Impact of Heart Failure Education on Readmission Rates

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Abstract

Background: Heart failure (HF) is the leading cause of global morbidity and mortality. The epidemic has an increasing incidence in the United States, as one the most common complex cardiovascular diseases. Research demonstrates that pre-discharge, patient-centered HF education has a substantial impact on patient health outcomes. Education ensures patient's comprehension of their disease process and facilitates behavior alterations leading to a reduction in hospital readmissions.

Objective: The purpose of this quality improvement (QI) project was to evaluate the impact of an inpatient HF nurse-led education consult on guideline directed medical therapy (GDMT) titration, patient ejection fraction (EF) readings, and the occurrence of HF hospital readmission rates to improve knowledge regarding trends in readmissions.

Methods: A retrospective chart analysis of de-identified patient data was accumulated on thirty-nine patients admitted with a HF diagnosis from an acute care hospital system in the southwestern United States. A statistical comparison between patients that received a pre-discharge education consult with those who did not was emphasized. Additionally, EF readings, the titration of GDMT, and the occurrence of hospital readmission(s) within the 120-day follow-up period were assessed.

Results: Data analysis was captured through descriptive statistics, Chi-square tests and Paired *t*-test. Thirty-nine patients were assessed in the study with 18 patients (46%) receiving a HF nurse education consult. The critical 30-day readmission time period demonstrated 15 readmissions, with 8 (44%) having had an education consult. The occurrence of HF readmission was greatest for those who did not receive a consult at the 31-to-90-day time period (n = 10). GDMT was

below guideline recommendations at 120 days, with 15% (*n* = 6) patients on the four pillars of treatment, with 16% (*n* = 3) patients having received a HF education consult.

Conclusion: This study has demonstrated that the current education program had little impact on the improvement of GDMT, patient EF readings, and HF readmission rates. Further research is needed to determine if current patient education can improve the measured outcomes. Moreover, additional research is essential to investigate the causes for decreased GDMT administration.

Keywords: *Heart Failure, patient education, readmission rates, guideline directed medical therapy.*

Impact of Heart Failure Education on Readmission Rates

Heart failure (HF) is one of the leading causes of hospitalizations in the United States. It is designated as an emerging epidemic and major public health crisis. HF generates high costs to patients and our healthcare system. Significant focus has been placed on the issues surrounding increased readmissions. Specifically, deficient patient education and the inability of patients to comprehend how to care for themselves and their complex disease after discharge. A nurse-led structured educational intervention completed during a hospitalization is a strategy aimed at improving patient health autonomy, elevating of health outcomes of those diagnosed with HF, and assisting in dramatically reducing readmission rates.

Background and Significance

Problem Statement

Heart failure, an emerging epidemic, impacts more than 26 million people worldwide with 6.2 million adults in the United States diagnosed with the condition (Albert & Estep, 2019; CDC, 2023). According to a report released by the Arizona Department of Health Services (ADHS) in 2022, heart disease was the leading cause of death in Arizona, with 14,536 cases linked to heart disease (ADHS, 2022). The economic burden to society is extensive, with projected medical costs increasing to $69.8 billion annually by 2030 (Urbich et al., 2020; Virani et al., 2020). Readmission following a HF hospitalization is a common occurrence, with 25% of patients readmitted within a month of discharge, attributing to the significant financial burden (Kwok, et al., 2020; Thandra et al., 2023). Center for Medicare and Medicaid services (CMS), reports readmissions could be avoided if interventions are targeted to patients initially hospitalized for HF events (Thandra et al., 2023). Attempts to reduce readmissions and increase medical treatment adherence is an important quality initiative.

