CPR Skill Proficiency, Attitudes, and Learning Needs Among Trainees in an In-Service Training Cohort at a Chinese University: A Survey Analysis

Shengnan Tang[a], Chengqi Tang[b,*], Changyan Yuan[a], Xiaojuan Wu[a], Yu Zou[a], Qi Luo[a]

[a]921 Hospital of the Joint Logistics Support Force of the People's Liberation Army of China, Changsha, Hunan, China
[b]College of Basic Education, National University of Defense Technology, Changsha, Hunan, China
*NUDT2013@126.com

Abstract. This study investigated the proficiency, attitudes, and learning needs regarding cardiopulmonary resuscitation (CPR) skills among trainees in an in-service training cohort at a Chinese university, in order to inform the development of first-aid training programmes. A simple random sampling method was used to survey 101 trainees with a self-designed anonymous questionnaire covering demographic characteristics, CPR skill proficiency, learning attitudes, and learning needs; the instrument was developed within a dual framework integrating the Kirkpatrick training evaluation model and the health belief model. Data were analysed with SPSS 26.0 and are presented as frequencies and percentages. All 101 questionnaires were returned and valid. Respondents showed high correct response rates on core theoretical knowledge: 91.09% for the golden time window, 85.15% for the correct CPR sequence, 90.10% for compression rate, and 92.08% for the compression-to-ventilation ratio. However, only 60.40% identified all three comprehensive CPR initiation indicators, and 15.84% were unable to use an automated external defibrillator or had never heard of one. Although 75.25% expressed willingness to perform rescue, 85.15% cited insufficient personal competence and 53.47% cited fear of trouble or legal disputes as barriers. Regarding needs, 90.10% preferred theoretical instruction combined with practical guidance from healthcare professionals, 49.50% favoured one-on-one instruction, and 76.24% supported formal assessment of both theory and practice. The trainees' profile is characterised by sound theoretical knowledge but weaker practical competence. Tiered curricula, scenario-based practical teaching, and a closed-loop assessment and recertification mechanism are recommended.

Keywords: CPR skills, in-service trainees, Chinese university, learning needs, questionnaire survey, training optimization

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1 Introduction

Despite continuous advancements in clinical treatment modalities for cardiac arrest, the epidemiological burden of this condition remains substantial, and overall survival outcomes still require further improvement. Currently, the survival rate for adult out-of-hospital cardiac arrest patients is only approximately 10.5%, while that for in-hospital cardiac arrest patients is 23.6%[1]. Against this clinical backdrop, the American Heart Association (AHA) 2025 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care explicitly articulate that the core purpose of the guidelines is to provide standardized best-practice recommendations in the field of cardiopulmonary resuscitation and emergency cardiovascular care[1]. Cardiopulmonary resuscitation (CPR) is the core life-saving technique for rescuing patients with cardiac arrest. Strict adherence to guideline-recommended standardized CPR protocols is a critical factor that directly influences patient survival rates and long-term prognosis. Previous studies have confirmed that in out-of-hospital cardiac arrest emergencies, the first responders are often lay bystanders; consequently, the public's CPR proficiency and willingness to actively perform rescue are pivotal determinants of patient survival outcomes[1].

Public knowledge of CPR remains inadequate in many contexts. A study in Hubei Province found that only 22% of the general public had a moderate or higher level of CPR knowledge, and merely 9.8% felt confident in performing CPR[2]. Similarly, an international study reported that despite 84.8% of participants expressing interest in learning CPR, only 5% actually knew how to perform the manoeuvres correctly[3]. This gap between high willingness and low competence is a well-documented challenge[4]. Among non-medical populations the pattern is particularly pronounced: research on non-medical college students indicates that although over 97% recognize the importance of first-aid knowledge, their actual mastery of CPR skills remains limited[5]. Furthermore, recent surveys among healthcare professionals, such as anaesthesiologists, reveal that even among trained clinicians only 43.3% achieved a theoretical knowledge score of 80% or higher, and over 30% expressed dissatisfaction with their own resuscitation performance, primarily because of unskilled AED use and poor chest compression quality[6]. This evidence collectively suggests that the issue of solid theoretical knowledge combined with weak practical competence is not isolated to a single population but reflects a broader systemic deficiency in CPR training.

