table 5.

Discussion

Safe care provided by pre-hospital emergency medical technicians is defined as incident scene management in conjunction with proficient clinical skills and effective interaction to deliver principled and safe patient care. Subsequently, based on the derived conceptual framework, an instrument for assessing safe care by pre-hospital emergency medical technicians was developed and psychometrically evaluated. This instrument was initially designed with 44 items across three dimensions. During the qualitative content evaluation, 4 items were eliminated; in determining the content validity ratio, 5 items were removed; and in assessing the content validity index, 2 items were excluded, resulting in a 33-item scale for face validity assessment. In determining face validity, 3 items had an impact score below 1.5 and were consequently eliminated. In the exploratory validity phase, the questionnaire structure was delineated into three dimensions: "incident scene management" (12 items), "efficient clinical skills" (10 items), and "effective interaction" (8 items). The confirmatory validity analysis corroborated the instrument's structure from the exploratory validity phase without item deletion or repositioning. The scale's reliability, assessed via Cronbach's alpha, was reported as 0.95. These findings indicate the instrument's suitability for measuring safe care practices among pre-hospital emergency medical technicians in the Iranian context. It is important to note that specific instruments for assessing safe care among pre-hospital emergency medical technicians were unavailable to the researchers. Consequently, two instruments - one for safe nursing care in hospitals and another for safety attitudes towards emergency medical services - employed in studies evaluating safe care, were utilized for a comprehensive discussion.

The Safe Nursing Care Scale was developed by Rashvand et al. (2017) in Iran to assess safe nursing care through an exploratory study. Initially, a qualitative study employing conventional content analysis was conducted. Subsequently, the Safe Nursing Care questionnaire was designed. This questionnaire comprises 32 questions across four dimensions: nursing skills (16 items), patient psychological safety assessment (4 items), patient physical safety assessment (7 items), and nurse teamwork evaluation (5 items). All items are scored on a 5-point Likert scale, with higher scores indicating safer nursing care. This scale demonstrates appropriate face and content validity. In the exploratory validity phase, the factor loadings of the instrument's items ranged from 0.503 to 0.758. The exploratory factor analysis revealed four factors explaining 63.54% of the observed variance. The

Table 5 Emergency Medical Services Safe Care Scale (EMSSCS)

Dimensions	Item	Always	Often	Sometimes	Rarely	Never
Incident scene management	I meticulously observe and assess the incident scene as the initial step.					
	Prior to entering the incident scene, I evaluate any potential hazards, including fire, explosions, electrical risks, and other dangers.					
	I conduct patient triage without discrimination and in adherence to principles of equity.					
	I pay particular attention to patient safety principles at the incident scene.					
	I encourage bystanders to maintain distance from the incident scene.					
	I invite the companions of the injured to remain calm.					
	I evaluate my own performance and that of my colleagues at the scene.					
	I execute my duties at the incident scene to the best of my ability.					
	I supervise the performance of other members of the care team at the incident scene.					
	I manage stress, fear, and apprehension at the incident scene.					
	I transfer the patient to the medical center while maintaining safety principles and a calm demeanor.					
	I encourage the patient and their companions to maintain composure and tranquility.					
Efficient clinical skills	I conduct patient and casualty triage with precision and acumen in the shortest possible time.					
	I thoroughly examine and assess patients' conditions.					
	I perform patient mobilization and immobilization with careful adherence to safety principles.					
	I strive to avoid causing harm to the patient when performing invasive procedures.					
	I utilize the latest guidelines and evidence-based nursing practices in patient care.					
	I am proficient in the scientific and proper use of medical equipment.					
	I am skilled in performing emergency interventions in high-risk situations.					
	I employ critical thinking and clinical reasoning skills in the provision of care.					
	I endeavor to develop and enhance my clinical skills.					
	I utilize the clinical experiences of my colleagues to strengthen my own clinical skills.					
Effective interaction	I pay attention to patient privacy and confidentiality in the provision of care.					
	I interact with patients and their companions with patience.					
	I have the ability to manage and lead a team					
	I treat my colleagues with respect.					
	I am committed to the principles of teamwork and interdisciplinary collaboration.					
	I maintain patience in my interactions with colleagues.					
	I preserve the dignity and respect of the patient and their companions.					
	I accept responsibility for my behavior and performance and will be accountable.					

confirmatory validity analysis substantiated the instrument's structure from the exploratory validity phase without item deletion or repositioning. The instrument's reliability, calculated using Cronbach's alpha coefficient, was reported as 0.92 for the entire instrument, with a test-retest reliability of 0.91 [15]. While this instrument shows sufficient validity and reliability for assessing safe nursing care, it is essential to acknowledge that the working conditions of pre-hospital emergency medical technicians differ significantly from those in hospital settings. Technicians frequently encounter patients in unpredictable and challenging environments, such as on streets and highways, where they do not completely understand the context of each incident. They must quickly evaluate the scene, manage their emotions, and apply critical thinking to ensure they provide the highest

standard of care to patients with no prior familiarity or information. Consequently, developing a customized tool to assess safe care practices among pre-hospital emergency medical technicians may substantially benefit effectiveness and efficiency. Additionally, factors such as culture, attitudes, and social norms can greatly influence care provision in pre-emergency situations. In Iran, the prevalence of male operational personnel in pre-hospital emergency services may affect the delivery of safe and ethical care.

