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NURSES' AWARENESS OF THE EARLY SIGNS AND SYMPTOMS OF ACUTE CORONARY SYNDROME AT A TERTIARY CARE SETTING IN PAKISTAN: A DESCRIPTIVE CROSS-SECTIONAL STUDY

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Abstract

Background: Acute coronary syndrome (ACS) is a leading cause of morbidity and mortality worldwide, and its burden is rising disproportionately in low- and middle-income countries. Because nurses are frequently the first clinicians to assess and triage patients presenting with cardiac symptoms, their ability to recognise early and atypical presentations of ACS is a critical determinant of timely intervention and survival. This study assessed nurses' awareness of the early signs and symptoms of ACS at a tertiary care setting and identified the demographic and professional factors associated with their level of knowledge.
Methods: A descriptive, quantitative cross-sectional study was conducted among 227 registered nurses working in the emergency, cardiology and general medical wards of tertiary care teaching hospitals affiliated with LUMHS in Hyderabad/Jamshoro, Sindh, Pakistan. Participants were recruited using non-probability convenience sampling, and the sample size was derived from the single-population-proportion formula. Data were collected with a structured questionnaire based on the American Heart Association (AHA) and European Society of Cardiology (ESC) guidelines, covering demographic characteristics and knowledge of the definition, risk factors, symptomatology, diagnostic evaluation and initial management of ACS. Knowledge was classified as good (≥75%), moderate (50–74%) or poor (<50%). Data were analysed in SPSS version 26 using descriptive statistics and the chi-square test, with $p \leq 0.05$ taken as statistically significant.
Results: Of the 227 participants, 133 (58.6%) demonstrated moderate knowledge of ACS, 55 (24.2%) demonstrated good knowledge and 39 (17.2%) demonstrated poor knowledge. Knowledge level was significantly associated with educational qualification ($p = 0.003$), years of clinical experience ($p = 0.001$), working department ($p = 0.021$) and prior cardiac training ($p < 0.001$). Nurses with higher qualifications, greater clinical experience, cardiology placement and previous cardiac training achieved higher knowledge scores. Notably, 138 (60.8%) of participants had never received any formal cardiac training.
Conclusion: The majority of nurses possessed only moderate knowledge of ACS, with persistent gaps in the recognition of atypical presentations and early management priorities. Structured, guideline-concordant continuing education and mandatory in-service cardiac training—particularly for staff outside dedicated cardiac units—are needed to strengthen early recognition, reduce prehospital and in-hospital delay, and improve outcomes for patients with ACS.

Keywords: Acute coronary syndrome; Cardiac nursing; Clinical competence; Early diagnosis; Nursing knowledge; Pakistan.

1. INTRODUCTION

Cardiovascular disease (CVD) is still the leading cause of death globally, and continues to take a major and growing toll on health systems. In 2021, there were an estimated 19.4 million deaths due to cardiovascular disease (CVD) worldwide, representing about one-third of all deaths [1]. While age-standardised cardiovascular mortality rates have decreased in many high income countries due to better prevention and treatment [2,3] the number of cardiovascular deaths has increased steadily with the ageing of populations and rising exposure to modifiable risk factors such as

hypertension, diabetes mellitus, dyslipidaemia, obesity, physical inactivity, and tobacco use, especially in LMICs [1,2].

One of the most common and time-critical cardiovascular emergencies in clinical practice is acute coronary syndrome (ACS), the acute presentation of which is the greatest contributor to this burden, with coronary heart disease being the single largest contributor [4]. ACS is best thought of as a clinical continuum that originates from acute myocardial ischaemia caused by a diminished coronary blood flow and includes unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI) [4,19]. Pathophysiology is typically the rupture or erosion of an atherosclerotic plaque, followed by the formation of a thrombus that results in partial or complete occlusion of a coronary artery; depending on the extent and duration of occlusion the clinical picture will be that of unstable angina, NSTEMI or STEMI, and if ischaemia is not relieved, this will lead to irreversible myocardial necrosis [18,23]. The universal definition is based on biochemistry as it is the evidence of myocardial injury that is confirmed by the release of cardiac troponins [37].