In-service personnel may encounter sudden cardiac or respiratory arrest emergencies in their daily work, daily life, and various public settings. Emergency rescue capability is a fundamental professional competency for in-service personnel, as it directly affects the success rate of treating acute emergencies and ensuring personnel safety[7]. Therefore, mastering standardized, high-quality CPR skills is an essential foundational ability for in-service personnel. Currently, domestic institutions have yet to establish a unified, standardized first-aid training system for in-service trainees. There is a certain disconnect between existing training content and actual emergency rescue needs, and a systematic evaluation mechanism for assessing trainees' CPR skill proficiency and retention is lacking. This issue is not unique to a single institution; a

review of existing first-aid training research indicates that the domestic first-aid training industry generally lacks unified, standardized training standards and skill certification systems. This has resulted in variable training quality, making it difficult to guarantee the emergency rescue capabilities of the general public and in-service personnel[8].

Based on the above, this study takes in-service trainees in colleges and universities as its research subjects. Using a questionnaire survey grounded in the Kirkpatrick training evaluation model and the health belief model (HBM), it systematically evaluates the current CPR skill proficiency, learning attitudes, and specific training needs of the trainees. The findings are expected to provide a scientific empirical basis for optimizing the first-aid training system in academic institutions, refining training content, and enhancing the comprehensive emergency rescue capabilities of in-service personnel.

2 Subjects and Methods

2.1 Study Subjects

A total of 101 trainees from an in-service training cohort at a Chinese university in April 2023 were selected as study subjects using a simple random sampling method. Inclusion criteria were trainees currently undergoing systematic training who voluntarily participated in the study and signed the informed consent form. Exclusion criteria were those unable to complete the questionnaire due to health or other reasons, as well as those who refused to participate in the study.

2.2 Theoretical Framework and Questionnaire Design

The questionnaire was developed on the basis of a dual theoretical framework integrating the Kirkpatrick training evaluation model[9] and the health belief model (HBM)[10]. The Kirkpatrick model was used to structure the assessment of training outcomes across multiple levels: the learning level (Level 2) was operationalized through items assessing both theoretical knowledge (for example, the golden time window, CPR sequence, and compression parameters; Questions 8-9 and 11-18) and self-perceived competence (Questions 7, 10 and 18); the behavioural level (Level 3) was approximated by measuring rescue willingness (Question 5) and perceived barriers to action (Question 6); and learning needs and preferences (Questions 22-24) were used to infer feedback relevant to the reaction level (Level 1). The health belief model was applied to explain the psychological mechanisms underlying trainees' attitudes and behavioural intentions. Key constructs, including perceived barriers (Question 6: personal incompetence and fear of disputes), self-efficacy (Questions 10 and 18: ability to assess vital signs and to use an AED), and behavioural intention (Question 5), were directly measured in order to identify factors that facilitate or impede the translation of knowledge into action. This integrated framework ensures that each question-

naire item is grounded in validated theoretical constructs, enhancing the construct validity of the instrument.

2.3 Survey Instrument

A self-designed structured anonymous questionnaire was developed as the survey instrument, covering four dimensions: demographic characteristics (gender, age, educational level, professional background, and so forth), CPR skill proficiency (including theoretical knowledge such as the golden time window and initiation indicators, and practical skills such as compression location and rate), learning attitudes (including willingness to rescue and influencing factors), and learning needs (including training content, delivery methods, and assessment expectations). The questionnaire was reviewed by three experts in emergency medicine, and the content validity index (CVI) was 0.92, indicating good content validity.

2.4 Data Collection and Statistical Analysis

The questionnaires were distributed on site by uniformly trained researchers, completed anonymously, and collected on the spot. A total of 101 questionnaires were distributed and 101 were returned, yielding a response rate of 100%. After review, all 101 questionnaires were valid, giving an effective rate of 100%. For data processing, descriptive statistical methods were employed, with data presented as frequencies (n) and percentages (%) to describe the distribution characteristics of each indicator, with a focus on core data regarding skill proficiency, attitudes, and needs.

3 Results

3.1 Demographic Characteristics of the Study Population

A total of 101 participants were enrolled in this study. The majority were female (n = 80, 79.21%), with males accounting for 20.79% (n = 21). The predominant age group was 30-40 years (n = 60, 59.41%), followed by 20-30 years (n = 35, 34.65%) and 40-50 years (n = 6, 5.94%). Regarding educational level, the majority held doctoral degrees (n = 74, 73.27%), followed by master's degrees (n = 25, 24.75%) and bachelor's degrees (n = 2, 1.98%). In terms of professional background, the majority (n = 89, 88.12%) were from non-medical fields, while medical-related backgrounds accounted for 11.88% (n = 12).

