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Research Article

Knowledge and Skills Regarding Cardiopulmonary Resuscitation among Staff of the 108 Ambulance Service in Sagar District, Madhya Pradesh, India: A Cross-Sectional Study

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ABSTRACT
Background: Cardiopulmonary resuscitation (CPR) is a time-critical intervention that significantly improves survival after cardiac arrest. Ambulance personnel are often the first healthcare providers to initiate CPR in out-of-hospital cardiac arrest (OHCA); however, deficiencies in CPR knowledge and practical skills may compromise patient outcomes.
Objectives: To assess CPR knowledge and practical skills among personnel of the 108 ambulance service in Sagar district, Madhya Pradesh; to evaluate the availability and functionality of emergency equipment; and to identify training gaps.
Methods: A cross-sectional observational study was conducted among 161 ambulance personnel working in Basic Life Support (BLS) and Advanced Life Support (ALS) ambulances. Data were collected using a structured questionnaire based on American Heart Association recommendations, direct observation of CPR skills using standardized checklists, and assessment of ambulance equipment.
Results: The study revealed considerable deficiencies in both CPR knowledge and practical skills despite prior training among many participants: 57.1% had average knowledge and 54.7% had average skills, while only 19.9% and 18.0%, respectively, achieved a good level. Knowledge and skill levels were significantly associated ($x^2 = 26.71$, df = 4, p = 0.00002). Equipment assessment showed high overall availability (ALS: 95.6%; BLS: 93.6%) and functionality (ALS: 95.0%; BLS: 95.9%), with selected deficiencies in AEDs, infant/child AMBU bags, and select airway devices.
Conclusion: Regular simulation-based refresher training, competency assessment, and improved ambulance preparedness are essential to strengthen prehospital emergency care under the 108 ambulance system.

Keywords: Cardiopulmonary Resuscitation, Basic Life Support, Ambulance Staff, Emergency Medical Services, 108 Ambulance, Prehospital Care.

INTRODUCTION

Cardiopulmonary resuscitation (CPR) is a fundamental lifesaving intervention performed during cardiac arrest to maintain cerebral and coronary perfusion until return of spontaneous circulation or advanced medical care is achieved. High-quality CPR characterized by adequate chest compression depth and rate, minimal interruptions, and timely defibrillation remains the cornerstone of successful resuscitation and is strongly emphasized in current American Heart Association (AHA) and International Liaison Committee on Resuscitation (ILCOR) guidelines.[1,2]

Out-of-hospital cardiac arrest (OHCA) continues to represent a major global public health challenge, with survival remaining low despite advances in emergency medical systems. Survival has been reported to decrease by approximately 7–10% for every minute that CPR is delayed, underscoring the importance of rapid recognition and immediate intervention.[1,3] The "Chain of Survival," comprising early recognition, prompt activation of emergency services, immediate CPR, rapid defibrillation, advanced life support, and post-resuscitation care, provides the framework for improving patient outcomes.[1,4]

Ambulance personnel serve as the first professional responders in most OHCA cases and play a critical role in initiating CPR during the "golden minutes" before hospital arrival. In India, the government-supported 108 ambulance service has substantially improved access to emergency medical care across urban and rural areas; however, the effectiveness of prehospital resuscitation largely depends on the knowledge, practical skills, and preparedness of ambulance staff.[5,6]

Despite widespread implementation of CPR training programs, several studies have reported persistent deficiencies in both theoretical knowledge and psychomotor skills among ambulance personnel and other healthcare workers.[7–9] CPR skills deteriorate considerably within months of training if regular practice and refresher courses are not provided, underscoring the need for competency-based education and simulation training.[10,11] Furthermore, the availability and functionality of essential emergency equipment—including automated external defibrillators, airway devices, and ventilation equipment—significantly influence the quality of prehospital resuscitation.[12]

Evidence regarding CPR competency among 108 ambulance personnel in central India remains limited. The present study was therefore undertaken to assess CPR knowledge and practical skills among ambulance staff in Sagar district, Madhya Pradesh; to evaluate the availability and functionality of emergency equipment; and to identify training gaps that may inform strategies to strengthen prehospital emergency care.