Purpose and Rationale

The ongoing initiative by the United States Department of Health and Human Services (USDHHS) outlined in Healthy People 2030, places a substantial focus on the prevention and treatment of heart disease. These strategies include interventions to improve overall cardiovascular health, and schemes to reduce HF hospitalizations (Healthy People 2030, 2023). The desired outcome of Healthy People 2030 (2023) is to reduce the number of HF hospitalizations from 366.9 per 100,000 to 330.2 per 100,000 adults. CMS initiated a program in 2010 to encourage acute care hospitals to improve coordination between patients and caregivers during the discharge planning with instructions presented to impact HF readmissions (Psotka et al., 2020). Under the Hospital Readmission Reduction Program (HRRP), financial penalties will be given to care centers with high rates of HF readmissions that exceed national averages. The organizations will be penalized up to 1% of their total inpatient Medicare payments with the maximum penalty increasing to 3% (Psotka et al., 2020). The intention of this project was to obtain data to evaluate the impact of current HF educational practices on patient medication titration, patient ejection fraction (EF) measurements, and HF readmission rates. Ultimately, this will result in the reduction of HF readmission rates and decrease the hospital penalty percentages.

National Initiatives

As part of the Patient Protection and Affordable Care Act in 2010, the HRRP was established in response to costly and highly preventable readmission rates. The program imposed Medicare payment penalties for hospitals that had higher-than-expected unplanned readmission rates with the penalties taking effect fiscal year of 2013 (Psotka et al., 2020). The intention of the

program was to institute accountability and stimulate coordination of care during times of transition to improve communication and care coordination efforts (Psotka et al., 2020).

As the prevalence and incidence of HF increases, it is essential that evidence-based practice (EBP) initiatives are developed to prevent the amplification of HF symptoms in the general population. The goal of the national initiatives is to reduce HF hospitalizations with the increase in guideline directed medical therapy (GDMT) titration and optimization which can impact heart function and EF measurements leading to decreased admissions. Education care-coordination, specifically targeting adherence to medication recommendations have proven successful with patient adaptations to new mediation regimes (Patel, 2021).

Internal Evidence

A large metropolitan acute care hospital system in the southwestern United States offers comprehensive inpatient and outpatient cardiac care. An elite medical team ensures high-quality patient care with a focus on clinical innovation, advanced trials, and personalized cardiac patient care. The current practice review has demonstrated the need for a 1:1 HF coordinator consultation to fill the gaps in the plan of care for HF patients. Healthcare collaboration among providers and patients, improves patient education, emphasizing HF education, signs and symptoms of disease progression, and medication adherence to enhance patient outcomes. The treatment of HF is expensive with a large portion of the health system's budget spent on preventable factors, reducing these costs is an initiative for this health system project site.

PICOT Question

An extensive review of the current literature led to the clinically relevant PICOT question. In patients with a recent admission for heart failure (P), how does a pre-discharge education consult by a HF nurse coordinator (I) compared to no pre-discharge teaching consult

(C) affect guideline-directed heart failure medical titration, ejection fraction readings, and re-admissions for HF (O) over a period of 120 days (T).

Literature Review

Search Strategy

To answer the PICOT question, three primary databases were extensively searched for the most current evidence to include in the literature review. The databases include PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and the Cochrane Library. Databases were selected based upon their relevance and preciseness to the medical field and the strong scientific research base. Keywords common to all databases included; *heart failure, guideline directed medical therapy, patient education,* and *readmission rates.*

PubMed, CINAHAL, and Cochrane Library

The initial search of the three database searches resulted in over 700,000 peer reviewed articles related to *heart failure*. When *heart failure and readmission rates* were searched, the PubMed search produced 280 results, 1791 in Cochrane Library, and CINAHL with 1,188. To further refine the search, dates were limited to the past five years; results produced 183 primary articles in PubMed and in 566 CINAHL. To include the intervention in the PICOT question, the keyword of *patient education* produced 10 respectively in PubMed, 58 in CINAHAL, and 112 in Cochrane Library.

Limitations, Inclusion, and Exclusion Criteria

To determine if current practices of pre-discharge teaching influenced key patient variables, title and abstracts of articles underwent further review and ten research studies from the three different databases were chosen to be critically evaluated (see Appendix A, Table A1).

Of the ten chosen, all the studies were qualitative in nature; two randomized control trials, three retrospective studies, two prospective data collection studies, and two open-label trials.

Inclusion criteria consisted of articles published from 2018 to 2023, HF patients receiving patient education, journals written in English, and journals that included abstracts and full texts. Exclusion criteria included studies out of date range, patient education involving a telehealth-based structure, and non-inpatient settings.