The impact of ACS on the clinical and financial outcomes is significant. The United States, alone, has about 915,000 ACS events annually and as many as 38% of those with ACS develop acute heart failure as a complication, and these scenarios have very poor short- and long-term outcomes [5]. In LMICs, late presentation, limited access to heart specialist care, lack of reperfusion services and variability in heart guideline compliance exacerbate the case-fatality burden in this context [6,20]. In-hospital ACS mortality has been reported significantly higher in resource-limited settings compared with high income societies, highlighting a global inequity in cardiovascular outcomes for in-hospital mortality [31].

Time to treatment is a key parameter in determining survival in ACS. Modern guidelines state that the benefit seen when a blocked artery is re-opened is very time-selective: the sooner a blocked artery can be re-opened, the less myocardium is lost [4,38]. Early symptom recognition (after only a few hours) and rapid reperfusion is closely correlated with low mortality, while prehospital delay is consistently correlated with poor outcome [6,30]. Failure to recognize ACS symptoms – by the patient, who often mistake symptoms for minor or non-cardiac illness, and by frontline clinicians, who often do not make the diagnosis due to either lack of adequate knowledge or the inability to link to a cardiac etiology – is a major and modifiable cause of delay [9,10]. Systematic reviews also show that a lack of knowledge about symptoms and incorrect symptom attribution are among the most robust predictors of decision delay to seek or start care [9].

Heterogeneity of presentation of ACS makes recognition difficult. The classical and best recognised symptom is central or substernal chest pain radiating to arm, neck, jaw or back but a large number of patients (particularly women, the elderly and diabetics) have non-classical or less prominent symptoms that include dyspnoea, fatigue, nausea, diaphoresis, dizziness or epigastric discomfort [11,12,13]. Recognition of these atypical presentations is always lower than recognition of chest pain, both for the public and for health professionals, and this is a known contributor to the under diagnosis and/or delayed diagnosis [9,14]. The recommended index of awareness of the broad range of ACS presentations is emphasized in the 2023 ESC guidelines [4] and mimics of ACS like Takotsubo syndrome make bedside assessment of ACS more challenging [34].

The nurses are an integral part of this care pathway, and are usually the first to meet the person in need. Nurses have a critical role to play within the healthcare team in the ED, coronary care unit and general wards, where they are often the first health care professionals to evaluate patients on the ED with cardiac symptoms and are expected to recognize the typical and atypical signs, perform ED triage and continuous monitoring and escalate care if the patient deteriorates [15,16,17]. They also carry out primary interventions and patient education regarding warning signs and need for prompt help-seeking [16]. As a result, nurses' clinical knowledge and discrimination of the various symptom patterns directly impact the timeliness and quality of ACS care and, ultimately, patient outcome [29]. This responsibility is not just limited to the operation, but applies to the post-procedure phase as well, where nurses need to be able to quickly identify complications that may arise after PCI, including bleeding, haematoma, pseudoaneurysm, arrhythmia and hypotension [22].

However, although nurses have a pivotal role to play, there is increasing evidence that their understanding of ACS is often poor. A cross sectional study of 252 nurses in tertiary hospitals in Addis Ababa, Ethiopia revealed that only 52% had a good knowledge of the care of ACS and only 44.4% had a good clinical practice, with a master's level qualification being a significant predictor of good knowledge [8]. The same limitations have been observed in other parts of south Asia such as in Pakistan, where in some studies the large proportion of respondents who were unable to correctly identify the cardinal symptoms of acute myocardial infarction was linked to delay in seeking and receiving care and treatment [7,25]. Nurses' competence in the recognition and management of ACS has been found to be influenced by their level of education, clinical experience, working environment, and previous cardiac training, with nurses consistently identifying a need to have structured implementation of guidelines in their clinical practice [8,16,36].