One of the most prevalent instruments for assessing safe care is the Emergency Medical Services-Safety Attitudes Questionnaire (EMS-SAQ). This questionnaire comprises 30 primary items across six dimensions (safety climate, teamwork climate, management perceptions, job satisfaction, working conditions, and stress recognition), scored on a 5-point Likert scale, with higher scores indicating more positive safety attitudes. The original version of this questionnaire demonstrates appropriate content, exploratory, confirmatory validity, and suitable reliability [14]. Norouzinia et al. (2024) conducted a psychometric evaluation of this questionnaire in Iran. The Persian version comprises 22 items across five dimensions: safety climate, teamwork, job satisfaction, stress management, and working conditions. This version exhibits appropriate face, content, construct validity, and reliability. In the exploratory validity phase, the factor loadings of the instrument's items ranged from 0.464 to 0.835. The exploratory factor analysis revealed five factors explaining 38.75% of the observed variance. In the confirmatory validity analysis, two items were eliminated. The instrument's reliability, assessed via Cronbach's alpha coefficient and McDonald's omega, was reported as satisfactory [26]. Although this questionnaire demonstrates appropriate validity and reliability in the Iranian context, it primarily evaluates pre-hospital emergency medical technicians' attitudes towards safety considerations at the incident scene and establishing a safe environment. While attention to safety at the incident scene is crucial in providing safe and high-quality care, it does not encompass all aspects of safe care. Consequently, there is a need for a specific instrument to assess safe care practices among pre-hospital emergency medical technicians.

Limitation

One limitation of the present study was the use of individual interviews for data collection in the study's qualitative component (first phase), as employing alternative data collection methods could yield richer results for this qualitative research. Therefore, it is recommended that further studies be conducted to evaluate the safe care of pre-hospital emergency medical technicians using other qualitative data collection methods, such as observation and focus groups, in addition to individual interviews. Furthermore, it is suggested that the psychometric properties of this instrument be tested with a larger population of pre-hospital emergency medical technicians and across various cultures.

Conclusion

Safe care provided by pre-hospital emergency medical technicians is defined as incident scene management coupled with efficient clinical skills and effective interaction to deliver principled and safe patient care. The instrument designed in this study, comprising three dimensions - "incident scene management" (12 items), "efficient clinical skills" (10 items), and "effective interaction" (8 items) - demonstrated appropriate face, content, exploratory, and confirmatory validity. Consequently, healthcare administrators may employ this instrument to evaluate safe care practices among EMS personnel.

Abbreviations

EMS	Emergency medical services
CVI	Content validity index
CVR	Content validity ratio
EMS-SAQ	Emergency medical services-safety attitudes questionnaire
ASNC	Assessment of safe nursing care

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Author contributions

MB and FM was involved in the conception and organization of the study. MB, RS and SK were involved in the execution and data collection of the study; FM, MS and MB participated in statistical analysis design and/or execution. All authors contributed to the preparation, critical review and all of them approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The institutional review board of the Hamadan University of Medical Science located in the West of Iran provided ethical approval (IR.UMSHA.REC.1403.394). All methods were conducted in accordance with the relevant guidelines and regulations, and adhered to the ethical principles outlined in the Declaration of Helsinki. Prior to each interview, the researcher provided a self-introduction, elucidated the study's objectives, and assured participants of the confidentiality of their information. It was emphasized that participants retained the right to withdraw from the study at any time without incurring any negative consequences. Subsequently, informed written consent was obtained from all study participants.

Consent to publish

Not applicable.

Competing interests

The authors declare no competing interests.

Author details
[1]Chronic Diseases (Home Care) Research Center and Autism Spectrum Disorders Research Center, Department of Nursing, Hamadan University of Medical Sciences, Hamadan, Iran
[2]Department of Emergency Medicine, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran
[3]Department of Epidemiology, School of Health Research Center for Health Sciences. Health Sciences & Technology Research Institute, Hamadan University of Medical Sciences, Hamadan, Iran
[4]Department of Medical Surgical Nursing, School of Nursing, Fasa University of Medical Sciences, Fasa, Iran
[5]Prehospital Emergency Research Center (PERC), Tehran, Iran

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