3.2 CPR Skill Proficiency

3.2.1 Theoretical Knowledge.

Knowledge of the golden time window for cardiac arrest resuscitation. The majority of respondents (n = 92, 91.09%) correctly identified 1-4 minutes as the optimal time window, whereas 6 respondents (5.94%) incorrectly selected 1-6 minutes, 2 re-

spondents (1.98%) selected 1-10 minutes, and 1 respondent (0.99%) responded that they did not know (Figure 1). The high correct response rate suggests that the vast majority of participants demonstrated satisfactory awareness of the golden time window.

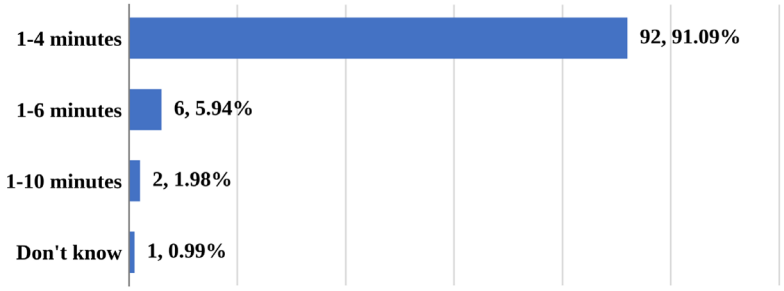


Fig. 1. Awareness of the golden time window for cardiac arrest resuscitation.

Identification of CPR initiation indicators. This item allowed multiple responses. The mention rates from highest to lowest were pulselessness in 93 respondents (92.08%), apnoea in 90 respondents (89.11%), and unconsciousness in 63 respondents (62.38%). The mention rate of unconsciousness was therefore substantially lower than that of pulselessness and apnoea, suggesting relatively insufficient awareness of consciousness assessment as a core vital-sign indicator and indicating a certain degree of one-sidedness in judgement. Considering the response combinations, only 61 respondents (60.40%) were able to identify all three comprehensive indicators (apnoea, pulselessness, and unconsciousness), indicating that nearly 40% of respondents lacked a complete understanding of CPR initiation criteria (Figure 2).

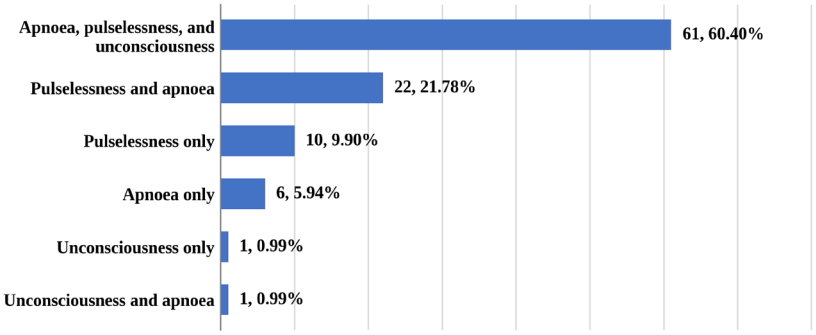


Fig. 2. Response combinations for CPR initiation indicators.

Self-perceived level of first-aid knowledge and ability to assess vital signs. A total of 39 respondents (38.61%) considered themselves familiar with first-aid knowledge, 58 respondents (57.43%) rated themselves as not very familiar, and 4 respondents (3.96%) rated themselves as not at all familiar. When asked whether they were able to assess consciousness, pulse, and breathing, 96 respondents (95.05%) answered yes and 5 respondents (4.95%) answered no, indicating that self-rated confidence in vital-

sign assessment was considerably higher than self-rated familiarity with first-aid knowledge in general (Figure 3).