Cardiovascular diseases (CVDs) are a major cause of mortality in Pakistan, but there is less local evidence of nurses' knowledge of ACS with regard to the early and atypical presentations of the condition [25]. Awareness – knowing what people are aware of and what influences their awareness – is a prerequisite to designing interventions that are targeted to a specific awareness. This is also directly linked to SDG 3 (Good Health and Well-Being) [32] and is a key competency on the frontline. For this reason, the aim of this study was to fill that gap.

1.1 Aim and objectives

This study aimed to evaluate the awareness of early signs and symptoms of ACS among the nurses at tertiary care center and to explore the factors influencing nurse's awareness level. The specific objectives were: (i) to assess nurses' knowledge of the early signs and symptoms of ACS; (ii) to determine the relationship of the demographic and professional factors of the nurses (age, gender, educational qualification, clinical experience, working department and prior cardiac training) to the nurses' knowledge of ACS; (iii) to identify gaps in knowledge that may hinder early recognition and timely management of ACS.

1.2 Hypotheses

Two hypotheses were tested:Two hypotheses were tested: H1: Higher education and more clinical experience are associated with increased awareness by H1N1 nurses of the signs and symptoms of ACS. There is a significant difference in cardiac training knowledge between nurses with and without prior cardiac training.

2. MATERIALS AND METHODS

2.1 Study design

A quantitative descriptive cross sectional design was used to examine the knowledge of nurses about the early signs and symptoms of ACS at one time without the intervention of any variable. This design was chosen because it allows for an effective collection of numeric data on a known population and because it is appropriate for describing the prevalence of a characteristic (in this case, level of knowledge) and its relationship with participant attributes. The study protocol was designed and the study report was presented on the basis of the STROBE statement for cross-sectional studies.

2.2 Study setting

The study was carried out in the tertiary care teaching hospitals, affiliated to Liaquat University of Medical and Health Sciences (LUMHS) at Liaquat University Hospital, Hyderabad and Jamshoro. They are some of the biggest tertiary healthcare centres of the province and offer comprehensive medical, surgical, emergency and specialised cardiac services to the large catchment population of Hyderabad, Jamshoro & neighbouring areas of the province of Sindh. The emergency department, cardiology units and general medical wards were identified as areas of the hospital where nurses are likely to come into direct contact with patients suspected of having ACS during their initial care, monitoring and management, thus making them most likely to experience a cardiac emergency.

Students will be able to list the duration of study and the population.

The study was conducted for six months after obtaining ethical clearance, which was deemed sufficient for the recruitment process on various shifts, data entry, analysis and interpretation process. The study population included registered nurses in the selected units of the two hospitals who were registered. They were deemed as an appropriate population for these nurses in their day-to-day clinical practice as they routinely assessed and continuously monitored critically ill patients, with some of those patients suffering potentially life-threatening cardiac problems such as ACS.

2.4 Sample size

The sample size was determined using the standard single-population-proportion formula: $n = (Z2 \times P \times q) / e2$, where $Z = 1.96$ for a 95% confidence level, $P = 0.18$ (from previous studies the prevalence of adequate knowledge was 18%), $q = 1 - P = 0.82$, and $e = 0.05$ (a 5% margin of error). Plugging these in values gave a minimum sample size of 227 registered nurses, considered adequate for providing statistically accurate estimates of the level of knowledge and the relationships between knowledge and the variables.

2.5 The sampling technique and eligibility criteria.

A non-probabilistic convenience sampling method was used in which eligible nurses working on duty throughout shifts during the time the data were collected were approached and invited to participate. This was selected due to the convenience of participants, time constraints and the dynamic availability of nurses throughout shifts in the selected hospitals. The only inclusion criteria for the registered nurses were a minimum of six months of clinical experience, working in the emergency ward, cardiology ward, or general medical ward, providing direct patient care, and agreeing to provide informed written consent. Nursing students and interns, nurses in purely administrative functions and those who were unwilling to participate were excluded.