Critical Appraisal and Synthesis of Evidence

For the review of the extensive evidence, ten studies were selected to be critically appraised of study quality and level of evidence using the rapid critical appraisal process developed by Melnyk and Fineout-Overholt (2019). Randomized controlled trials (RCT) are the highest level due to their unbiased design, with three studies selected with level I evidence demonstrating compelling evidence towards patient education increasing compliance with medical instructions and decreasing hospital readmissions. The remaining seven studies were level II, retrospective and prospective with a focus on the impact of patient education on readmission rates and the titration of GDMT in the HF population.

The study population across all ten studies were primarily white males, diagnosed with HF, and of older age (54-73 years old). The settings of the studies occurred in hospital/academic centers with participating countries of China, Poland, Taiwan, Germany, and the United States. Common measurement tools to assess if the interventions were successful included patient surveys, echocardiograms, the occurrence of readmissions all of which are current standards of care in HF medication assessment.

Improvements in HF management to reduce readmission rates have made remarkable advancements. Most studies contributed positively to the care of patients with HF with favorable

outcomes. The research has shown when educational interventions, 1:1 nurse/coordinator visits and the use of HF GDMT which are initiated quickly upon HF diagnosis and optimized within the weeks following discharge generate therapeutic and favorable outcomes (Abdin et al., 2021; McMurray & Milton, 2021). The overall aim is to improve symptoms and quality of life while reducing hospitalizations and unnecessary procedures.

Conclusion from Evidence

HF a leading global cause of morbidity and mortality. The evidence is extensive and presents a compelling argument for the necessity for increased patient education. An extensive review of the literature revealed patient education and measures to augment post discharge lifestyle modifications can lead to improved adherence and titration of guideline-directed medical therapy (GDMT). This could lead to increased EF readings, and ultimately reduced readmission rates (Nair et al., 2020). The mainstay management of HF is GDMT with the addition of multiple medications prescribed according to patient tolerance and the adjustment of doses frequently to achieve maximum tolerated therapy (Maddox et al., 2021). The American Heart Association (AHA) guidelines endorse GDMT quadruple drug therapy with (1) beta-blockers (BB), (2) mineralocorticoid receptor antagonists (MRAs), (3) sodium-glucose cotransporter-2 inhibitor (SGLT2i), and the addition of one of the following class of medications, angiotensin-converting enzyme inhibitors (ACE), angiotensin II receptor blockers (ARB), or angiotensin receptor-neprilysin inhibitors (ARNI) (Bress & King, 2019; Faridi et al., 2022). Implementation of effective strategies to reduce the treatment gap, include the reinforcement of national HF guidelines, medication adherence throughout the patient's hospitalization, and education from HF nurse clinicians, all proven to elevate patient care (Khan et al., 2021).

Evidence-based projects are crucial for the improvement of processes and practices within the realm of patient care. The use of clinical evidence guides the establishment of interventions to collect and analyze data, to safeguard providers, with the interest in improving efficiency and patient outcomes for HF patients. The projects aim is to improve symptoms and quality of life while reducing hospitalizations and unnecessary procedures. Based on this information, a QI project was completed to determine through retrospective chart analysis if a coordinator led HF education consult impacts GDMT titration, improves EF, and ultimately results to a reduction in HF readmissions. The same outcomes were compared against patients who have not received the intervention.

Theory Application

HF is a complex and challenging condition with increasing costs to manage the disease. Application of strategies to change attitudes by understanding behavior and how best to elicit change can be accomplished with a model used to guide health promotion and disease prevention. The theoretical framework chosen for this project that addresses these challenges is the Health Belief Model (HBM) (see Appendix B, Figure B2). This model can be used as a foundation for health behavior interventions needing modifications, utilization of the HBM increases the degree of involvement by assuming that behavior depends on the expected outcome of the action and the value of those outcomes (Baghiaimoghadam et al., 2013). The core concept, perceived susceptibility, is determined by the extent to which the patient realizes how vulnerable they are to their condition (National Cancer Institute, 2005). Perceived barriers are an influential component, if the barriers to change are challenging, the individual is unlikely to incorporate the needed modification. One such barrier is lack of knowledge in understanding their HF diagnosis and medication regimen, by creating a greater understanding with a more patient-focused

