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*Article*

# Effectiveness of Discharge Education on 30-Day Readmission in Patients with Heart Failure: A Systematic Review and Meta-Analysis

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## ABSTRACT

**Background**: Heart failure (HF) remains a leading cause of morbidity, mortality, and healthcare utilization globally, with nearly 20–25% of patients experiencing rehospitalization within 30 days of discharge. Despite advances in pharmacologic and device-based therapies, gaps in post-discharge care, particularly patient education, contribute significantly to preventable readmissions. Current literature lacks a focused synthesis of high-quality evidence evaluating the specific impact of structured discharge education on early readmission in HF patients. **Objective**: This study aimed to evaluate the effectiveness of structured discharge education in reducing 30-day readmission rates among adult patients with heart failure, based on a systematic review and meta-analysis of randomized controlled trials (RCTs). **Methods**: A systematic review and meta-analysis of 11 RCTs involving a total of 2,320 adult patients diagnosed with HF was conducted. Studies included those that evaluated discharge education interventions focusing on self-care, medication adherence, diet, symptom management, and follow-up compliance. Literature was retrieved from PubMed, CINAHL, Google Scholar, and PakMediNet for English-language studies published from 2001 onward. The Joanna Briggs Institute (JBI) checklist was used for quality appraisal. Meta-analysis was conducted using RevMan 5.4.1 to compute pooled risk difference (RD) under a fixed-effect model. Ethical compliance was ensured under the Helsinki Declaration. **Results**: The pooled analysis showed a statistically significant reduction in 30-day readmissions in the intervention group (349/1156) compared to the control group (405/1164), with a risk difference of -0.05 (95% CI: -0.08, -0.02; p = 0.003). Clinical relevance was supported by consistent findings across diverse populations and care settings, with no evidence of publication bias. **Conclusion**: Structured, nurse-led discharge education significantly reduces early readmissions among patients with heart failure. The findings support the incorporation of standardized educational interventions as part of routine discharge planning to improve clinical outcomes and optimize healthcare resource utilization.

**Keywords**: Heart Failure, Discharge Education, Hospital Readmission, Randomized Controlled Trials, Self-Care, Meta-Analysis, Transitional Care.

## INTRODUCTION

Heart failure (HF) is a complex clinical syndrome marked by the heart's diminished capacity to pump blood effectively, leading to substantial physiological limitations, frequent hospitalizations, and reduced quality of life. It is among the leading causes of hospitalization and rehospitalization globally, particularly in the elderly population, where 30-day readmission rates for HF range from 9% to over 50% depending on patient comorbidities and healthcare systems (1, 2). These early readmissions are widely regarded as indicators of suboptimal care transitions and have prompted intensified focus on improving discharge processes. Despite significant advances in pharmacotherapy and device-based treatments, post-discharge management remains an area of vulnerability that is insufficiently addressed by many healthcare institutions (3). One of the most consistently cited yet under-implemented interventions for reducing readmissions is structured discharge education, which encompasses tailored instructions regarding medication adherence, dietary recommendations, symptom monitoring, weight management, and follow-up care (4, 5). Empirical evidence supports the theoretical basis that informed patients are better equipped to engage in self-care, identify early signs of decompensation, and adhere to treatment plans, all of which can contribute to reduced

readmissions (6). However, despite endorsement by major cardiac societies, including the American Heart Association, implementation of discharge education remains highly variable across institutions, and its standardized effectiveness across populations has not been definitively established (7).

While several prior reviews have examined transitional care models and discharge strategies, their conclusions are often constrained by methodological inconsistencies and a lack of specificity. Many earlier systematic reviews combine multifaceted interventions (e.g., home visits, telemonitoring, and case management) without isolating the effect of structured discharge education, thereby limiting the interpretability of findings in real-world clinical settings (8). Moreover, some meta-analyses include heterogeneous study designs, such as quasi-experimental or observational studies, which inherently carry a higher risk of bias and confounding factors. For example, studies that include telemonitoring or multidisciplinary team interventions confound the specific contribution of discharge education alone. This lack of stratification undermines scientific clarity and limits clinical applicability.