MATERIALS AND METHODS

Study design and setting: A cross-sectional observational study was conducted among personnel of the 108 ambulance service in Sagar district, Madhya Pradesh, India, during 2023–2026. Ethical approval was obtained from the Institutional Ethics Committee of Government Bundelkhand Medical College, Sagar, prior to the commencement of the study.

Study population: The study included ambulance personnel deployed in both Basic Life Support (BLS) and Advanced Life Support (ALS) ambulances, including emergency medical technicians (EMTs), pilot drivers, and other staff directly involved in emergency response. Personnel who were actively working during the study period and provided written informed consent were included; those unavailable during data collection, on long-term leave, or unwilling to participate were excluded. A complete enumeration approach was adopted, and all eligible personnel were enrolled, yielding a final sample of 161 participants.

Data collection: Data were collected using a predesigned, structured questionnaire developed according to the 2020 American Heart Association Basic Life Support guidelines. The questionnaire captured socio-demographic and occupational characteristics age, gender, educational qualification, designation, work area, duration of service, previous CPR training, and refresher-training history. CPR knowledge was assessed through objective questions covering recognition of cardiac arrest, activation of emergency services, the compression-airway-breathing (CAB) sequence, compression rate and depth, compression-to-ventilation ratio, airway management, rescue breathing, and automated external defibrillator (AED) use.

Practical CPR skills were evaluated through direct observation using a standardized checklist. Performance was assessed for scene safety, responsiveness assessment, pulse and breathing assessment, chest compression technique, airway management, rescue breathing, and adherence to recommended CPR procedures. Participants who required improvement received immediate on-site demonstration and correction of technique.

A separate observational checklist assessed the availability and functionality of essential emergency equipment in BLS and ALS ambulances, including oxygen delivery systems, AMBU bags, suction devices, airway equipment, AEDs, blood pressure apparatus, and pulse oximeters.

Statistical analysis: Data were entered into Microsoft Excel and analyzed using SPSS. Descriptive statistics were expressed as frequencies, percentages, means, and standard deviations, while associations were examined using the chi-square test, with $p < 0.05$ considered statistically significant.

RESULTS

A total of 161 ambulance personnel working under the 108 ambulance service in Sagar district participated in the study. The assessment included evaluation of overall CPR knowledge, practical CPR skills, the relationship between knowledge and skill levels, and the availability and functionality of emergency

