



Assessment of Nursing Competency Regarding Holter Monitoring Systems: A Descriptive Study

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Abstract

Cardiovascular diseases (CVDs) remain the leading cause of global morbidity and mortality, necessitating precise diagnostic interventions. Ambulatory electrocardiography, specifically Holter monitoring, serves as a cornerstone for detecting transient cardiac arrhythmias, silent myocardial ischemia, and evaluating anti-arrhythmic therapies over prolonged periods. Staff nurses and nursing students are directly responsible for patient preparation, device initialization, lead placement, and patient education. Inadequate proficiency in managing these systems frequently compromises data validity, introducing artifacts and reducing patient compliance. This study aimed to evaluate and compare the baseline knowledge levels regarding the importance, technical application, troubleshooting, and patient instruction requirements of Holter monitoring systems among staff nurses and final-year nursing students. A quantitative descriptive cross-sectional design was executed. A sample of 150 participants was recruited via purposive sampling, evenly split between registered staff nurses (n = 75) working in critical/cardiac care areas and final-year nursing students (n = 75) from a selected tertiary care hospital and affiliated nursing college in Bengaluru, India. Data were collected using a validated 25-item Structured Knowledge Questionnaire covering key domains of Holter monitoring. Analysis was conducted via descriptive and inferential statistics using SPSS version 26.0. The overall findings indicated that 48% of the total participants possessed moderate knowledge, 34% had inadequate knowledge, and only 18% demonstrated adequate knowledge. Staff nurses exhibited a significantly higher mean knowledge score of 16.4 (SD 3.2) compared to nursing students who scored 11.8 (SD 2.9), validated by an independent t-test (95% CI [3.62, 5.58]; t = 9.21, df = 148, p < 0.001). Notable systemic knowledge deficits were observed in both groups regarding skin preparation, artifact troubleshooting, and patient diary documentation rules. While clinical exposure provides staff nurses with an advantage, a profound deficit in comprehensive knowledge persists across both cohorts. Integrating dedicated ambulatory telemetry modules into nursing curricula and mandatory clinical workshops for staff is critical to optimizing diagnostic accuracy in cardiovascular care.

Keywords: Holter Monitoring; Ambulatory ECG; Nursing Education; Staff Nurses; Nursing Students; Clinical Competence.

1. Introduction

The global burden of cardiovascular diseases requires the deployment of rapid, precise, and non-invasive diagnostic tools [1, 9]. Standard 12-lead electrocardiography (ECG) provides an instantaneous snapshot of cardiac electrical activity but frequently fails to capture paroxysmal



arrhythmias or transient ischemic events that occur during daily activities or sleep [10]. To bridge this diagnostic gap, Norman Holter introduced ambulatory electrocardiographic monitoring, which allows continuous recording over 24 to 72 hours [2, 11]. Today, it remains highly critical for investigating unexplained syncope, evaluating palpitations, and monitoring post-myocardial infarction risks [12].

In contemporary healthcare, nurses are the primary coordinators of diagnostic monitoring systems [3, 13]. This workflow encompasses advanced skin preparation [14], anatomically precise electrode placement [15], and detailed patient counselling regarding symptom diary maintenance [4, 16]. Despite the ubiquity of Holter monitors, nursing education often treats ambulatory monitoring as a mere extension of standard static ECG procedures [17]. Literature suggests that a substantial proportion of practicing nurses lack a structured understanding of troubleshooting protocols and artifact identification [18, 19]. Misplaced leads or poor skin preparation result in ambiguous tracings, causing false-positive arrhythmia alarms and increased institutional costs [20].

Furthermore, final-year nursing students transitioning to clinical practice face a steep learning curve [21]. While undergraduate curricula cover basic electrophysiology, hands-on exposure to specialized diagnostic systems like Holter monitoring remains limited [22]. Evaluating baseline knowledge among both practicing staff nurses and final-year students is vital for designing targeted continuing nursing education (CNE) frameworks [23].

