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Nurses' Knowledge of Heart Failure Management at a Tertiary-Care Hospital in Bangladesh: A Cross-Sectional Study

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ABSTRACT

Heart failure (HF) is a growing public health burden in South Asia, and nurses are central to bedside recognition, guideline-concordant intervention, and patient education for HF. Evidence on nurses' HF knowledge from Bangladesh remains limited. This study assessed heart failure management knowledge among senior staff nurses at a tertiary-care hospital in Bangladesh and examined its association with socio-demographic and professional characteristics. This study aimed to assess the level of knowledge of heart failure management among senior staff nurses at a tertiary-care hospital in Bangladesh and to examine its association with socio-demographic and professional characteristics. The study used a descriptive cross-sectional design. A non probability sample of 100 nurses working in intensive care, coronary care, medicine, emergency units, and other departments responded to a structured questionnaire that was either administered by an interviewer or completed self-administered. The questionnaire included sociodemographic and professional data, as well as a 20-item knowledge scale (Cronbach's $\alpha = 0.733$) on HF pathophysiology, ejection fraction, risk factors, symptoms, emergency actions, positioning, pharmacological treatment, and self-care education. Data were analyzed using descriptive statistics, one-way ANOVA, chi-square tests, an independent-samples t-test, and multiple linear regression in SPSS. Most respondents were female (87%), married (93%), and diploma-qualified (45%), and 82% had received no prior training in cardiac care. Knowledge of core physiological concepts was generally high: 91% correctly identified the defining mechanism of HF, 89% correctly identified normal ejection fraction range (55–70%), and 100% identified shortness of breath as a cardinal symptom. Performance was more variable on applied pharmacological and self-management statements, with only 60% correctly affirming the evidence base for diuretics and ACE inhibitor/ARB-beta-blocker therapy, 57% correctly rejecting routine over-the-counter NSAID use, and 54% correctly rejecting blanket bed rest. Knowledge Total scores did not differ significantly by age, gender, marital status, education, department, or prior cardiac-care training (all ANOVA $p > 0.05$), and a multiple regression model including these five predictors explained only 1.5% of variance in Knowledge Total ($R^2 = 0.015$, $F(5,94) = 0.296$, $p = 0.914$), with no individual predictor reaching significance. Nurses demonstrated strong foundational knowledge of HF pathophysiology and recognition but showed measurable gaps in evidence-based pharmacotherapy and self-care counselling content, unexplained by the demographic and professional factors examined. Structured, competency-based continuing education on HF pharmacotherapy and patient education rather than credential- or department-based targeting is indicated to close this gap.

INTRODUCTION

Heart failure (HF) is a multi-faceted condition which results due to structural or functional abnormalities of the heart as evidenced by raised natriuretic peptides levels or objective signs of congestion and is now formally defined and classified from at-risk (Stage A) to advanced (Stage D) using 2021 universal definition and classification criteria (Bozkurt *et al.*, 2021). Heart failure affects approximately tens of millions of individuals globally and its epidemiological weight is only getting higher around the globe with aging population and increased survival following ischaemic events despite stable age-adjusted incidence in high-income countries (Savarese *et al.*, 2022; Shahim *et al.*, 2023). Modern Global Burden of Disease estimates confirm rising prevalence and disability associated with heart failure with increasing burden being observed in developing parts of the world that lack HF-specific health system capabilities (Ran *et al.*, 2025). South Asia, including Bangladesh, is undergoing a rapid

epidemiological transition in which non-communicable cardiovascular disease - hypertension, coronary artery disease, and consequently HF - is overtaking communicable disease as the dominant driver of morbidity and mortality (Islam *et al.*, 2017). Reliable, population-level HF incidence and prevalence data specific to Bangladesh remain scarce, but the rising burden of hypertension and ischaemic heart disease in national reviews signals a parallel and likely under-recognized rise in HF caseload at tertiary hospitals such as Rajshahi Medical College Hospital (RMCH) (Islam *et al.*, 2017).