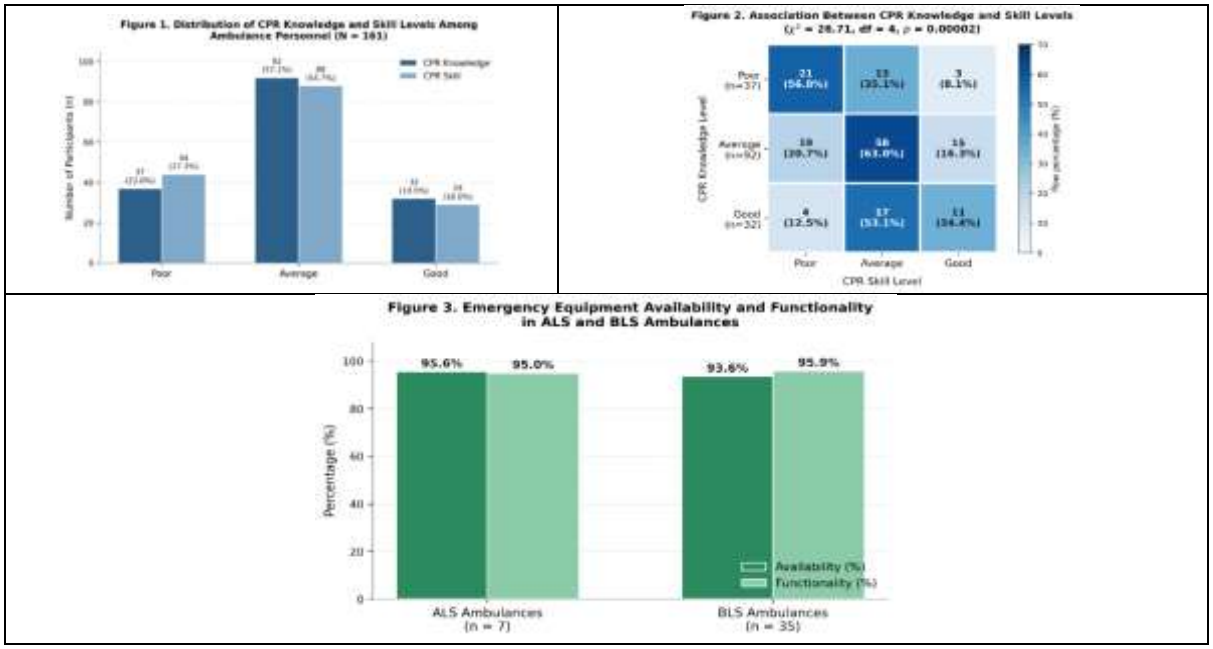
equipment in Advanced Life Support (ALS) and Basic Life Support (BLS) ambulances.

As presented in Table 1 and Figure 1, the majority of participants demonstrated an average level of CPR knowledge, with 92 (57.1%) scoring in the average category. Poor knowledge was observed among 37 (23.0%) participants, while only 32 (19.9%) achieved a good level of CPR knowledge.

Similarly, 88 (54.7%) participants demonstrated an average level of practical CPR skills, whereas 44 (27.3%) had poor skills and only 29 (18.0%) demonstrated good practical competency. The distribution of practical skills closely paralleled the pattern observed for theoretical knowledge.

Table 1. Distribution of Study Participants According To Overall CPR Knowledge and Skill Levels (N = 161)

Level	CPR Knowledge, n (%)	CPR Skill, n (%)
Poor	37 (23.0)	44 (27.3)
Average	92 (57.1)	88 (54.7)
Good	32 (19.9)	29 (18.0)
Total	161 (100.0)	161 (100.0)



The relationship between CPR knowledge and practical skills is presented in Table 2 and Figure 2. Among participants with poor knowledge, 21 (56.8%) also exhibited poor practical skills, while only 3 (8.1%) demonstrated good skills. Among those with average knowledge, 58 (63.0%) demonstrated average practical skills. In contrast, participants with good knowledge showed comparatively better performance, with 11 (34.4%) achieving good practical skills. The association between knowledge level and skill performance was statistically significant ($\chi^2 = 26.71$, df = 4, p = 0.00002), indicating a positive relationship between theoretical knowledge and practical competency.

Table 2. Association between CPR Knowledge Level and Skill Level among Study Participants

Knowledge Level	Skill: Poor	Skill: Average	Skill: Good	Total
Poor	21	13	3	37
Average	19	58	15	92
Good	4	17	11	32
Total	44	88	29	161

Chi-square (χ^2) = 26.71; degrees of freedom (df) = 4; p = 0.00002.

The assessment of emergency equipment in seven ALS ambulances comprised 273 expected equipment observations. As shown in Table 3, 261 items were available, corresponding to an overall equipment availability of 95.6%. Most essential life-support equipment, including oxygen cylinders, adult AMBU bags, intravenous supplies, monitoring devices, and folding stretchers, was available in all ALS ambulances. Slightly lower availability was observed for AEDs, infant and child AMBU bags, eye goggles, cervical collars, head immobilizers, and air splints. Of the available equipment, 248 items (95.0%) were functional, although isolated instances of non-functionality were identified in portable ventilators, AEDs, suction machines, laryngoscopes, pulse oximeters, digital thermometers, and fire extinguishers.