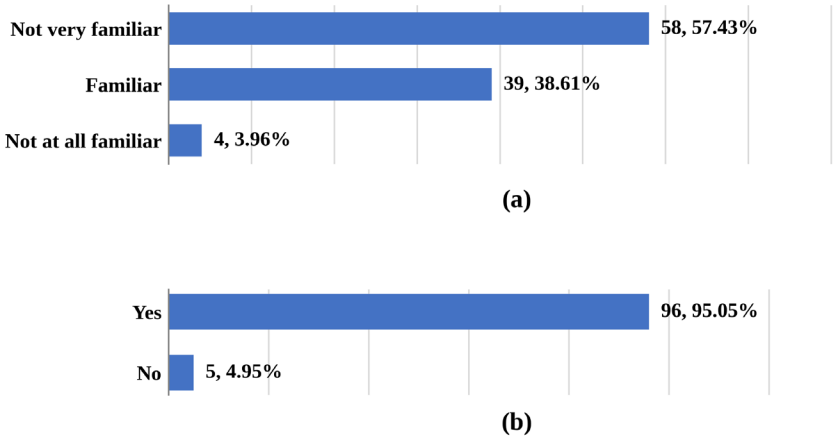


Fig. 3. Self-assessment items: (a) self-perceived level of first-aid knowledge; (b) self-reported ability to assess consciousness, pulse, and breathing.

3.2.2 Operational Skills.

Knowledge of the correct CPR sequence. Regarding knowledge of the correct CPR sequence, 86 respondents (85.15%) correctly identified the sequence as chest compression, open airway, rescue breathing (C-A-B), 13 respondents (12.87%) incorrectly chose open airway, chest compression, rescue breathing (A-C-B), and 2 respondents (1.98%) incorrectly chose chest compression, rescue breathing, open airway (C-B-A). The correct response rate of 85.15% indicates that the vast majority of respondents had mastered the correct CPR sequence (Figure 4).

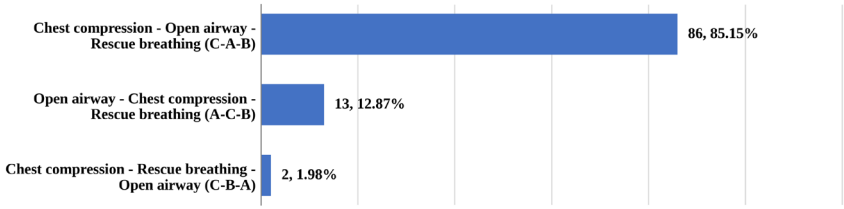


Fig. 4. Distribution of knowledge on the CPR sequence.

Recognition of hand placement for chest compressions. This item also allowed multiple responses. The midpoint of the nipple line (in males) was mentioned by 98 respondents (97.03%), the junction of the middle and lower thirds of the sternum by 45 respondents (44.55%), and two finger-widths above the xiphoid process by 26 respondents (25.74%); a further 2 respondents (1.98%) selected the midpoint of the nipple line without qualification (Figure 5). Although recognition of the nipple-line landmark was therefore near-universal, only 47 respondents (46.53%) selected a single anatomical description, while 54 respondents (53.47%) selected two or more, and

26 respondents (25.74%) included a landmark inconsistent with the others they had chosen. The dispersion of response patterns indicates that respondents did not share a standardized description of the compression position.

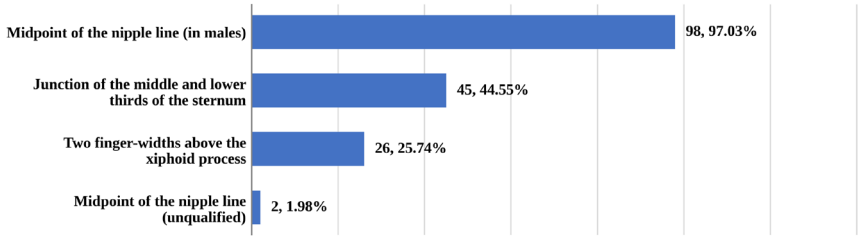


Fig. 5. Anatomical landmarks mentioned for chest compression hand placement (multiple responses permitted).

Key operational parameters. With respect to chest compression rate, 91 respondents (90.10%) correctly identified 100-120 compressions per minute as the recommended frequency. Regarding the compression-to-ventilation ratio, 93 respondents (92.08%) accurately selected 30:2 as the standard ratio. The correct response rates for both key operational parameters surpassed 90%, suggesting that the vast majority of respondents had a satisfactory command of the essential technical parameters of CPR (Figure 6).