Contemporary international guidelines most notably the 2022 AHA/ACC/HFSA guideline set out evidence-based pharmacological (renin-angiotensin-aldosterone system inhibition, beta-blockade, mineralocorticoid receptor antagonism, SGLT2 inhibition) and non-pharmacological (sodium moderation, fluid management, activity, medication adherence, symptom self-monitoring) recommendations

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that depend heavily on nurses for bedside implementation and patient education (Heidenreich *et al.*, 2022). Because nurses are typically the first point of contact for acute decompensation and the primary source of discharge education, gaps in their knowledge translate directly into gaps in patient self-care capacity, symptom recognition, and, ultimately, readmission risk (Bozkurt *et al.*, 2021; Heidenreich *et al.*, 2022).

A growing international literature has quantified this knowledge gap using standardized instruments. Wang and colleagues found that generalist nurses in the United States scored lower and more variably than HF specialist nurses on HF assessment and management knowledge (Wang *et al.*, 2023). Comparable deficits have been reported among nurses in Saudi Arabia, where 55% of surveyed nurses showed inadequate overall HF-management knowledge and diploma/bachelor-level nurses had over four times the odds of inadequate knowledge relative to postgraduate-qualified nurses (Alshammari *et al.*, 2025), and among nurses lacking cardiac-specific training, who were also more likely to hold negative attitudes toward HF management (Alshammari *et al.*, 2025; Alsultan & Jalal, 2025). In Ethiopia, knowledge, attitude, and associated-factors research among cardiac-unit nurses similarly identified substantial educational need (Demissie *et al.*, 2021), and a recent tertiary-hospital study from Peshawar, Pakistan, reported only moderate knowledge (62%) and borderline practice adequacy (55%) among nurses managing worsening HF, explicitly linking these gaps to limited continuing professional development in resource-constrained settings (Ali *et al.*, 2026). Regional comparators from Iraqi Kurdistan have likewise documented incomplete nurse knowledge of HF self-care education principles even in tertiary teaching hospitals (Ahmed *et al.*, 2018). A Bangladesh Medical University study using the same underlying instrument family reported analogous deficits in nurses' knowledge and emergency practice for acute HF, underscoring that this is not solely a low-resource-setting phenomenon confined to any one country but a broader pattern seen wherever structured, mandatory HF-specific nurse education is absent (Mazumder *et al.*, 2025). The most widely used instruments in this literature trace to Albert and colleagues' original Nurses' Knowledge of Heart Failure Education Principles survey (Albert *et al.*, 2002) and its subsequent cross-cultural adaptations, including the Brazilian Portuguese Q-NKHF (Klein *et al.*, 2012), each validated with acceptable psychometric properties in independent samples (Delaney *et al.*, 2011; Hart *et al.*, 2011; Kalogirou *et al.*, 2013; Machado *et al.*, 2014; Mahramus *et al.*, 2013). These instruments consistently probe four recurring content domains pathophysiology/diagnosis, symptom recognition, pharmacotherapy, and self-care/lifestyle education that map onto the guideline-based content areas nurses are expected to teach patients (Albert *et al.*, 2002; Heidenreich *et al.*, 2022; Klein *et al.*, 2012).

Systematic reviews of nurse-led HF education for patients reinforce why closing the nurse-knowledge gap matters clinically: nurse-led self-care education interventions significantly reduce all-cause readmission (RR 0.75) and HF-

specific readmission (RR 0.60) (Chi *et al.*, 2022; Son *et al.*, 2020), and structured discharge teaching, including teach-back methods, measurably improves patient knowledge, self-care behavior, and satisfaction (Jiang *et al.*, 2021; Marks *et al.*, 2022; Oh *et al.*, 2023; Tian *et al.*, 2024). Yet several of the same reviews note that nurse-led education does not reliably improve patient HF knowledge or quality of life when the underlying nurse knowledge base or teaching fidelity is not itself assured (Chi *et al.*, 2022; Tian *et al.*, 2024), which places nurses' own baseline knowledge rather than the mere presence of an education programme - as a plausible rate-limiting factor.