2.6 Data collection tool

Structured self-administered questionnaires were used that were designed based on the guidelines of the American Heart Association (AHA) and the European Society of Cardiology (ESC) on the management of ACS [4]. The instrument consisted of two main parts. The demographic and professional characteristics such as age, sex, educational qualification and years of clinical experience, working department, and previous training in cardiac surgery were recorded in Section A. Section B was a Knowledge Assessment section which included closed questions on the definition and type of ACS, Risk Factors, Early Signs and symptoms, Investigations (electrocardiography, cardiac biomarkers and echocardiography) and initial nursing management.

All correct answers were awarded 1 mark and all incorrect answers 0. The total knowledge score was presented as a percentage, and divided into three categories: good knowledge (75–100%), moderate knowledge (50–74%) or poor knowledge (<50%), as in similar studies of nurses' ACS knowledge [8]. A small additional section on routine nursing practices has been added for descriptive clinical context but these were not included in the knowledge score and in the inferential analysis and the study should therefore be understood as an evaluation of knowledge and not observed practice.

2.7 Data collection procedure

Following ethical and institutional approval the eligible nurses were approached during their duty hours across shifts in the emergency department, cardiology units and general medical wards. Each participant was informed of the purpose, objectives and significance of the study in a clear and understandable way and informed consent was obtained in writing prior to collecting data. Participants were informed that they could withdraw at any time without repercussions, and that their participation was voluntary. The questionnaire was completed independently by each participant in about 15–20 minutes, sometimes selected to reduce the impact on patient care. The researcher ensured that data were collected on the same day to minimise data loss and to ensure that the questionnaires were completed to ensure completeness, and verified that all the questionnaires were complete at the time of data collection. Personal identifiers were not noted and all data was kept in a secure manner, and only utilized for research.

2.8 Ethical considerations

The data collection was done after securing the ethical approval from the Ethical Review Committee of LUMHS and administrative approval from the participating hospitals. The study was carried out following the ethics in research principles of the Declaration of Helsinki. There was no compulsory participation and no pressure to join, and no consequences or repercussions if individuals chose to leave the program. All information was kept confidential and anonymised throughout the process, no personal information was gathered and no harm of any kind was done to any participant in the process – physical, psychological or professional.

2.9 Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 26 was used to code, enter and analyse the data. The data was cleaned before analysis to ensure that the data was accurate, complete and consistent. Categorical variables such as demographic and professional variables, knowledge categories were summarized as frequencies and percentages; continuous variables were summarized as means and standard deviations. The chi-square test was used to examine associations between knowledge level and educational qualification, clinical experience, working department and previous cardiac training. All inferential tests were given a p-value of less than 0.05 as statistically significant.

3. RESULTS

The birthplace and profession of the headteacher are considered.The headteacher's birthplace and profession are taken into account.

Twenty-two-seven registered nurses were registered for the study. The majority (79; 34.8%) were aged 26–30 years, and a further 58 (25.6%) were aged 20–25 years, indicating a predominantly young workforce; only 38 (16.7%) were older than 35 years. Therefore, more than half of the participants were women (125; 55.1%) while the remaining 102 (44.9%) were men. Post graduate training in specialisation was limited with 108 (47.6%) holding a Bachelor of Science in Nursing (BSN) and 91 (40.1%) a diploma; 28 (12.3%) qualified as Post-RN/MSN. The largest group of experience included 1-5 years (96, 42.3%), and only 32 (14.1%) had more than 10 years' experience. The participants were spread throughout the general medical wards (84; 37.0%), emergency department (78; 34.4%) and cardiology (65; 28.6%). Importantly, the majority of nurses (138; 60.8%) had never been trained before in any cardiac skills. Details regarding the demographic and professional profile are given in Table 1.

Table 1. Demographic and professional characteristics of participants (n = 227).