educational approach, medication adherence can be improved. Additionally, perception of severity is related to how likely an individual believes the condition will have serious consequences (National Cancer Institute, 2005). The more educated the patient is about the significance of their disease, the less likely they are to be readmitted (Płotka et al., 2017). The HBM describes perceived benefits as the potential or positive outcomes of an intervention. Increasing awareness and addressing behaviors that could prevent and control their disease process can lead to better behaviors (Baghiaimoghadam et al., 2013). The final core concept, self-efficacy, is the amount of confidence one feels to successfully perform their action or behavior (National Cancer Institute, 2005). The association that pursing the recommended action, results in positive impacts to patient health and outcome, will assist in the context of this project. By showing the relationship between improved clinical outcome with nurse educator-delivered teaching sessions, the HBM will be the foundation for this project and will result in reduced HF readmission rates and improved ejections fractions.

Implementation Framework

This project will be guided by the Plan-Do-Study-Act (PDSA) framework which is a method widely used in healthcare improvement to test and evaluate the changes needed to improve the quality of systems (Taylor et al., 2014). The model for improvement (Appendix B, Figure B1) is a four-stage cycle approach that is similar to the scientific method; hypothesis creation, data collection, analysis, and interpretation (Taylor et al., 2014). EBP changes are initiated with the plan phase, determining the aimed statement or opportunity for improvement (Taylor et al., 2014). In this project, the current processes will be analyzed and reviewed to determine if the intervention is effective. The second phase, implementing the plan of action or doing the intervention along with collecting the data. It is important at this phase to also

document problems encountered, any unexpected effects, or general observation that could be significant in the analysis phase. Following the do phase, the study phase includes data analysis, reviewing results, and determining the success or failure of the intervention (Donnelly & Kirk, 2015). The process is a cycle, with the act phase where reflection on the outcomes according to the problem are reflected upon. If the intervention resulted in success, continued implementation is carried out. Planning an intervention, putting it into place, determining any barriers, and practice change is the PDSA cycle that could result in change.

Methods

Ethical Considerations and Institutional Review Board Approval

Institutional Review Board (IRB) approval was received by Arizona State University (see Appendix C, Figure C1) along with IRB exemption and approval from project site (see Appendix C, Figure C2). Further review by the boards confirmed this project complies with all the health care industry regulations. Four ethical principles guided this project: autonomy, beneficence, nonmaleficence, and justice. Respect for persons was maintained with autonomy and protection of privacy with the inclusion of de-identified data, no patient identifying factors or names were known. The obligation to not harm the patient is the principle of nonmaleficence, weighing the benefits against burdens with the intent to choose the best care for patients (Varkey, 2021). During the project, adhering to this principle was done by evaluating an intervention with the intent to assist in reducing HF readmissions, no patients will be at an increased risk of harm. Justice is the final principal and requires fair and equal distribution of benefits and resources (Varkey, 2021). The project adhered to this principle by fair and equal selection of participants and by attempting to avoiding bias (Varkey, 2021). Participants will be selected based on

inclusion and exclusion criteria which will be explicit in order to ensure equal opportunities to participate (Varkey, 2021).

Setting and Key Stakeholders

The project was conducted within a large southwestern metropolitan hospital system. This system offers comprehensive cardiac care by an elite cardiovascular expertise team. The cardiac team focuses on clinical innovation, performing advanced trials, and personalizing patient care at multiple inpatient and outpatient care sites in a southwestern metropolitan area. The key stakeholders involved in this quality improvement (QI) project included the HF clinical nurse educators and the project site champion, a cardiac electrophysiology nurse practitioner. The clinical nurse educators are essential in guiding and implementing the HF education for the health system inpatients.