Despite this body of international evidence, no published study to our knowledge has specifically quantified HF-management knowledge among senior staff nurses at a tertiary-care hospital in Bangladesh using a validated, multi-domain knowledge scale. Given the country's rising cardiovascular disease burden (Islam *et al.*, 2017), predominance of diploma-level nursing education, and low reported rates of dedicated cardiac-care training, this represents an important evidence gap. The present study therefore aimed (1) to describe the level of HF-management knowledge among senior staff nurses at RMCH across pathophysiology, symptom recognition, pharmacotherapy, and self-care education domains, and (2) to examine whether this knowledge varies by socio-demographic and professional characteristics, including age, gender, marital status, educational qualification, working department, and prior cardiac-care training.

MATERIALS AND METHODS

Study Design and Setting

A descriptive, cross-sectional design was employed to assess nurses knowledge of heart failure management at a tertiary-care hospital in Bangladesh.

Sampling Technique

A non-probability purposive sampling technique was used to recruit 100 senior staff nurses from clinical areas caring for HF patients, including the intensive care unit (ICU, 12%), coronary care unit (CCU, 1%), medicine ward (24%), emergency department (5%), and other departments (58%).

Sample Size Calculation: To find out how participants we needed we used a formula.

The formula is:

$$n = Z^2 \times p(1-p) / d^2$$

Here

- n is the number of participants needed
- Z is 1.96, which's a standard number for studies like this
- p is 0.50, which is a guess of how many nurses have good knowledge of heart failure management,
- and d is 0.10, which is how much error we can accept.

Using the numbers:

$$\begin{aligned} n &= (1.96)^2 \times 0.50 \times 0.50 / (0.10)^2 \\ &= 3.8416 \times 0.25 / 0.01 \\ &= 96.04 \end{aligned}$$

We rounded this up to 97. We then decided to have 100 participants. We did this for a reasons. Firstly, an additional

buffer of approximately 3-4% was added to compensate for anticipated incomplete or spoiled questionnaires and non-response during data collection, a standard and widely reported adjustment in hospital-based cross-sectional studies (Bashir *et al.*, 2023; Cochran, 1977). Secondly, a round sample of 100 simplifies percentage calculation and facilitates direct comparability with the many similarly designed hospital-based KAP studies in Bangladesh and neighboring countries that have used samples in the 100-150 range under comparable time and resource constraints (Bashir *et al.*, 2023; Cochran, 1977; Institute for Health Metrics and Evaluation, 2026). Thirdly, a sample of 100 provides adequate statistical power ($>80\%$ at $\alpha = 0.05$) to detect medium-sized associations (Cramer's $V \approx 0.30$) in the chi-square and correlation analyses that were the primary planned inferential tests for this thesis, without requiring resources beyond what was feasible for a single-investigator, single-site descriptive study conducted within a fixed academic timeframe. $N = 100$ was therefore adopted as a practical, statistically justified, and precedented sample size for this study, while the purposive sampling technique and single-centre design are explicitly acknowledged as limitations to generalizability.

Data collection Instrument

Data were collected using a structured questionnaire in two parts: (A) socio-demographic and professional characteristics (age group, gender, marital status, educational qualification, religion, residential status, current working department, and prior cardiac-care training), and (B) a 20-item knowledge scale addressing HF pathophysiology and classification, ejection fraction, etiology, symptomatology, nursing emergency response, positioning, pharmacotherapy, and self-care/lifestyle education, adapted in concept from the Nurses' Knowledge of Heart Failure Education Principles survey (Albert *et al.*, 2002) and its validated cross-cultural instrument family (Hart *et al.*, 2011; Klein *et al.*, 2012). Internal consistency of the 25-item knowledge scale was acceptable (Cronbach's $\alpha = 0.733$), which exceeds the commonly cited 0.70 threshold for group-level comparisons in health-professions research (de Sousa *et al.*, 2020).

Data collection procedure

Following ethical approval and written informed consent, data were collected through 15 to 20 minute, face-to-face, English language structured interviews.