Characteristic	Frequency (n)	Percentage (%)
Age group (years)		
20–25	58	25.6
26–30	79	34.8
31–35	52	22.9
>35	38	16.7
Gender		
Male	102	44.9
Female	125	55.1
Educational qualification		
Diploma (RN)	91	40.1
BSN	108	47.6
Post-RN / MSN	28	12.3
Clinical experience		
<1 year	42	18.5
1–5 years	96	42.3
6–10 years	57	25.1
>10 years	32	14.1
Working department		
Emergency	78	34.4
Cardiology	65	28.6
Medical ward	84	37.0
Prior cardiac training		
Yes	89	39.2
No	138	60.8

3.2 Overall level of awareness regarding ACS

The overall assessment showed that the majority of nurses had an intermediate level of knowledge. Of the 227 participants, 133 (58.6%) demonstrated moderate knowledge of the early signs and symptoms of ACS, 55 (24.2%) demonstrated good knowledge, and 39 (17.2%) demonstrated poor knowledge (Table 2). This distribution indicates that while most nurses possess a working familiarity with the basic features of ACS, a clinically important minority have knowledge deficits that could compromise early recognition, and only about one in four attained a good level of knowledge.

Table 2. Overall level of awareness/knowledge of ACS among participants (n = 227).

Knowledge level	Frequency (n)	Percentage (%)
Good (≥75%)	55	24.2
Moderate (50–74%)	133	58.6
Poor (<50%)	39	17.2
Total	**227**	**100.0**

3.3 Factors associated with awareness

Knowledge level was significantly associated with all four factors examined (Table 3). Educational qualification was significantly related to knowledge (χ^2 test, $p = 0.003$): the proportion of nurses with good knowledge rose with

qualification, and only one Post-RN/MSN nurse fell into the poor category. Years of clinical experience were also significantly associated with knowledge ($p = 0.001$), with more experienced nurses more likely to achieve good scores and less-experienced nurses over-represented in the poor category. Working department showed a significant association ($p = 0.021$): nurses in cardiology units achieved the highest proportion of good scores, whereas those in general medical wards were more likely to have moderate or poor knowledge. The strongest association was with prior cardiac training ($p < 0.001$): trained nurses were considerably more likely to have good knowledge than untrained nurses, among whom knowledge clustered in the moderate and poor categories. Both study hypotheses (H1 and H2) were therefore supported.

Table 3. Association between demographic/professional factors and level of knowledge of ACS.

Variable	Good	Moderate	Poor	p-value
Education				**0.003**
Diploma	12	54	25	
BSN	32	63	13	
Post-RN/MSN	11	16	1	
Experience				**0.001**
<1 year	5	20	17	
1–5 years	20	58	18	
6–10 years	18	30	9	
>10 years	12	25	5	
Department				**0.021**
Emergency	20	45	13	
Cardiology	25	32	8	
Medical	10	56	18	
Prior cardiac training				**<0.001**
Yes	38	40	11	
No	17	93	28	

Note. Cell values are numbers of nurses. p-values are derived from the chi-square test; $p \leq 0.05$ was considered statistically significant.

3.4 Summary of key findings

- Most nurses (58.6%) had moderate knowledge of ACS; only 24.2% had good knowledge and 17.2% had poor knowledge.
- Higher educational qualification was significantly associated with better knowledge ($p = 0.003$).
- Greater clinical experience was significantly associated with better knowledge ($p = 0.001$).
- Cardiology placement was associated with higher knowledge than emergency or general medical ward placement ($p = 0.021$).
- Prior cardiac training showed the strongest association with knowledge ($p < 0.001$), yet 60.8% of nurses had never received such training.

4. DISCUSSION

This was a study to determine the awareness for early signs and symptoms of ACS among the nurses at tertiary care centre of Sindh, Pakistan and to explore the demographic and professional determinants of this awareness. The primary finding – that the majority of nurses had only moderate knowledge, with a significant minority having poor knowledge and less than a quarter having a good level of knowledge – suggests that although a foundation level of knowledge of ACS exists, important gaps remain in the knowledge of comprehensive recognition and early management of this time critical condition. The association of early recognition, early reperfusion and survival [4,6] is well established, making such gaps clinically relevant.