Subjects and Recruitment

This project is designed as a retrospective chart audit of adult patients aged 18 and older who have been hospitalized for a heart failure event. Patients participating in other comprehensive medical center research studies and those who will not continue care within the heart group after discharge will be excluded from this project. The target sample size for this project is 15 patients who have received the consult intervention compared to 15 patients who have not received the intervention. Data collection was be completed through electronic medical records system, EPIC, with de-identified data abstracted and utilized for analysis. Due to the retrospective nature of the project, recruitment and consenting of participants will not be indicated.

Data Collection Plan and Intervention

A QI project was conducted to evaluate if a congestive HF nurse led education consult increases titration of GDMT and reduces HF readmission rates. After IRB approval was obtained, an offsite retrospective record review was completed. Demographics were collected and de-identified by the health system Senior Clinical Informaticist. The aggregate information supplied pertained to patients hospitalized with a diagnosis of HF from January 1, 2023, to July 1, 2023 in the health systems six primary facilities. The total span for data analysis for each subject was for 120 days, beginning with initial HF consultation visit and concluding after 120 days from this date. Demographics collected included age in years, gender, ethnicity, HF type, and insurance status. The following quality measures were included; EF (initial and at 120 days), GDMT (mono, dual, triple, quad, or none), and any HF readmission events that occur within the 120-day data collection span. To complete the needed statistical analysis, a goal of 15 patients who received the education consult and 15 patients who did not receive the intervention were gathered.

Data Analysis Plan and Budget

The data analysis and statistical tests were completed using a chart audit form constructed in Excel and then inputted in the IntellectusStatistics ™ software (Intellectus Statistics, 2023). Participant confidentiality was protected by obtaining de-identified data from the project site information technology department. The data was stored on a password protected computer. The data will be available for review for five years upon completion of project. Descriptive statistics were used to describe the sample and outcome variables. Demographic variables include age in years, gender, ethnicity, heart failure type, and insurance status. Chi-square test was used to test the relationship among the following quality measures; ejection fraction, guideline directed medication therapy (mono, dual, triple, quad, or no therapy), and any HF readmission events. A

two tailed test was done with the critical value set at $p < .05$. The retrospective patients were categorized by subject number, occurrence or nonoccurrence of consult, and the outpatient visit time frame; initial HF visit to 30 days (T1), 31 to 90 days (T2), and final visit at/around 91 to 120 days (T3). The patients were categorized utilizing identifiers beginning with 100.

Actual expenses for this project were minimal. No external funding sources were secured for this project.

Results

Intellectus Statistics ™ was used to store, manage, and analyze the data. Thirty-nine patients admitted with a HF diagnosis were included in this project. The average age of the patients was 71 (SD = 11.24) with the range of 46 to 92 years of age. Demographic analysis shows most of sample were males 27 (69%) with females being 12 (30%) and a majority of subjects being white 31 (79%), the remainder were Black 4 (10%), Asian/Other 3 (7%), and Hispanic 1 (2%). Medicare insurance coverage was the primary coverage 30 (76%). The average measured baseline EF was 41%, it ranged from 13% to 79% with a median of 38%. Most of the sample experienced a reduced EF (*n*=25), the remainder of the sample experienced a preserved EF (*n*=14) reduced EF is considered <35% and preserved EF includes measurements <45% (See Appendix D, Table D1).

Readmission Data

Of the total number of subjects (N=39), 18 (46%) patients received the HF nurse education consult with 21 (53%) patients not receiving the consult with the primary admission. The primary outcome variable of concern was the occurrence of readmission when compared to receiving or not receiving a HF nurse education consult. Three time periods were analyzed for each subject, initial HF visit to 30 days, 31-to-90-days, and 91-to-120-days. Descriptive

statistical analysis showed HF readmissions occurred most frequently during the 31-to-90-day time period (n =16). A Chi-square Test of Independence was conducted to examine whether a HF nurse consult, and the occurrence of a HF readmission were dependent of one another. The results of the Chi-square test were not significant therefore reporting the two variables are independent of one another, 0 to 30 days $\chi^2(1) = 0.51$, $p = .477$, 31 to 90 days $\chi^2(1) = 0.82$, $p = .366$, and 91 to 120 days indicated $\chi^2(1) = 3.49$, $p = .06262$ (See Appendix E, Table E1).