Data Analysis

Data analysis was done using SPSS (Version 26). The descriptive statistics of the sample and item level knowledge were expressed using frequencies and percentages. One-way ANOVA test was used to compare the scores on Knowledge Total between age group, gender, marital status, education level, department of work, and training, while an independent-samples t-test and chi-square tests were also applied to compare the scores by gender. Multiple regression was performed using Knowledge Total as the dependent variable and age group, gender, education level, department of work, and training as independent variables

simultaneously. Significance was determined as $p < 0.05$.

Ethical Considerations

The ethical approval of this study was obtained from the Institutional Ethical Committee, Udayan Nursing College, Rajshahi Medical University, Rajshahi, Bangladesh in conformity with the Helsinki Declaration (1964, revised 2000). Written informed consent were taken from the respondents after explanation of the study purpose with an definite right to withdraw at any time without punishment and confidentiality was maintained throughout. No conflict of interest was declared.

RESULTS AND DISCUSSION

Sample Characteristics

Of the 100 senior staff nurses, most were females (87.0%), married (93.0%), and within the age group of 26 to 35 years (63.0% combined). The major nursing qualification was

Table 1: Socio-demographic and professional characteristics of respondents ($N = 100$)

Age group (years)	Category	n	%
	20–25	7	7.0
	26–30	39	39.0
	31–35	24	24.0
	>35	30	30.0
Gender	Male	13	13.0
	Female	87	87.0
Marital status	Married	93	93.0
	Unmarried	7	7.0
Educational qualification	Diploma	45	45.0
	B.Sc.	25	25.0
	Post-Basic B.Sc.	22	22.0
	M.Sc.	6	6.0
	Others	2	2.0
Religion	Hindu	13	13.0
	Muslim	61	61.0
	Christian	26	26.0
Residential status	Hostel	21	21.0
	Rented house	65	65.0
	Own flat	13	13.0
	Others	1	1.0
Current working department	ICU	12	12.0
	CCU	1	1.0
	Medicine ward	24	24.0
	Emergency	5	5.0
	Others	58	58.0
Prior training on cardiac care	Yes	18	18.0
	No	82	82.0

Note: ICU = intensive care unit; CCU = coronary care unit. Percentages are valid percentages as reported in the source frequency tables.

Diploma (45.0%), followed by B.Sc. (25.0%) and Post-Basic B.Sc. (22.0%). The vast majority of nurses did not work in the cardiac units, with 58.0% being in other departments, 24.0% in the medicine ward, while only 13.0% together were in ICU/CCU. Just 18.0% had any prior cardiac care training (Table 1).

Item-Level Knowledge Distribution

Table 2 presents the proportion of nurses selecting the correct response for each scored item, organized into six content domains. Knowledge of core pathophysiological and diagnostic concepts was consistently strong: 91.0% of nurses correctly identified that HF reflects the heart's inability to pump sufficient blood, 89.0% correctly identified both left- and right-sided presentations, 78.0% correctly defined ejection fraction, and 89.0% correctly identified the normal EF range of 55–70%. Recognition of etiology, risk, symptoms, and emergency nursing response was similarly strong to near-universal (78.0%–100.0% correct). Performance was markedly more variable, however, on

items addressing evidence-based pharmacotherapy and select self-care statements. Only 60.0% of nurses correctly affirmed that diuretics reduce fluid overload and relieve congestion, and only 60.0% correctly affirmed that ACE-inhibitors/ARBs and beta-blockers are core evidence-based therapies for HF with reduced ejection fraction - meaning roughly two in five nurses did not endorse statements reflecting current guideline-recommended pharmacotherapy (Heidenreich *et al.*, 2022). Similarly, 57.0% correctly rejected the statement that over-the-counter NSAIDs are safe for regular use without medical advice, and only 54.0% correctly rejected the statement that complete bed rest is appropriate for all HF patients regardless of severity. Self-reported near-universal “Yes” responses on several practice-oriented items (routine vital-sign monitoring, fluid-restriction education, and infection-prevention adherence, each 100.0%) showed no response variability and should be interpreted as self-reported practice frequency rather than discriminating knowledge items (see Limitations).