Furthermore, a critical appraisal of previous reviews reveals inconsistent inclusion criteria, with many not clearly delineating the educational components being assessed. Some reviews, while comprehensive, fail to adhere to strict methodological quality standards such as PRISMA or fail to evaluate risk of bias using validated tools like the JBI or Cochrane ROB instruments, raising questions about the internal validity of their conclusions (9, 10). Additionally, many earlier reviews do not report pooled risk differences or risk ratios in a uniform manner, and few use meta-analytic tools like RevMan to produce publication bias assessments such as funnel plots, which are essential to validate the robustness of pooled findings.

This scientific ambiguity is especially problematic in settings with limited resources, where healthcare professionals require clear, evidence-based interventions that are low-cost, nurse-led, and feasible to implement. In low- and middle-income countries, such as those in South Asia, where the burden of cardiovascular diseases is growing at a disproportionately high rate and healthcare infrastructure remains fragmented, early rehospitalization for HF presents a significant clinical and economic challenge (11). Here, discharge education could serve as a practical and scalable solution—but only if its efficacy is clearly and rigorously demonstrated through high-quality evidence synthesis.

Therefore, the current systematic review and meta-analysis addresses a significant gap in the literature by focusing exclusively on randomized controlled trials that evaluate structured discharge education as a standalone intervention for reducing 30-day readmissions in patients with HF. By employing rigorous methodological standards, including comprehensive database searches, strict eligibility criteria, JBI-based quality appraisal, and meta-analytic synthesis with RevMan, this review aims to provide robust, clinically actionable evidence. The central research question guiding this study is: Does structured discharge education, delivered prior to hospital discharge, significantly reduce 30-day readmission rates in adult patients with heart failure compared to usual care? This focused approach not only improves internal validity but also enhances the translational value of the findings for policy-makers, clinicians, and nurse educators across diverse healthcare settings.

## MATERIAL AND METHODS

The methodology of this systematic review and meta-analysis was developed and reported in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (24), ensuring a transparent, structured, and reproducible synthesis of evidence. The primary objective of the review was to evaluate the effectiveness of structured discharge education on reducing 30-day hospital readmission rates among adult patients diagnosed with heart failure. The review protocol was formulated before study commencement to minimize selection and reporting bias, and all procedural decisions were documented to facilitate auditability.

A comprehensive literature search strategy was employed to identify relevant randomized controlled trials (RCTs). Searches were conducted in four electronic databases: PubMed, CINAHL (Cumulative Index to Nursing and Allied Health Literature), Google Scholar, and PakMediNet. These databases were chosen to ensure inclusion of both global and region-specific studies, particularly from low- and middle-income countries where the burden of heart failure is escalating. The search included English-language studies published between January 2001 and October 2023. The search strategy was developed iteratively using both Medical Subject Headings (MeSH) and free-text terms related to heart failure, discharge education, readmission, and randomized controlled trials. Boolean operators (AND, OR) were used to optimize the search logic, and database-specific filters were applied to limit results to human studies and adult populations. A full search strategy, including the exact search strings used in each database, was documented and is available upon request.

After conducting the search, all references were imported into Mendeley Reference Manager for de-duplication. The study selection process involved two levels of screening. In the first stage, two independent reviewers (the principal author and Ms. Tazeem Akhter [TA]) screened titles and abstracts based on the predefined eligibility criteria. In the second stage, full texts of potentially eligible studies were retrieved and reviewed in detail. Studies were included if they (1) were randomized controlled trials, (2) enrolled adult patients (aged ≥18 years) with a clinical diagnosis of heart failure, (3) evaluated discharge education interventions targeting at least two or more components of self-care (such as medication adherence, dietary control, weight monitoring, exercise, symptom recognition, or follow-up compliance), (4) compared these interventions with standard or usual care, and (5) reported 30-day hospital readmission as a primary or secondary outcome. Studies were excluded if they lacked a control group, were not randomized, focused on broader disease management without isolating the effect of discharge education, or if they were published in non-peer-reviewed formats (e.g., conference abstracts, dissertations, grey literature).

Disagreements between reviewers were resolved through discussion and consensus. Where discrepancies persisted, a third

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reviewer was available but not required in this instance. The selection process was documented using a PRISMA 2020 flow diagram, and reasons for exclusion at the full-text screening stage were recorded.