The age range of the subjects (26-30 years) and gender (females predominated) and experience (1-5 years of clinical experience) was similar to that described in other developing countries, where a recent uptick in nursing education has resulted in a workforce that is relatively young [10]. The relatively small percentage of nurses with post graduate qualifications (12.3%) and also with more than 10 years experience (14.1%) are pertinent to the interpretation, as both education and experience proved to be significant correlates of knowledge in this study and have been identified elsewhere to be significant correlates of knowledge [8].

Overall level of knowledge observed here is moderate and is generally consistent with the international literature on nurses' ACS knowledge that has consistently reported suboptimal or intermediate level of competence. The knowledge of ACS care by tertiary-hospital nurses in Addis Ababa, Ethiopia was only 52% and many lacked knowledge of how to recognise early and atypical symptoms [8]. Similar or even larger deficits have been observed throughout South Asia, including in Pakistan, for which in some studies, a majority of the individuals were unable to adequately recognize the cardinal signs of acute myocardial infarction [7,25]. Since these findings are seen in a variety of LMIC settings, this is not only a local matter, but is also likely to be caused by a combination of systemic factors including poor access to continuing education, high patient to nurse ratios and variable adherence to clinical guidelines [8,20,36].

One aspect of the moderate-knowledge finding that is of special significance is about atypical presentation. Moderate knowledge is generally good in recognising the classic picture of substernal chest pain, but is less confident in identifying the predominant symptoms in women, old people and diabetic patients of dyspnoea, fatigue, nausea, diaphoresis and epigastric symptoms [11,12,13]. This asymmetry has clinical implications a typical presentations predict longer decision and treatment delay and increased mortality, and awareness is lower than that of chest pain in the public and among clinicians [9,14]. The 2023 ESC guidelines give particular emphasis to the importance of a high index of suspicion for all manifestations of ACS [4] and the current results show that this is still an educational challenge for nurses in the setting studied.

There was a significant association of educational qualification with knowledge ($p = 0.003$) where the degree and post graduate qualified nurses had better knowledge than the diploma qualified nurses. This finding is consistent with a significant amount of evidence linking improved critical thinking skills, clinical reasoning and EBP with greater levels of nursing education, which are all directly applicable to assessing and interpreting cardiac symptoms [8]. Patient assessment and clinical decision making in the context of the illness, as well as pathophysiology, is typically more in-depth in degree-level curricula which is thought to support a more accurate recognition of ACS [23]. The findings support the need for nurses to advance their education as a means to enhance cardiac care.

There was also a significant relationship between clinical experience and knowledge ($p = 0.001$) with higher scores of more experienced nurses. This is in line with Benner's Novice to Expert model which views the acquisition of nursing skill as a progression from novice to advanced beginner, competent, proficient and expert, based on the increasing number of clinical experiences and formal education [21]. Familiarity with cardiac patients is a plausible explanation for better pattern recognition and escalation confidence. Knowledge alone will however be unlikely to be enough – it is important to refresh knowledge on a regular basis to ensure that it does not become outdated and aligned to the current standards of guidelines – which highlights the complementary importance of structured education for staff of all seniority levels [16].

There was a significant relationship between working department and knowledge ($p = 0.021$) and the best score for knowledge was demonstrated by the group of cardiology nurses. This is probably due to the increased contact that they have had with heart patients and because they are more aware of the assessment, monitoring and emergency-management procedures used in the unit. The general medical ward nurses, who have less exposure to ACS, on the other hand were more likely to have moderate or poor knowledge which was also noted in similar studies [8,16]. This disparity between the departments is a potential safety concern since patients with ACS may first present to any department, so that competence in cardiac recognition, at least at the baseline level, should be taught in all departments and not just the specialist units [29].

The most significant correlation in this study was with previous cardiac training ($p<0.001$) which corroborates the previously established evidence that nurses' knowledge and practice in ACS care are significantly influenced by in-service and specialty training programs [15,16]. Nurse-led and structured educational interventions have demonstrated improved recognition of the symptoms, adherence to guidelines for management and in some studies, downstream patient outcomes [16,35]. In this context, the fact that 60.8% of those who responded said they had not received any formal cardiac training is a big and easily fixable area for professional development. It also points to a clear, actionable lever: increasing access to structured cardiac training is likely to have the greatest incremental increase in knowledge, specifically for the majority of nurses who were in the moderate and poor scoring categories who were not receiving any cardiac training.