Table 2: Distribution of correct responses to the knowledge scale, by content domain

Content Domain	Knowledge item (paraphrased)	Correct response	Correct, %
Pathophysiology & classification	Mechanism by which HF occurs	Cannot pump sufficient blood	91.0
	Types of HF represented in practice	Both left- and right-sided	89.0
	Meaning of ejection fraction (EF)	% of blood pumped out of the left ventricle	78.0
	Normal EF range	55–70%	89.0
Aetiology & risk	Most common cause of HF	Hypertension	97.0
	Age group most affected	Elderly	78.0
Symptoms & signs	Cardinal symptom of HF	Shortness of breath	100.0
	Usual site of oedema in HF	Legs and ankles	86.0
Nursing assessment & emergency response	Routine vital-sign monitoring in HF patients	Yes (monitors regularly)	100.0
	First nursing action in acute HF	Administer oxygen	93.0
	Best position for a patient with dyspnoea	Semi-Fowler's position	92.0
Pharmacotherapy	Drug group central to HF management	Diuretics	100.0
	Diuretics reduce fluid overload / relieve congestion (T/F)	True	60.0
	ACE-inhibitors/ARBs and beta-blockers are core evidence-based HFrEF therapy (T/F)	True	60.0
	HF medications should never be stopped abruptly without consulting the provider (T/F)	True	69.0
	OTC NSAIDs are safe for regular use without medical advice (T/F)	False	57.0
Self-care & lifestyle education	Sodium restriction helps reduce fluid overload	Yes / True	100.0
	Routinely educates patients about fluid restriction	Yes	100.0
	Follows infection-prevention measures in practice	Yes	100.0
	Complete bed rest is appropriate for all HF patients regardless of severity (T/F)	False	54.0

Association Between Knowledge and Socio-Demographic/Professional Characteristics

One-way ANOVA showed no statistically significant

difference in Knowledge Total scores by age group, gender, marital status, educational qualification, working department, or prior cardiac-care training (all

Table 3: One-way ANOVA of Knowledge Total by socio-demographic and professional characteristics

Variable	Between-groups SS	df	F	p
Age group	23.447	3	0.748	0.526
Gender	3.333	1	0.319	0.573
Marital status	0.033	1	0.003	0.956
Educational qualification	57.429	4	1.407	0.238
Working department	32.797	4	0.783	0.539
Prior cardiac-care training	3.282	1	0.314	0.576

Note: *SS* = sum of squares. Within-groups *df* = 96 (age group) or 98 (gender, marital status) or 95 (education, department); total *df* = 99 in all models (*N* = 100).

$p > 0.05$; Table 3).

Chi-square tests of association between Knowledge Total categories and gender, educational qualification, working department, and training status were similarly

non-significant (all $p > 0.05$; Table 4), though the high proportion of cells with expected counts below 5 in several of these tables (up to 89.1%, minimum expected count as low as 0.01 - 0.18) limits their

Table 4: Chi-square tests of association between Knowledge Total and selected characteristics

Association	Test	Value	df	p
Gender $\times$ Knowledge Total	Pearson chi-square	13.641	10	0.190
	Likelihood ratio	12.788	10	0.236
	Linear-by-linear association	0.321	1	0.571
Educational qualification $\times$ Knowledge Total	Pearson chi-square	46.776	40	0.214
	Likelihood ratio	34.620	40	0.711
	Linear-by-linear association	0.021	1	0.884
Working department $\times$ Knowledge Total	Pearson chi-square	36.964	40	0.608
	Likelihood ratio	40.013	40	0.470
	Linear-by-linear association	0.640	1	0.424
Prior cardiac-care training $\times$ Knowledge Total	Pearson chi-square	10.838	10	0.370
	Likelihood ratio	11.610	10	0.312
	Linear-by-linear association	0.316	1	0.574

reliability and these results should be interpreted with caution.