Table 3. Distribution of Emergency Equipment According To Availability and Functionality in ALS Ambulances (N = 7)

S. No.	Equipment	Available (Yes)	Functional (Yes)
1.	Portable ventilator	7	6
2.	Oxygen cylinder with humidifier	7	7
3.	AED	6	5
4.	Infusion syringe pump	6	6
5.	Portable suction machine	7	6
6a	AMBU bag – Infant	6	6
6b	AMBU bag – Child	6	6
6c	AMBU bag – Adult	7	7
7.	Laryngoscope	7	6
8.	Endotracheal tubes	7	6
9.	Suction catheter	7	6
10.	Nasogastric tubes	6	6
11.	Oxygen masks	7	7
12.	Nebulization device	6	6
13.	Face mask	7	7
14.	IV cannula	7	7
15.	Digital thermometer	7	6
16.	Stethoscope	7	7
17.	Pulse oximeter	7	6
18.	BP apparatus	7	7
19.	Torch	7	6
20.	Glucometer	6	6
21.	IV stand	7	7
22.	Syringes & needles	7	7
23.	Scissors	7	7
24.	Bandages	7	7
25.	Triangular bandage	7	6
26.	Betadine	7	6
27.	Cotton	7	7
28.	Adhesive tape	7	7
29.	Eye goggles	6	6
30.	Gloves	7	7
31.	Cervical collar	6	6
32.	Head immobilizer	6	6
33.	Air splint	6	5
34.	Folding stretcher	7	7
35.	Reflective safety wear	6	6
36.	Biomedical waste bins	7	7
37.	Fire extinguisher	7	6
38.	Total	261	248

Equipment assessment in 35 BLS ambulances comprised 1,155 expected observations. As presented in Table 4, 1,081 items were available, giving an overall availability of

93.6%. Essential equipment such as oxygen cylinders, intravenous cannulae, stethoscopes, gloves, and basic consumables was available in nearly all ambulances, whereas infant AMBU bags, air splints, eye goggles, and digital thermometers showed comparatively lower availability. Among the available items, 1,037 (95.9%) were functional, with occasional non-functionality observed in digital thermometers, biomedical waste bins, eye goggles, child AMBU bags, and head immobilizers. Overall equipment availability and functionality across ambulance categories are summarized in Figure 3.

Table 4. Distribution of Emergency Equipment According To Availability and Functionality in BLS Ambulances (N = 35)

S. No.	Equipment	Available (Yes)	Functional (Yes)
1.	Oxygen cylinder with humidifier	35	34
2.	Portable suction machine	32	31
3a	AMBU bag – Infant	27	26
3b	AMBU bag – Child	30	28
3c	AMBU bag – Adult	35	34
4.	Suction catheter	34	32
5.	Oxygen masks	35	34
6.	Nebulization device	31	30
7.	Face mask	35	34
8.	IV cannula	35	35
9.	Digital thermometer	28	22
10.	Stethoscope	35	35
11.	Pulse oximeter	32	31
12.	BP apparatus	35	34
13.	Torch	32	31
14.	Glucometer	30	28
15.	IV stand	34	32
16.	Syringes & needles	35	35
17.	Scissors	35	34
18.	Bandages	35	34
19.	Triangular bandage	32	31
20.	Betadine	34	32
21.	Cotton	35	35
22.	Adhesive tape	33	32
23.	Eye goggles	26	22
24.	Gloves	35	35
25.	Cervical collar	31	30
26.	Head immobilizer	32	30
27.	Air splint	27	26
28.	Folding stretcher	35	34
29.	Reflective safety wear	31	30
30.	Biomedical waste bins	35	31
31.	Fire extinguisher	35	35
32.	Total	1081	1037