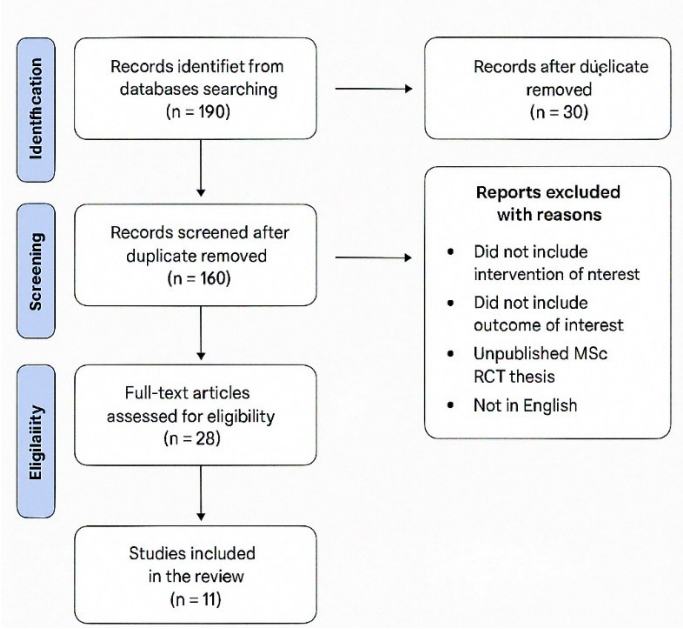


**Figure 1 PRISMA flow diagram**

Data was extracted independently by both reviewers using a pre-designed data extraction form based on PRISMA and Cochrane guidance. Extracted data included: study characteristics (author, year, country, setting), participant demographics (age, gender, sample size), intervention details (duration, theoretical framework, method and timing of delivery, intervention components), comparator characteristics, outcome data (number of 30-day readmissions in each group), and follow-up duration. Where data were missing or unclear, attempts were made to contact corresponding authors for clarification. Data were cross-verified by both reviewers to ensure consistency and completeness. To assess the methodological quality and risk of bias of included studies, the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Randomized Controlled Trials was used. This 13-item tool evaluates internal validity across key domains, including the adequacy of random sequence generation, allocation concealment, baseline similarity of groups, blinding of participants, personnel and outcome assessors, treatment of incomplete outcome data, selective outcome reporting, and statistical analysis appropriateness. Each item was rated as "Yes," "No," "Unclear," or "Not Applicable." The assessment was conducted independently by both reviewers (TA and the primary author), and disagreements were resolved through consensus. No studies were excluded based on quality score alone, but the quality assessments were used to inform the interpretation of the review findings. The detailed results of the JBI appraisal were tabulated and are presented in the Results section.

Quantitative synthesis was performed using Review Manager (RevMan) version 5.4.1, a software tool developed by the Cochrane Collaboration. The primary outcome was the proportion of patients readmitted within 30 days following hospital discharge. For each study, the number of events and total sample size in both intervention and control groups were entered. The pooled effect estimate was calculated using Risk Difference (RD) with 95% Confidence Intervals (CI), which allows for a straightforward interpretation of the absolute difference in readmission rates between groups. Heterogeneity was assessed using the $I^2$ statistic, with a threshold of 50% used to determine model selection. As the heterogeneity was moderate ($I^2$ = 39%), a fixed-effect model was applied. The significance of the pooled effect was assessed using the Z-test, with a p-value less than 0.05 considered statistically significant. To assess the presence of publication bias, a funnel plot was generated and visually examined for asymmetry. Given the relatively small number of studies, the funnel plot was interpreted cautiously, but no obvious evidence of publication bias was observed.

This systematic review was conducted and reported in full compliance with PRISMA 2020 recommendations, including full documentation of study identification, selection, data extraction, quality appraisal, and synthesis procedures. The involvement of two independent reviewers throughout the process, use of a validated quality assessment tool, and standardized statistical software enhance the credibility and reproducibility of the findings. Collectively, the methodological rigor adopted in this review ensures that the pooled estimates are reliable and relevant for informing evidence-based strategies to reduce early readmission in patients with heart failure.