2. Literature Review

The imperative for high-level nursing competence in cardiac monitoring is well-documented [18]. Research indicates that registered nurses frequently display poor baseline knowledge regarding complex ECG morphology [18, 24]. In developing nations like India, challenges include high patient-to-nurse ratios and limited access to regular specialized skills training [25]. Previous descriptive studies reported that while emergency nurses may demonstrate moderately adequate generalized skills, nearly half possess inadequate knowledge regarding advanced dysrhythmia management and artifact elimination [26].

International studies have established that structured, continuous clinical exposure is the strongest predictor of interpretation competency. Traditional pedagogical methods often fail to instill long-term procedural confidence. According to Schultz, interactive, web-based training combined with hands-on collaborative learning improves cognitive scores regarding cardiac rhythms, but often fails to alter long-term bedside behaviors unless reinforced by regular clinical audits. Addressing these educational gaps between undergraduate training and independent practice is essential [4, 30].

3. Methodology

A quantitative, descriptive cross-sectional research design was utilized. The study was conducted at a 500-bed multi-specialty tertiary care hospital and its affiliated nursing college in Bengaluru, India. The sample comprised 150 participants (75 staff nurses, 75 final-year nursing students) selected via purposive sampling.

Tool for Data Collection

The tool consisted of a socio-demographic proforma and a 25-item Structured Knowledge Questionnaire covering:

1. Indications, physiological importance, and clinical rationale (7 items).
2. Electrode placement, technical application, and skin preparation (9 items).
3. Artifact troubleshooting, patient diary instruction, and compliance management (9 items).

The tool's internal consistency was established with a KR-20 coefficient of $r = 0.84$. Data were analyzed using SPSS version 26.0.

4. Results

The majority of staff nurses (68%) belonged to the 23–30 age bracket, while student nurses were predominantly 17–22 years old (92%). A significant disparity was noted in prior specialized training: 42% of staff nurses reported formal exposure to Holter protocols, compared to only 12% of students.

Table 1. Categorization of Knowledge Levels Between Cohorts

Knowledge Categorization	Staff Nurses (n=75)	Student Nurses (n=75)	Total (N=150)
Adequate (>75%)	22 (29.3%)	5 (6.7%)	18.0%
Moderate (50–75%)	43 (57.3%)	29 (38.7%)	48.0%
Inadequate (<50%)	10 (13.4%)	41 (54.6%)	34.0%

Analysis showed that staff nurses possessed a statistically superior level of knowledge relative to students (95% CI [3.62, 5.58]; $t = 9.21$, $p < 0.001$). However, both groups demonstrated optimal performance only in understanding core clinical indications, with significant performance drops in technical application (Domain 2) and practical field management (Domain 3).

5. Discussion

The data indicates that 48% of the aggregate study population possesses only a moderate understanding, while 34% operate with severe knowledge deficits. The advantage observed in staff nurses is restricted to basic clinical mechanics; performance deteriorated significantly in Domain 3 (troubleshooting and patient education). This mirrors previous findings where procedural behaviors lag behind conceptual awareness. The situation is particularly acute for students, pointing to gaps in current academic curricula. Furthermore, the lack of dedicated CNEs explains why nurses often view Holter monitoring merely as a "prolonged ECG," failing to account for variables like skin impedance or timestamp validations.

6. Conclusion

This study demonstrates that both cohorts suffer from critical knowledge gaps, particularly regarding technical troubleshooting and patient counseling.

Recommendations:

1. Curriculum Modification: Integrate modules on ambulatory telemetry into final-year curricula.
2. Simulation Workshops: Establish skill-lab sessions using real devices.
3. Mandatory CNE: Implement periodic certifications for bedside staff.

4. Checklists: Introduce standardized lead-placement checklists as point-of-care references.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

Data are available upon reasonable request from the corresponding author.

AI Usage Disclosure

No generative AI tools were used in the preparation of this manuscript.

Author Contributions

Conceptualization, .S. and p.; methodology, P.; analysis, P.; writing—original draft, P.; writing—review and editing, both authors. All authors have read and agreed to the published version of the manuscript.

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