Guideline Directed Medical Therapy Level Data

Descriptive analysis was run for the GDMT level of administration for each time period, 0-to-30-days, 31-to-90-days, and 91-to-120-days. Most frequent level at 120 days was mono therapy (n = 13). A secondary outcome variable of GDMT level administration and HF nurse education consult was compared during the three time periods, 0 to 30 days, 31 to 90 days, and 91 to 120 days. A Chi-square test of Independence was conducted to examine whether the consult and GDMT level were dependent. The results of the test were not significant therefore reporting the two variables are independent of one another, 0 to 30 days $\chi^2(4) = 2.80$, $p = .591$, 31 to 90 days $\chi^2(4) = 2.86$, $p = .581$, and 91 to 120 days $\chi^2(4) = 0.85$, $p = .931$ (See Appendix F, Table F1).

Ejection Fraction

The outcome variable of EF was compared to baseline and follow up with a two-tailed paired sample t-test. The result of the test was significant, and the hypothesis was rejected, t (38) = 2.80, $p = .008$. Due to multiple missing EF outcome points (n = 9) at the follow-up time period, intent-to-treat (ITT) was used to replace missing data. EF average was 28% (SD 19. 42) with a range of 0 and 64%. (See Appendix G, Table G1).

Impact and Sustainability

The findings of this study were shared with the project site. The intent of the project was to determine if current HF educational practices have an impact on HF readmission rates. Research demonstrates the effectiveness in nurse-led patient education, but the data analyzed for this project does not reflect the same outcome and ultimately, the results of this scholarly project did not correlate with the literature. With the recognition of gaps in current practices, calls for the continuous improvement in ensuring HF consults are ordered and completed. Future evidence-based projects with the need for patient HF education should be addressed to have a positive effect on patients' health outcomes.

Sustainability may be continued with the establishment of teaching efforts that target and evaluate a patients' understanding of their individual disease process and adopting strategies with education materials that are easy to understand. Interestingly, the implementation of GDMT at 120 days follow-up measured below national guideline recommendations, this could have impacted the readmission rates. Possible reasons for gaps in GDMT prescriptions were not explored, although the overall use and titration of medications among patients was shown to be a critical unmet need. This project can be utilized by the site to identify areas of patient education needing improvement with a focus on improvement of a medication guidance. Furthermore, education and support of greater nurse engagement in care planning and developing feasible interventions for HF programs can affect HF-related readmissions.

Discussion

The management of HF is a complex and debilitating disease. It is related to increased hospitalizations and has an enormous impact on healthcare expenditures in the United States. Published research has shown in-depth nurse-led education can help HF patients manage their symptoms, reduce hospital stays, and lead to the recommended medical therapy levels (Cui et al.,

2019; Chen et al., 2020; DeVore et al., 2021). The objective of the QI project was to evaluate if providing a HF nurse-led educational consult to patients admitted for HF prior to discharge would impact HF readmission rates, titration of GDMT to guideline recommendations, and EF readings. The analysis found the occurrence of educational consults completed on the sampled patients to be less than 50%. The management of HF is intricate and positive patient clinical outcomes are elevated with a structured educational intervention with tremendous benefit over no inpatient education (Koelling et al., 2005). The gap between receiving the consult and not receiving one could be multifactorial. Specifically, the lack of consult requests by practitioners and the rapid patient discharges with no cardiac education provided contributing to the lower completion percentage.

Health system strategies to reduce the preventable hospitalizations, such as patient education, can influence the rates of readmissions. Due to CMS financial penalties assessed for high readmission rates, hospital systems have placed focus on 30-day readmission rates as a metric to improve upon. The retrospective analysis of this project compared the occurrence of a HF readmission during three different time periods, 0-to-30-days, 31-to-90-days, and 91-to-120-days against whether the subject received a HF education consultation. The results of the analysis determined the two variables were not statistically significant and cannot conclude the variables are associated with each other. Several studies have attempted to gain understanding on how patient education could result in a patient's increased understanding of the disease and medication requirements. While not explored in this project, teaching efforts that consistently assist in disease comprehension by targeting medication routines, reinforcing dietary changes, and stress the importance of follow-up appointments can have a profound effect (Koelling et al.,

2005). The variation between patient comorbidities, education level, and patient interest and family member engagement could also impact the retention of the information presented.