## RESULTS

The PRISMA 2020 flow diagram illustrates the systematic and transparent process used for study selection in this review. A total of 190 records were initially identified through database searches. After removing 30 duplicates, 160 records remained for title and abstract screening. Of these, 137 were excluded for reasons including non-interventional design, unmatched study populations or outcomes, and irrelevance to the intervention of interest. The remaining 23 full-text articles were assessed for eligibility. At this stage, 12 additional studies were excluded because they lacked relevant outcomes, involved unpublished MSc RCT theses, had no comparison group, or were not available in English. Ultimately, 11 studies met the inclusion criteria and were included in the systematic review and meta-analysis.

Findings from **Table 1**, which presents the characteristics of the included RCTs, demonstrate significant variation in intervention components, delivery modes, and theoretical underpinnings across the studies. The trials spanned across multiple countries including the USA, Canada, New Zealand, China, Iran, and the Philippines, with sample sizes ranging from 76 to 773 participants. The majority of the studies had male-dominant samples, with mean ages of participants typically between 50 and 75 years. Most interventions were grounded in structured educational models, with five specifically citing adherence to the American Heart Association (AHA) guidelines. Educational sessions were typically delivered face-to-face, with some incorporating telephone or video follow-up. Common components included medication education, dietary advice, exercise promotion, symptom monitoring, weight control, and follow-up adherence. Of the 11 studies, 8 demonstrated a statistically significant reduction in 30-day readmission rates in the intervention groups compared to

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usual care, underscoring the potential efficacy of discharge education in heart failure management. In **Table 2**, the risk of bias across studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for RCTs. This evaluation revealed that most studies had low or moderate risk of bias.

**Table 1. Risk of Bias Summary for Included RCTs Based on the JBI Critical Appraisal Checklist (n = 11)**

| Sr. No | Author (Year) | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 | D11 | D12 | D13 | Overall Risk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Doughty et al. (2002) | – | – | + | + | + | ? | + | + | + | + | ? | + | + | Low |
| 2 | Harrison et al. (2002) | + | ? | + | – | – | – | + | + | + | + | + | + | + | Moderate |
| 3 | Naylor et al. (2004) | + | – | + | + | – | + | + | + | + | + | + | + | + | Low |
| 4 | DeBusk et al. (2004) | + | ? | + | – | – | – | + | + | + | + | + | + | + | Moderate |
| 5 | Bowles et al. (2011) | + | – | + | + | + | + | + | + | + | ? | + | + | + | Low |
| 6 | Davis et al. (2012) | + | + | + | + | + | + | + | + | + | – | + | ? | + | Low |
| 7 | Black et al. (2014) | + | + | + | + | + | + | + | – | ? | + | + | – | + | Moderate |
| 8 | Kachian et al. (2016) | + | ? | + | – | – | + | + | + | + | + | ? | + | + | Moderate |
| 9 | Young et al. (2016) | + | – | + | + | + | – | + | + | ? | + | + | + | + | Moderate |
| 10 | Cajanding et al. (2017) | + | + | + | – | + | + | + | – | + | + | ? | + | + | Moderate |
| 11 | Cui et al. (2019) | + | + | ? | + | – | + | + | + | + | + | ? | + | + | Low |

*Key: Low risk of bias – = High risk of bias ? = Unclear risk of bias* D1–D13 = JBI Checklist Domains

While several studies had concerns related to randomization concealment, participant blinding, or unclear reporting on specific checklist items, the majority were rated as methodologically sound. Notably, no study was excluded based on quality assessment alone. Of the 11 trials, six demonstrated low overall risk of bias, and five showed moderate risk, largely due to difficulties in blinding participants in behavioral interventions and incomplete reporting in certain domains.