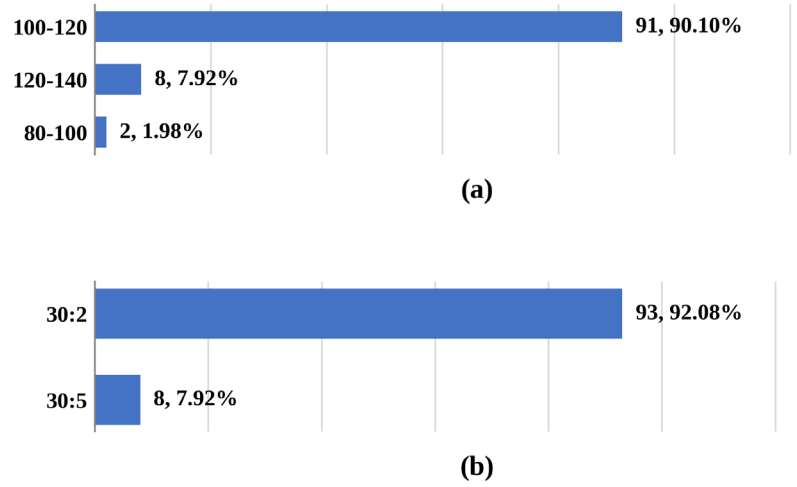


Fig. 6. Distribution of knowledge on key CPR operational parameters: (a) compression rate; (b) compression-to-ventilation ratio.

Ability to use an AED. Regarding the ability to use an AED, 85 respondents (84.16%) reported that they could use an AED, 14 respondents (13.86%) reported that they could not, and 2 respondents (1.98%) reported that they had never heard of an AED (Figure 7). More than 80% of the respondents therefore self-rated as capable of using an AED; however, 15.84% still lacked the relevant skills or awareness.

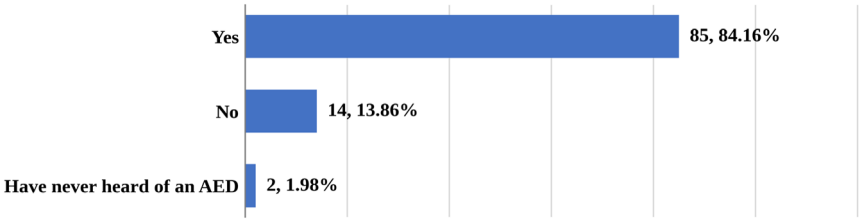


Fig. 7. Proportion of respondents proficient in the use of an automated external defibrillator (AED).

3.3 Attitudes Toward CPR Rescue

With respect to willingness to rescue, the majority of respondents (n = 76, 75.25%) reported that they would provide assistance to individuals in need of rescue, whereas 25 respondents (24.75%) explicitly stated that they would not. The item on factors influencing rescue willingness allowed multiple responses, and 52 respondents (51.49%) selected more than one factor, so the percentages below sum to more than 100%. Insufficient personal competence was identified as a constraining factor by 86 respondents (85.15%), followed by fear of trouble or legal disputes during rescue in 54 respondents (53.47%), a dangerous scene or lack of rescue conditions in 32 respondents (31.68%), and unwillingness to get involved in 4 respondents (3.96%) (Figure 8).

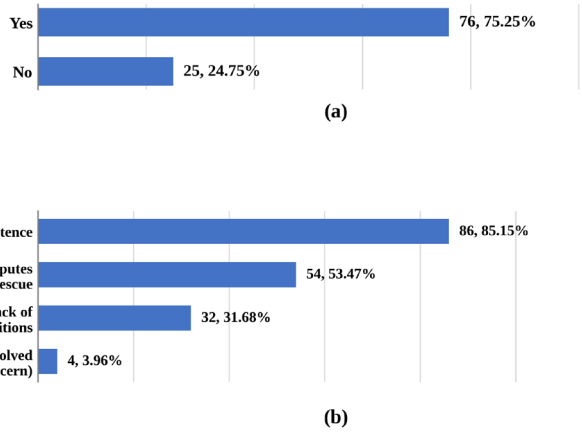


Fig. 8. Willingness to rescue and influencing factors: (a) willingness to rescue; (b) influencing factors.

3.4 CPR Training Needs

3.4.1 Previous Training Experience.

Seventy-five respondents (74.26%) reported having received professional CPR training, while 26 respondents (25.74%) reported having no such training. For the

item concerning the types of training received, 84 respondents (83.17%) selected theory and practice, 16 respondents (15.84%) selected theory only, and 1 respondent (0.99%) selected practice only (Figure 9). Percentages for this item were calculated using the total sample of 101 respondents.