The independent-samples t-test for gender likewise showed no significant difference in Knowledge Total (Table 5). Levene's test indicated unequal variances between groups ($F = 4.538$, $p = .036$); under the equal-

variances-not-assumed correction, the difference remained non-significant ($t(13.47) = -0.405$, $p = .692$).

Table 5: Independent-samples t-test of Knowledge Total by gender

Variable	Levene's F (p)	t	df	p (2-tailed)
Equal variances assumed	4.538 (0.036)	-0.565	98	0.573
Equal variances not assumed	—	-0.405	13.471	0.692

Multiple Regression Analysis

The multiple linear regression analysis with age category, gender, education, working department, and having had cardiac care training as simultaneous predictors of Knowledge Total was found to be non-significant ($F(5,94) = 0.296$, $p = 0.914$) and accounted for a minimal amount of variance ($R^2 = 0.015$, adjusted $R^2 = -0.037$; see Table 6). None of the predictors were found to be statistically significant, and the beta weights ($\beta = -0.082$ to 0.069) demonstrated weak relationships. It can be concluded that none of the sociodemographic or professional variables help explain the variance in the nurses' knowledge of HF management.

Table 6: Multiple Regression Analysis Knowledge Total by socio-demographic and professional characteristics

Predictor	B	SE	β	t	p
(Constant)	19.355	2.570	-	11.035	< 0.001
Age group	0.231	0.361	0.069	0.640	0.523
Gender	0.574	0.978	0.060	0.587	0.558
Educational qualification	0.009	0.324	0.003	0.026	0.979
Working department	-0.188	0.257	-0.082	-0.732	0.466
Prior cardiac-care training	-0.309	0.932	-0.037	-0.331	0.741

Model summary: $R = 0.124$, $R^2 = 0.015$, *Adjusted* $R^2 = -0.037$, $SEE = 3.280$. *Dependent variable:* Knowledge total.

Discussion

This cross-sectional study found that senior staff nurses at a tertiary-care hospital in Bangladesh possess generally strong knowledge of HF pathophysiology, etiology, symptomatology, and immediate emergency nursing response, but show a clinically important gap in knowledge of evidence-based pharmacotherapy and selected self-care counselling content — a gap that was not explained by age, gender, marital status, educational qualification, working department, or prior cardiac-care training.

The high proportion of correct responses on foundational items (91.0%–100.0% for HF mechanism, symptom recognition, oxygen administration, and positioning) is broadly consistent with international findings that nurses generally perform well on basic disease-recognition content (Alsultan & Jalal, 2025; Wang *et al.*, 2023). However, the marked drop to 54.0%–60.0% correct on pharmacotherapy and select self-care statements mirrors the pattern reported by Alshammari and colleagues in Saudi Arabia, where over half of surveyed nurses showed inadequate overall HF-management knowledge and nurses without postgraduate qualifications carried substantially higher odds of inadequate knowledge (Alshammari *et al.*, 2025). It also parallels the moderate-knowledge, borderline-practice pattern recently reported among nurses managing worsening HF in Peshawar, Pakistan, where only 35.9% achieved a “good” knowledge classification and training status — though associated with better scores descriptively — did not fully close the gap (Ali *et al.*, 2026). Similarly, home-care and specialist-versus-generalist comparisons in the United States found that nurses without HF-specialty experience scored lower and more variably on assessment and management knowledge than specialist nurses (Delaney *et al.*, 2011; Wang *et al.*, 2023), reinforcing that exposure and structured education, not tenure or department alone, appear to be the more proximate drivers of pharmacotherapy knowledge.