**Table 2. Characteristics of Included Randomized Controlled Trials on Discharge Education in Heart Failure (n = 11)**

| S.No | Reference | Country | Male (%) | Age (Mean ± SD) | Sample Size (Control / Intervention) | Theoretical Basis | Duration & Mode of Intervention | Components Included[1] | 30-Day Readmission<br>n (%) | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Doughty et al. (2002) | New Zealand | 64 | 72.5 ± 11.6 | 197 (99 / 98) | Not Reported (NR) | 1.5–2 h, Face-to-face (FTF), Phone | Med, Diet, Exer, SC, FU, WtC | CG: 38 (21%) IG: 23 (35%) | SS |
| 2 | Harrison et al. (2002) | Canada | 54 | 75.5 ± 10.4 | 192 (96 / 96) | AHA Guidelines | 40 min, FTF | Med, Diet (NR), Exer, SC, FU, WtC | CG: 29 (32%) IG: 21 (23%) | SS |
| 3 | Naylor et al. (2004) | USA | 79 | 76.4 ± 6.9 | 239 (119 / 120) | AHA Guidelines | 2 h, FTF | Med, Diet, Exer, SC, FU, WtC | CG: 67 (55.4%) IG: 53 (44.9%) | SS |
| 4 | DeBusk et al. (2004) | USA | 51 | 67 ± 29 | 162 (86 / 76) | Situation-Specific Theory | 15–30 min, FTF, Phone | Med, Diet, Exer, SC (NR), FU, WtC | CG: 43 (37%) IG: 38 (33%) | SS |
| 5 | Bowles et al. (2011) | USA | 36 | 55 ± 4.7 | 217 (108 / 109) | NR | 45 min, FTF, Video Call (VC) | Med, Diet, Exer, SC, FU, WtC | CG: 10 (9%) IG: 8 (8%) | NS |
| 6 | Davis et al. (2012) | USA | 56 | 60 ± 13 | 125 (62 / 63) | AHA Guidelines | 40 min, FTF, Phone | Med, Diet, Exer, SC, FU, WtC | CG: 12 (19%) IG: 14 (22%) | NS |
| 7 | Black et al. (2014) | USA | 54 | 62 ± 24 | 773 (386 / 387) | Lorig's CDSMT | 40 min, FTF, Phone | Diet, Exer, SC, WtC (Med & FU = NR) | CG: 156 (21.6%) IG: 167 (22.7%) | NS |
| 8 | Young et al. (2016) | USA | 36 | 70.2 ± 12.2 | 100 (50 / 50) | AHA Guidelines | 45 min, FTF | Diet, Exer, SC, FU, WtC (Med = NR) | CG: 10 (19.6%) IG: 3 (6.1%) | SS |
| 9 | Kachian et al. (2016) | Iran | 50 | 49.5 ± 9.7 | 76 (38 / 38) | SCTN | 60 min, FTF | Med, Diet, Exer, SC, FU, WtC | CG: 23 (63%) IG: 16 (44.4%) | SS |
| 10 | Cajanding et al. (2017) | Philippines | 62 | 51 ± 4.3 | 143 (72 / 71) | AHA Guidelines | 45 min, FTF | Diet, Exer, SC, FU, WtC (Med = NR) | CG: 4 (12.5%) IG: 1 (5.9%) | SS |
| 11 | Cui et al. (2019) | China | 70 | 55.1 ± 13.4 | 96 (48 / 48) | SMTN | 40 min, FTF | Med, Diet, Exer, SC, FU, WtC | CG: 13 (27.1%) IG: 5 (10.4%) | SS |

Note: AHA Guidelines = American Heart Association Guidelines; CDSMT = Chronic Disease Self-Management Theory; SST = Situation-Specific Theory; SCTN = Self-Care Theoretical Nursing Framework; SMTN = Self-Management Theory Nursing; FTF = Face-to-Face; VC = Video Call; T = Telephone; Med = Medication education; Diet = Dietary management; Exer = Exercise promotion; SC = Self-care skills; FU = Follow-up adherence; WtC = Weight control; NR = Not Reported; SS = Statistically Significant difference between groups; NS = Not Significant. [1] All intervention components were delivered prior to discharge; several included post-discharge phone or video follow-up.