DISCUSSION

The present study assessed CPR knowledge, practical skills, and emergency equipment preparedness among 161 personnel of the 108 ambulance service in Sagar district, Madhya Pradesh. The majority of participants demonstrated average CPR knowledge (57.1%) and average practical skills (54.7%), while good competency was observed in fewer than one-fifth of participants. A significant positive association was found between knowledge and skill performance ($\chi^2 = 26.71$, $p = 0.00002$), indicating that better theoretical understanding translated into improved practical competency. The predominance of average knowledge scores suggests that although ambulance personnel possess basic CPR awareness, comprehensive understanding of current evidence-based resuscitation practice remains limited. These findings are comparable to those

of Hansda et al., who reported inadequate BLS knowledge among ambulance personnel in eastern India despite prior training, highlighting the limitations of one-time certification programs.[9] Similarly, Kayadelen et al. found moderate knowledge among paramedics in Turkey and identified recent CPR training and refresher courses as significant predictors of better competency.[10]

Practical skill performance in the present study was similarly suboptimal, with only 18.0% of participants demonstrating good CPR skills. This finding is clinically relevant, as the AHA and ILCOR emphasize that high-quality chest compressions, adequate depth, appropriate compression rate, minimal interruptions, and early defibrillation are essential determinants of survival following cardiac arrest.[1,2] The significant association between knowledge and skills observed in this study supports the recommendations of Greif et al. and Yeung et al., who demonstrated that simulation-based training, repeated hands-on practice, and structured feedback substantially improve both knowledge retention and psychomotor performance.[7,8]

Equipment assessment demonstrated encouraging preparedness within the 108 ambulance system. ALS ambulances showed 95.6% equipment availability with 95.0% functionality, while BLS ambulances demonstrated 93.6% availability and 95.9% functionality. Although most essential equipment was available, deficiencies in AEDs, infant AMBU bags, air splints, and certain airway devices were noted. Similar challenges have been reported in Indian prehospital emergency services, where limited availability of trained personnel and defibrillation equipment adversely affects out-of-hospital cardiac arrest outcomes.[11] International guidelines further emphasize that strengthening emergency medical systems requires not only functional equipment but also continuous competency assessment, regular refresher training, and quality-improvement programs to optimize prehospital resuscitation outcomes.[3–6]

Limitations

This study has several limitations. First, the cross-sectional design precludes causal inference between training history and CPR competency. Second, practical skills were assessed using standardized check list, which may not fully reflect performance during real-world OHCA events. Third, the study was confined to a single district, which may limit generalizability to other regions with differing training infrastructure. Future multicentric, longitudinal studies incorporating post-training follow-up are recommended to validate these findings.

CONCLUSION

This study identified important gaps in CPR competency among personnel of the 108 ambulance service in Sagar district, with most participants demonstrating average knowledge (57.1%) and practical skills (54.7%), while good competency was observed in fewer than one-fifth. A significant association between knowledge and skill levels indicates that improved theoretical understanding enhances practical performance. Although ALS and BLS ambulances showed high equipment availability and functionality, deficiencies in selected critical equipment remain. Regular simulation-based refresher training, competency-based certification, periodic skill assessments, and routine equipment audits are essential to strengthen prehospital emergency care and improve outcomes following out-of-hospital cardiac arrest.

Recommendations

Based on these findings, regular simulation-based CPR refresher training should be conducted for all 108 ambulance personnel to improve knowledge retention and practical skills. Periodic competency assessments using standardized checklists should be implemented to ensure adherence to current resuscitation guidelines. Routine audits should be undertaken to maintain the availability and functionality of essential emergency equipment, particularly automated external defibrillators, pediatric resuscitation devices, and airway equipment. Additionally, mock drills, supportive supervision, and continuous quality-improvement programs should be integrated into the 108 ambulance service to strengthen prehospital emergency care and improve patient outcomes.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee of Government Bundelkhand Medical College, Sagar, prior to the commencement of the study. Written informed consent was obtained from all participants.

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