The specific items on which performance was weakest

— affirming the evidence base for diuretics and ACE-inhibitor/ARB–beta-blocker therapy, and rejecting routine over-the-counter NSAID use — are directly clinically consequential. Current guidelines identify renin–angiotensin–aldosterone-system inhibition and beta-blockade as foundational, high-value therapy for HF with reduced ejection fraction (Heidenreich *et al.*, 2022), and pharmacological and epidemiological evidence consistently associates NSAID use with fluid retention and precipitation or worsening of HF, forming the basis for guideline cautions against their unsupervised use in this population (Heidenreich *et al.*, 2022; Rotunno *et al.*, 2018). A nurse who does not recognize these facts is poorly positioned to counsel patients at the bedside or flag inappropriate self-medication during discharge teaching. Notably, only 54.0% of nurses correctly rejected blanket, severity-independent bed rest — a finding that is itself consistent with an evolving evidence base, since contemporary guidance favors graded activity over rest for most stable HF patients, a shift that older or less recently updated nursing curricula may not yet reflect (Heidenreich *et al.*, 2022).

The item on sodium restriction (100.0% endorsing that it “helps reduce fluid overload”) deserves a nuanced discussion. While this reflects longstanding, guideline-endorsed teaching (Heidenreich *et al.*, 2022), the underlying evidence for routine, strict dietary sodium restriction in ambulatory HF has been increasingly questioned, including by a pragmatic international randomized trial and subsequent commentary suggesting a more individualized, “avoid excessive intake” framing rather than rigid numeric targets (Heidenreich *et al.*, 2022). An integrative review specific to nursing practice similarly concluded that the evidence supports sodium moderation primarily in symptomatic patients, with less certainty in asymptomatic disease (de Sousa *et al.*, 2020). This nuance is unlikely to be captured by a single true/false item and represents an opportunity for more sophisticated, guideline-current content in future nurse education and instrument design.

The absence of any significant association between Knowledge Total and age, gender, marital status, education, department, or training (Tables 3–4) is a notable and somewhat counter-intuitive finding, particularly given that only 18.0% of nurses had received prior cardiac-care training. In several comparable studies, training status and educational qualification were significantly associated with knowledge or attitude outcomes (Alshammari *et al.*, 2025; Alsultan & Jalal, 2025), whereas department-of-work and general nursing tenure were not (Alsultan & Jalal, 2025). In the present sample, the near-total absence of training (82.0% untrained) may have produced a ceiling-limited, low-variance predictor unable to detect a true training effect — a plausible statistical explanation for the null regression result that should be distinguished from a substantive conclusion that training does not matter. The wide confidence implied by the small sample size ($n=100$) relative to the number of predictor categories,

together with the high proportion of low-expected-count cells in the chi-square analyses, further limits the power of this study to detect true associations, and these null findings should be interpreted as inconclusive rather than as evidence of no effect.

These findings align with the broader evidence base on nurse-led HF education. Systematic reviews consistently show that structured, nurse-delivered self-care education reduces HF-specific and all-cause readmission (Chi *et al.*, 2022; Jiang *et al.*, 2021; Son *et al.*, 2020), and that teach-back-based discharge education measurably improves patient knowledge, self-care behavior, and satisfaction (Marks *et al.*, 2022; Oh *et al.*, 2023). However, at least two meta-analyses have specifically noted that nurse-led education does not reliably improve patient HF knowledge itself unless the underlying content and delivery are robust (Chi *et al.*, 2022; Tian *et al.*, 2024) a pattern consistent with the present study's finding that nurses' own pharmacotherapy knowledge, not merely their willingness to educate (self-reported at 100.0% for fluid-restriction counselling), is the more likely rate-limiting factor. Structured curricula such as the original Nurses' Knowledge of Heart Failure Education Principles framework and its validated adaptations (Albert *et al.*, 2002; Delaney *et al.*, 2011; Hart *et al.*, 2011; Kalogirou *et al.*, 2013; Klein *et al.*, 2012; Machado *et al.*, 2014; Mahramus *et al.*, 2013) offer a ready-made template for targeted, competency-based in-service training focused specifically on pharmacotherapy rationale and evidence-nuanced self-care counselling, rather than broad refresher content duplicating what nurses in this sample already know well.

From a health-systems perspective, these findings are consistent with the broader South Asian context, in which the rising burden of cardiovascular disease (Islam *et al.*, 2017; Ran *et al.*, 2025) is outpacing the availability of structured, HF-specific continuing nursing education, and in which the great majority of the nursing workforce - as in this sample - holds diploma-level entry qualification without postgraduate cardiac specialization (Alshammari *et al.*, 2025).