The overall methodological quality supports the reliability of the findings presented in the meta-analysis. Together, the detailed characteristics and quality assessments of the included studies reinforce the conclusion that structured discharge education—especially when guided by established clinical frameworks—can significantly reduce early readmissions in patients with heart failure. The forest plot presents the individual and pooled effect estimates from 11 randomized controlled trials, comparing discharge education with usual care in terms of 30-day hospital readmission rates among patients with heart failure. The meta-analysis included a total of 2,320 participants (1,156 in the intervention group and 1,164 in the control group). The total number of 30-day readmissions was 349 in the intervention group versus 405 in the control group. The overall pooled risk difference (RD) was -0.05 (95% CI: -0.08 to -0.02), indicating a statistically significant reduction in readmission risk favoring the intervention

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group. The Z-score was 2.97 with a p-value of 0.003, affirming the significance of this effect. Heterogeneity across the studies was moderate, with a $Chi^2$ = 16.41 (df = 10, p = 0.09) and $I^2$ = 39%, justifying the use of a fixed-effect model for the analysis. Among the included studies, several demonstrated strong individual effects (e.g., Young et al., 2016: RD = -0.14, 95% CI: -0.27 to -0.01; Cui et al., 2019: RD = -0.17, 95% CI: -0.32 to -0.01), supporting the consistent direction of benefit across diverse settings and patient populations. A few studies, such as Black et al., 2014 and Bowles et al., 2011, showed no significant difference, but none demonstrated harm from the intervention. The accompanying funnel plot was used to assess publication bias by plotting the standard error of the risk difference against the effect size. The plot reveals a relatively symmetrical distribution of studies around the pooled effect estimate, suggesting no substantial publication bias. The spread of points across both sides of the central axis and within the funnel boundaries indicates that smaller studies are not disproportionately missing, strengthening the validity of the meta-analytic findings. aken together, these graphical analyses corroborate the primary findings of the review: structured discharge education significantly reduces 30-day readmissions in

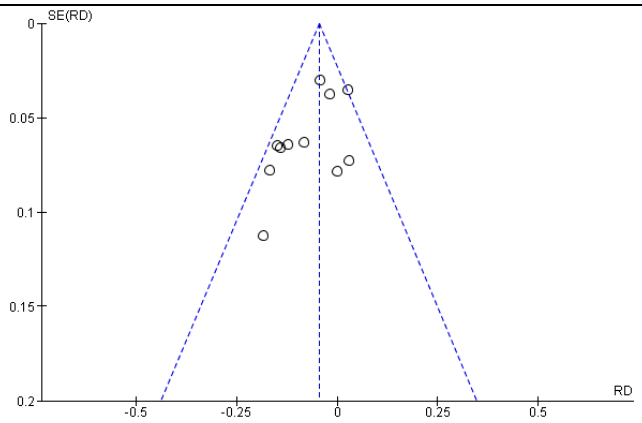


**Figure 2 Funnel Plot for Publication Bias**

patients with heart failure, and the evidence is consistent and robust across a moderate level of heterogeneity and low risk of reporting bias. This reinforces the clinical recommendation for implementing standardized, nurse-led discharge education programs in both high- and low-resource healthcare settings.