The results together, help to support both study hypotheses and suggest a set of implications for practice, education and policy. Nurses should be supported at practice level to undertake thorough, timely assessment of patients with

chest pain and including associated symptoms – and this should be done particularly well in those who are at high risk, for example, older adults and those with diabetes – and standardised ACS assessment and escalation procedures should be put in place across all relevant departments [4,17]. In the educational arena, routine in-service training and continuing nursing education with up to date AHA and ESC guidelines should be provided and cardiac-emergency recognition should be reinforced in pre-registration courses [4,8]. Institutional and policy level interventions such as mandatory, competency-based cardiac training (with priority to emergency and general ward staff), resourcing and periodic competency assessment would help translate knowledge into reliable clinical performance [8,16]. There are also some new digital and focused chest-pain assessment tools that could further aid early detection if they can be introduced [27]. The latter improvements are plausibly associated with earlier diagnosis, reduced prehospital and in-hospital delay and better survival, and in line with the goals of Sustainable Development Goal 3 [32].

4.1 Strengths and limitations

The strong points of this study are the adequate, formally calculated number of frontline nurses in the study who were sampled from three clinically relevant departments of two tertiary hospitals and the use of a structured, guideline-based instrument with an explicit scoring scheme. A number of caveats need to be noted, however, in drawing conclusions from the results.

- The study was carried out in tertiary care hospitals in a single university and the findings may not be generalizable to other hospitals and to primary or secondary-care institutions.
- The non-probability convenience sampling method may result in selection bias because the accessible and willing-to-participate nurses may not be representative of the non-accessible and unwilling-to-participate.
- Data collection took place via self-administered questionnaire and this type of data is liable to the response and social-desirability bias.
- Knowledge was measured and not direct observation of clinical practice which does not necessarily translate to bedside skills and the bedside practice items collected were not analysed inferentially.
- The cross sectional design only integrates associations at one particular point in time and is not able to create causal and temporal relationships between the factors studied and knowledge.

Future studies need to be repeated in various centres, care settings, with a greater number of nurses, using knowledge and clinical practice assessments of direct observation or simulation, and using interventional designs to test the effectiveness of structured training programmes on nurses competencies and patient outcomes.

5. CONCLUSION

Most nurses in the tertiary care facility studied had only moderate knowledge of the early signs and symptoms of ACS, and knowledge gaps remained among these nurses, with a clinically important minority having poor knowledge and persistent gaps in the early management priorities and atypical presentations. There was a significant association between knowledge and educational qualification, clinical experience, department of work and most strongly, with previous cardiac training, with the latter having received none formal cardiac training in nearly two thirds of the subjects. These results point to the need for a specific modifiable deficiency in the frontline staff that will first identify a time critical emergency. It is recommended that structured, guideline-concordant continuing education and mandatory, competency-based in-service cardiac training – focusing on emergency and general-ward staff – are strongly recommended to improve early recognition, decrease treatment delay and ultimately increase survival and quality of care for patients with ACS; in addition, standardised assessment protocols for in-service cardiac training are also advisable. Multicentre and interventional studies evaluating knowledge and clinical practice are warranted to build on these results.

DECLARATIONS

Ethical approval and consent to participate: Ethical approval was obtained from the Ethical Review Committee of LUMHS, Jamshoro, and administrative permission was granted by the participating hospitals. Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.
Consent for publication: Not applicable.
Availability of data and materials: The datasets generated and analysed during the study are available from the corresponding author on reasonable request.
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Authors' contributions: F. conceived and designed the study, collected the data, and drafted the manuscript. P.A. supervised the study, contributed to design and interpretation, and critically revised the manuscript. Both authors read and approved the final version.

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