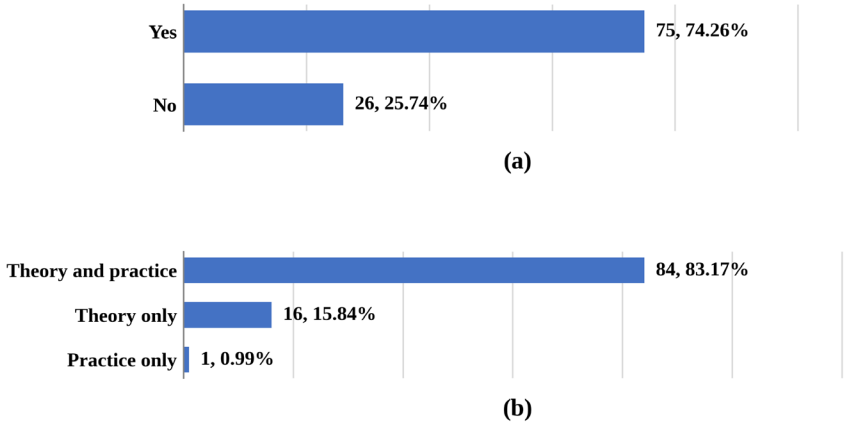


Fig. 9. Previous training experience: (a) receipt of professional training; (b) types of training received.

3.4.2 Training Preferences.

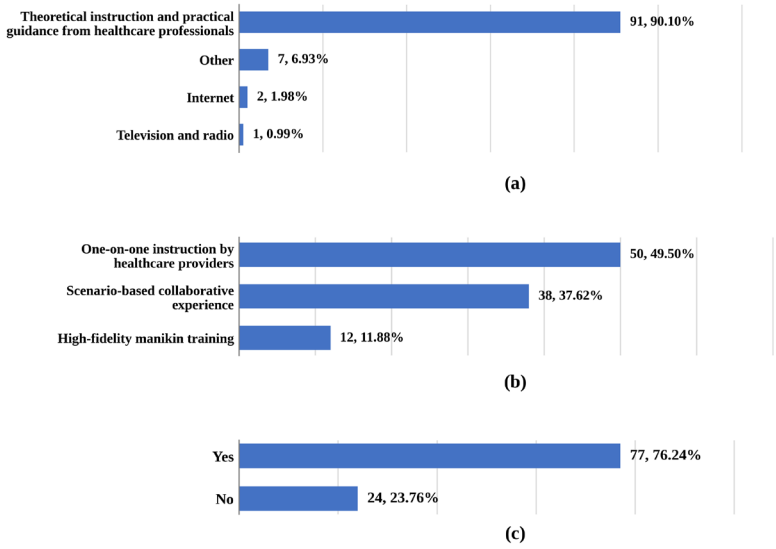


Fig. 10. Training preferences: (a) preferred learning channels; (b) preferred forms of practical training; (c) expectations for assessment.

With respect to preferred learning channels, the majority of respondents (n = 91, 90.10%) selected theoretical instruction and practical guidance from healthcare pro-

fessionals as their first choice, followed by other channels (n = 7, 6.93%, including two free-text responses), the internet (n = 2, 1.98%), and television and radio (n = 1, 0.99%). In terms of preferred forms of practical training, nearly half of the respondents (n = 50, 49.50%) favoured one-on-one instruction by healthcare providers, while 38 respondents (37.62%) preferred scenario-based collaborative experience and 12 respondents (11.88%) preferred high-fidelity manikin training; one respondent (0.99%) did not answer this item. Regarding expectations for assessment, the vast majority of respondents (n = 77, 76.24%) believed that both theory and practice should be assessed, whereas 24 respondents (23.76%) considered that no assessment is necessary (Figure 10).

4 Discussion

4.1 CPR Skill Proficiency: the Imbalance Between Theoretical Knowledge and Practical Competence

The present study revealed that participants demonstrated a relatively high level of theoretical knowledge regarding core CPR concepts, with correct response rates ranging from 85.15% to 92.08% on items such as the golden time window for cardiac arrest resuscitation and the correct CPR sequence. However, notable deficiencies were observed in practical operational details. First, considerable variability was found in the description of hand placement for chest compressions. Although 97.03% of respondents mentioned the midpoint of the nipple line, 53.47% selected two or more anatomical descriptions and 25.74% included two finger-widths above the xiphoid process alongside landmarks that locate the compression point differently. The dispersion of these response patterns suggests a lack of standardized understanding of anatomical landmarks for compression positioning. Second, 15.84% of respondents reported being unable to use an AED or having never heard of one, indicating a substantial gap in life-saving device operation.