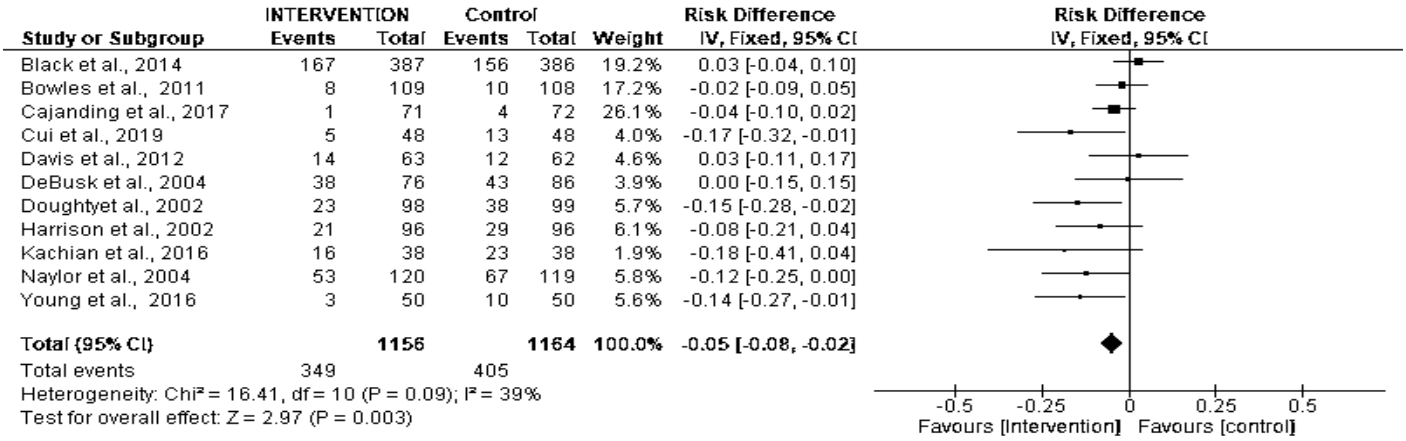


**Figure 3 Forest Plot for Pooled Effect Size Risk difference at 95% CI**

## DISCUSSION

This systematic review and meta-analysis synthesized evidence from 11 randomized controlled trials involving a total of 2,320 patients to evaluate the effectiveness of structured discharge education in reducing 30-day readmission rates among individuals with heart failure (HF). The pooled results, analyzed using a fixed-effect model due to moderate heterogeneity ($I^2$ = 39%), revealed a statistically significant reduction in readmissions in the intervention group compared to usual care, with a risk difference of -0.05 (95% CI: -0.08 to -0.02; p = 0.003). This finding reinforces the growing body of evidence supporting discharge education as a targeted, nurse-led intervention capable of addressing a critical window of vulnerability in heart failure management. Notably, these results are consistent with a prior meta-analysis that reported a significantly lower risk ratio for HF readmissions following structured discharge or self-care education (RR = 0.60, 95% CI: 0.42 to 0.85) (35), confirming that even modest improvements in self-management education can yield clinically meaningful reductions in hospital utilization.

The current findings support a growing consensus that nurses are particularly well-positioned to deliver discharge education, given their sustained patient contact and ability to establish therapeutic relationships. In each of the included studies, nurses served as the primary educators, and this consistency may have contributed to the overall effectiveness of the intervention. This aligns with previous literature emphasizing the unique role of nurses in transitional care, where they are often better equipped than other professionals to personalize education, reinforce comprehension, and encourage adherence to treatment plans (36). Discharge education not only improves patients' understanding of their condition but also enhances their confidence in managing symptoms and making informed decisions, which is critical in chronic illnesses like HF where self-care is central to preventing decompensation (27).

The included studies varied considerably in terms of theoretical frameworks, delivery formats, and educational content. While five studies explicitly adhered to the American Heart Association (AHA) guidelines, others utilized models such as the Self-Management Theory (33), Lorig's Chronic Disease Self-Management Model (13), and the Situation-Specific Theory (27). Despite this diversity, four

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of the five studies guided by AHA protocols demonstrated statistically significant reductions in readmissions (5, 29, 30, 32), suggesting that standardized, evidence-based frameworks may optimize the delivery and impact of discharge interventions. However, even interventions based on other theories yielded positive outcomes, indicating that while theoretical underpinning may enhance consistency, the core components of patient-centered education likely drive the observed benefits. This aligns with prior reviews that have advocated for the inclusion of multiple behavior-change theories in chronic disease education, as different patient populations may respond more favorably to different approaches (37). In terms of intervention components, this review confirms the value of a multifaceted educational strategy. All included studies covered several core elements, most notably medication adherence, dietary control, weight monitoring, exercise, symptom recognition, and follow-up compliance—components previously shown to correlate strongly with reduced readmissions in HF patients (36). Importantly, the inclusion of all six components was associated with a trend toward greater effectiveness, underscoring the necessity of comprehensive discharge planning rather than isolated educational efforts. Mechanistically, these components likely act synergistically to improve patient activation, reduce knowledge gaps, and mitigate avoidable clinical deterioration shortly after discharge.

The robustness of these findings is further supported by the low-to-moderate risk of bias observed across included studies, as assessed by the Joanna Briggs Institute (JBI) tool. The majority of trials demonstrated adequate methodological quality, with limitations primarily related to challenges in blinding due to the educational nature of the intervention—a common and often unavoidable feature in behavioral research. Additionally, the funnel plot analysis indicated no significant publication bias, enhancing confidence in the validity of the results. The consistency of effect across various settings—spanning North America, Asia, and Oceania—also suggests a degree of generalizability, although variations in healthcare infrastructure, discharge practices, and patient literacy levels may influence real-world implementation.