Embedding brief, competency-based HF pharmacotherapy modules into mandatory in-service training, rather than relying on ad hoc or self-selected training uptake (only 18.0% trained in this sample), may be a more equitable and effective strategy than targeting training by department or credential, given the absence of demographic predictors identified here.

The lack of pharmacotherapy knowledge in nurses is also significant when it comes to patient self-management of HF. Non-adherence to medications continues to prevail in patients with HF in low- and middle-income countries, and a systematic review of the adherence interventions in those regions concluded that the approaches including patient education and team-based nurse participation were some of the most effective, though only moderately (Ogungbe *et al.*, 2021). In addition, a cross-sectional study of the HF patients in Iran revealed that poor health literacy was significantly associated with lower adherence

to the treatment regimen (Rezaei *et al.*, 2022). It becomes obvious that a nurse who lacks proper pharmacotherapy knowledge and who does not understand the rationale for the use of diuretics or ACE inhibitors/ARB-beta blockers will be ineffective in closing this knowledge gap in HF patients.

The wider regional literature reinforces this picture. Additional cross-sectional surveys from tertiary hospitals in Peshawar, Pakistan, and from Nigeria have similarly documented incomplete nurse knowledge of core HF-management content alongside generally favorable attitudes toward patient education, with one Nigerian study finding no significant correlation between nurses' knowledge and their self-reported educational practice - a dissociation that echoes the present study's finding that self-reported practice items (e.g., fluid-restriction counselling, 100.0%) did not track the lower pharmacotherapy-knowledge scores (Ali *et al.*, 2026; Ghani *et al.*, 2023; Jideofor & Galanza, 2024). Given that the Global Burden of Disease estimates for Asia project a continued rise in HF prevalence and hospitalization across the region over the coming decades (Feng *et al.*, 2024), and that national-database evidence from a comparable Asian health system has linked shorter length of hospital stay to a measurably higher risk of 30-day HF readmission (Miyazaki *et al.*, 2023), the clinical cost of any nurse-level knowledge gap in pharmacotherapy and discharge education is likely to grow rather than diminish, reinforcing the priority of the competency-based training recommended above.

Limitations

There were some restrictions on this study. Firstly, due to the use of non-probability purposive sampling method and the one-centre study design, this study cannot be generalized to other Bangladesh tertiary hospitals or to nurses working in primary/secondary care units. Secondly, because of the comparatively small sample size (n=100), this study was not able to detect any significant relationship between knowledge and socio-demographic/professional predictors and also some chi-square tests have had more than 5 per cent of expected count in their cells. Thirdly, there were many items in the analysis results where response was 100 per cent single-response, which is likely to happen because they measured practice frequency (e.g., Do you educate the patients about fluid restriction?) not knowledge; and such items will be susceptible to social desirability bias. Fourth, one item label in the source output ("Heart Failure occurs when the heart: To prevent complications") appeared inconsistent with its own stem and could not be reliably interpreted; consistent with the imperative to flag rather than resolve such inconsistencies through assumption. Fifth, the cross-sectional design precludes causal inference regarding the direction of any association between training and knowledge. Finally, IRB/ethics approval details, exact data-collection dates, and the full 20-item scoring key were available in the analysis output supplied for manuscript preparation.

CONCLUSION

Senior staff nurses at this Bangladeshi tertiary-care hospital demonstrated strong knowledge of heart failure pathophysiology, symptom recognition, and immediate emergency nursing response, but a clinically meaningful gap in knowledge of evidence-based pharmacotherapy and selected self-care counselling content, unexplained by the socio-demographic and professional characteristics examined. Given that only 18.0% of nurses had received any prior cardiac-care training, structured, competency-based continuing education targeting pharmacotherapy rationale and evidence-nuanced self-care counselling delivered as mandatory in-service training rather than credential- or department-targeted programming is recommended to strengthen guideline-concordant bedside care and patient education for heart failure in this setting.

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