This deficiency in operational details appears to be a common challenge in CPR skill acquisition. In a survey conducted by Lan et al. among grassroots military personnel, compression depth (56.1%), compression rate (33.2%), and compression rhythm (30.3%) were identified as the most difficult technical details to master during CPR learning, reflecting the inherent difficulty in achieving fine motor skill proficiency through didactic instruction alone[11]. The root cause of this phenomenon can be traced to the current training model. Li et al. pointed out that traditional CPR courses suffer from a disconnect between theory and practice, as well as insufficient interaction between teaching and learning, which limits students' in-depth understanding and mastery of CPR skills[12]. In the present study, 83.17% of respondents selected training combining theory and practice, while 15.84% selected theory-only instruction. Nevertheless, the observed deficiencies indicate that the existing practical training may still be insufficient in intensity, standardization, or skill retention. This finding is consistent with the work of Fan, who demonstrated that students who had undergone simulation training on manikins achieved significantly higher success rates than those who had not ($P < 0.01$), confirming that adequate practical simulation is critical for

improving operational success rates[13]. Furthermore, given that 88.12% of respondents came from non-medical backgrounds, the lack of foundational knowledge in anatomy and physiology may have contributed to difficulties in mastering operational details such as hand placement. These findings collectively underscore the need for training content to be tailored to professional backgrounds, with particular emphasis on strengthening practical training components and establishing regular refresher training mechanisms.

4.2 Learning Attitudes: the Paradox Between Positive Willingness and Practical Concerns

A substantial majority of respondents (75.25%) expressed a willingness to provide rescue assistance, reflecting a strong sense of professional responsibility and prosocial orientation. However, this positive attitude was counterbalanced by significant concerns: 85.15% of respondents identified insufficient personal competence as a barrier to performing rescue, and 53.47% cited fear of trouble or legal disputes during rescue as a deterrent. That a majority of respondents endorsed the legal concern, rather than a small minority, indicates that liability anxiety is not a peripheral issue in this cohort. These findings are consistent with the health belief model, in which perceived barriers are known to inhibit behavioural intention even when motivation is present. Similar results were reported by Luo and He in their survey of the general public in Wuhan, where concerns about unsuccessful rescue or resulting legal disputes and concerns about non-standard technique were identified as the primary subjective factors for unwillingness to perform rescue[14].

The competence-related concerns are likely a direct consequence of inadequate practical training, as discussed above. Meanwhile, the fear of legal repercussions points to a gap in legal literacy. In the aforementioned survey, only 27.38% of the public were aware of the Good Samaritan exemption clause, suggesting that although legal protections have been established, public awareness has not kept pace[14]. Therefore, training programmes should simultaneously strengthen skill confidence and legal awareness, particularly through clarification of the Good Samaritan clause in the Civil Code, in order to alleviate unfounded fears and reinforce bystander confidence.

5 Conclusions and Recommendations

This study investigated the CPR skill proficiency, attitudes, and learning needs among in-service trainees at a Chinese university. The findings reveal a distinctive profile characterized by three key features.

First, participants demonstrated solid theoretical knowledge of CPR, with correct response rates around or above 90% on core items such as the golden time window for cardiac arrest resuscitation (91.09%), chest compression rate (90.10%), and the compression-to-ventilation ratio (92.08%). However, this theoretical strength was not matched by equivalent practical competence. Notably, only 60.40% of respondents were able to identify all three comprehensive CPR initiation indicators (apnoea, pulse-

lessness, and unconsciousness), and 15.84% reported being unable to use an AED or having never heard of one. Furthermore, while 97.03% mentioned the midpoint of the nipple line as a landmark for hand placement, over half of the respondents selected multiple and partly inconsistent anatomical descriptions, suggesting a lack of standardized understanding of compression positioning. Although 83.17% selected training combining theory and practice, the continuing gap between theoretical knowledge and practical competence indicates that practical training may still be insufficient in depth, frequency, standardization, or retention.

Second, although 75.25% of respondents expressed a willingness to provide rescue assistance, reflecting a positive attitude toward helping others, this willingness was substantially constrained by practical concerns. The most frequently cited barrier was insufficient personal competence (85.15%), followed by fear of trouble or legal disputes during rescue (53.47%) and a dangerous scene or lack of rescue conditions (31.68%). These findings suggest that while trainees hold favourable attitudes toward rescue, their confidence and willingness to act are undermined by perceived skill deficits and legal uncertainties, both of which are potentially addressable through targeted training interventions.