Nevertheless, this review has limitations that warrant acknowledgment. Only English-language publications were included, potentially excluding relevant studies from non-English-speaking regions. Grey literature, unpublished data, and dissertations were also omitted, which may introduce a degree of selection bias. The included studies varied in sample size, with several underpowered to detect small differences, and outcome measures were not always uniformly reported. Additionally, while this review focused on 30-day readmission—a commonly used quality metric—it did not assess longer-term outcomes such as mortality, quality of life, or cost-effectiveness, which are also critical to comprehensive heart failure care. Based on the findings of this review, future research should aim to disentangle the relative contribution of individual components of discharge education and explore the dose-response relationship between intervention intensity and clinical outcomes. Studies should also investigate the long-term sustainability of discharge education benefits and evaluate how different delivery modalities (e.g., face-to-face, digital, telephone-based) impact various patient populations, particularly those in low-resource settings.

## SYNTHESIS SUMMARY

This systematic review and meta-analysis consolidate evidence from 11 randomized controlled trials conducted across varied geographical, healthcare, and demographic contexts. Despite heterogeneity in study settings, intervention formats, and theoretical models, the findings consistently demonstrate that structured discharge education results in a statistically and clinically significant reduction in 30-day readmission rates among patients with heart failure. The interventions, largely nurse-led, were multifaceted and included medication education, dietary counseling, symptom recognition, follow-up adherence, and self-monitoring techniques. Studies adhering to guideline-based frameworks such as the American Heart Association (AHA) protocol yielded especially favorable outcomes. The consistency of effectiveness across diverse populations affirms the robustness of discharge education as a key transitional care strategy. Furthermore, low to moderate risk of bias and the absence of significant publication bias enhance the credibility of the findings.

## FUTURE IMPLICATIONS

These findings have substantial implications for healthcare systems, policy development, and clinical practice. The results advocate for the routine integration of standardized discharge education into hospital workflows, particularly for patients with chronic illnesses like heart failure. Implementation of nurse-led education protocols could be a low-cost, high-impact strategy to reduce preventable readmissions and associated healthcare burdens. Moreover, the study underscores the importance of investing in nursing education, transitional care infrastructure, and patient literacy programs. Future research should focus on comparing the relative effectiveness of individual educational components, assessing long-term outcomes such as mortality, quality of life, and cost-effectiveness, and exploring technology-assisted delivery methods such as telehealth, mobile applications, or automated reminder systems. Additional emphasis is needed on culturally tailored interventions, particularly in low- and middle-income countries where health literacy and care access remain suboptimal.

## LIMITATIONS

While the review provides valuable insights, several limitations should be acknowledged. Only English-language studies were included, which may introduce language bias and limit global generalizability. The exclusion of grey literature, unpublished data, and non-peer-reviewed sources could result in publication bias, although the funnel plot did not suggest this. Study-level limitations included variation in intervention intensity, delivery personnel, and follow-up duration, which may influence the magnitude of observed effects. The meta-analysis was limited to short-term outcomes (30-day readmission), without assessing broader health or economic impacts. Additionally, blinding of participants and personnel was generally not feasible due to the educational nature of the interventions, potentially introducing performance bias. Finally, despite the moderate heterogeneity observed, the use of a fixed-effect model assumes homogeneity in effect size, which may oversimplify complex intervention dynamics. These limitations underscore the need for more

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standardized, multicenter trials with rigorous reporting to strengthen the evidence base for discharge education interventions.

## CONCLUSION

In conclusion, this systematic review and meta-analysis provides robust evidence that structured discharge education interventions significantly reduce 30-day readmission rates in patients with heart failure, aligning directly with the study's objective of evaluating their effectiveness. The findings highlight the critical role of nurse-led, multi-component education—encompassing medication adherence, diet, exercise, symptom management, follow-up compliance, and weight monitoring—in enhancing patient self-care and promoting continuity of care after hospital discharge. These results carry important implications for human healthcare, advocating for the integration of standardized discharge education into routine clinical practice to improve patient outcomes and alleviate system-level burdens. Future research should focus on evaluating the long-term effects of such interventions on mortality, quality of life, and cost-effectiveness, as well as exploring the comparative effectiveness of individual components across diverse patient populations and healthcare environments.

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