Third, the learning needs expressed by participants were overwhelmingly practice-oriented. A total of 90.10% of respondents preferred theoretical instruction combined with practical guidance from healthcare professionals as their primary learning channel, and 49.50% favoured one-on-one instruction by healthcare providers as the preferred format for practical training. Additionally, 37.62% desired scenario-based collaborative experiences, and 76.24% supported the implementation of formal assessment mechanisms for both theory and practice. These preferences indicate a substantial demand for structured, hands-on, and assessment-oriented instruction.

Based on the findings of this study, several evidence-based recommendations are proposed to enhance the effectiveness of CPR training for in-service trainees in colleges and universities.

First, a tiered and differentiated training system tailored to trainees' professional backgrounds should be implemented. The data from this study indicate that 88.12% of the respondents came from non-medical professional backgrounds. The training curriculum should therefore incorporate foundational teaching modules in anatomy and physiology, with emphasis on core content such as anatomical landmarks for chest compression positioning and basic cardiovascular anatomy. This approach would help non-medical trainees understand the operational principles and solidify their practical foundation. Concurrently, training should be precisely targeted at identified skill weaknesses, with particular focus on hand placement for chest compressions, comprehensive recognition of CPR initiation indicators, and standardized AED operation. Training content should further be optimized by incorporating real-world emergency scenarios such as outdoor settings and public emergencies, ensuring alignment with the rescue demands of daily sudden cardiac emergencies and facilitating effective skill transfer to diverse actual emergency situations.

Second, practical training modalities should be innovated through interactive and contextualized teaching approaches. This study revealed that trainees demonstrated a strong preference for one-on-one instruction by healthcare providers (49.50%) and

scenario-based collaborative practical training (37.62%), indicating a clear inclination toward learning models that are highly practical, well guided, and context-rich. It is therefore recommended to construct a blended practical training model combining expert one-on-one guidance with immersive scenario simulation. Training scenarios should encompass common emergency rescue situations, including responder liability determination, ethical considerations in emergency response, and multi-person collaborative rescue coordination. Such an approach would not only enhance trainees' CPR operational proficiency but also effectively alleviate psychological barriers such as concerns about rescue liability and on-scene anxiety, helping trainees develop sound emergency psychological resilience.

Third, a closed-loop skill assessment and recertification system should be established. In this study, 76.24% of respondents recognized the necessity of standardized assessment, reflecting trainees' core demand for skill verification and standardized competency certification. It is therefore recommended to develop a comprehensive, multi-stage evaluation framework encompassing both theoretical and practical assessment modules. At the theoretical level, the focus should be on key knowledge points such as the golden time window for resuscitation and core chest compression parameters. At the practical level, emphasis should be placed on standardized AED operation, proper compression techniques, and execution of the complete rescue sequence. Furthermore, a routine periodic refresher training and skill recertification mechanism should be established to prevent skill decay over time. CPR certification could additionally be linked to trainee competency assessments and comprehensive performance evaluations, supported by incentive structures that encourage trainees to actively maintain their resuscitation skills. This would form a closed-loop training, assessment, application, and refresher mechanism, enabling sustainable enhancement of emergency response capabilities.

This study has several limitations. First, the research sample was drawn exclusively from in-service trainees at a single institution and comprised a single training cohort, which limits the generalizability and applicability of the findings to in-service trainees across colleges and universities nationwide. Second, the study employed a self-report questionnaire for data collection; indicators such as self-assessed skill proficiency and willingness to rescue are subject to recall bias and social desirability bias, rendering the data somewhat subjective. Third, as a cross-sectional study, this research reflects only the current training status at a single point in time and cannot track the long-term retention of CPR skills, nor establish causal relationships between existing training models and skill acquisition outcomes.

Future research should expand the scope of investigation through multi-centre, longitudinal follow-up studies incorporating objective assessment methods such as manikin-based practical examinations and on-site skill evaluations. Combined with long-term follow-up data, such studies could investigate the durability and stability of training effects. Additionally, interventional studies should be conducted to validate the practical effectiveness of optimized approaches including tiered curricula, scenario-based simulation teaching, and closed-loop assessment and certification systems, thereby providing more robust evidence for reforming first-aid training systems. Despite the aforementioned limitations, this study has systematically delineated the cur-

rent status, skill deficiencies, and training needs of CPR training for in-service trainees in colleges and universities, establishing a data-based research baseline for the refinement of first-aid training systems and the enhancement of emergency response capabilities.

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