Literature has demonstrated HF medical therapy is a clinician-led behavior with the practitioner prescribing behaviors having the largest impact in reaching GDMT levels (Devore et al., 2022). In this center, the majority of patients the hospital were not optimized on GDMT doses at discharge or during the 120-day follow-up period under routine care. Current EBP class I recommendations include in-hospital initiation and titration of GDMT for patients with HFrEF with full optimal doses within weeks after a hospitalization (Abdin et al., 2021; McMurray & Milton, 2021). Hospitalizations offer an opportunity to monitor key vital signs when the implementation of new medications are initiated. Several reasons could lead to the low rates of targeted GDMT levels in patients: provider inertia, patient intolerance, and lack of insurance coverage for the medications. These factors were not explored in this project and could have been barriers encountered by subjects.

Considered a predictor of cardiovascular outcome in HF patients, EF has a known relationship between decreased readings and mortality, but the relationship with nonfatal outcomes such as readmissions is not well defined (Solomon et al., 2005). In those patients with a preserved EF, <45%, the prediction of cardiovascular outcomes becomes less significant and not useful for further risk-stratifying and therefore the relationship with nonfatal outcomes such as readmissions is not well defined (Solomon et al., 2005).

Limitations and Challenges

The limitations of the study were impacted by a variety of challenges. With regard to aggregate data collection, the retrospective approach was limited to what was previously collected as stored data with multiple variables reported from the site. This data collection

method also demonstrates an inability to evaluate the education being presented, if the education structure is consistent and influences the measures to establish causation. The variation between patient comorbidities, patient education level, and patient interest and family member engagement could impact the retention of education received.

The benefits of HF medications adherence are when patients identify the importance of taking the cardiac medication and comply with ordered therapy (Koelling et al., 2005). The effects of an education program on patients with either HFpEF or HFrEF could be another challenge due to the difference in GDMT prescribing guidelines. The data analysis included 14 patients with preserved EF. AHA/ACC guidelines recommend medical treatment with diuretics and SGLT2i as first line therapy and the optimal treatment for decreasing the risk of admission. (Heidenreich et al., 2022). BB use is inconsistent with long-term benefits, ARBs and ACEI are not usually first line recommended drug therapies, with current guidelines they are considered a 2b recommendation; weak recommendation where usefulness or effectiveness is unknown/uncertain in patients with a preserved EF (Heidenreich et al., 2022).

Implications and Recommendations for Future Research

This project demonstrated the internal and external complexities in managing patients with HF. Advocacy for new research on the assessment of best practices to reduce HF readmissions is necessary. It is essential for patients to receive education on HF to support health autonomy and adherence to evidence-based prescriptive measures to prevent acute HF readmissions. HF guidelines released by the AHA/ACC are recommendations based upon evidence on how to safely and effectively treat HF patients, providing actionable plans for patient care to decrease avoidable readmissions (Heidenreich et al., 2022). Future efforts to study

the effect of nurse-led patient education on clinical outcomes of HF are needed and have the potential to enhance the HF disease path for patients.

Conclusion

In conclusion, during this analysis, a HF nurse-led pre-discharge educational intervention was not substantial in reducing readmission rates when compared to the absence of a consult. The evidence suggests a targeted structured educational intervention prior to discharge can be associated with improved medication titration, and more importantly, a reduction in readmission rates (Nair et al., 2020). Substantial and significant reduction in healthcare expenditures can be achieved when patients are guided by a targeted education program delivered by a nurse educator prior to discharge.

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Appendix A

Evaluation Table

Table A1

Evaluation Table for Quantitative Studies

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Płotka et al. (2017), Patients' knowledge of heart failure and their perception of the disease. **Country:** Poland **Funding:** Not disclosed **Bias:** None noted, declaration of interests disclosed	Inferred: Orem's Self-Care Theory	**Design:** Prospective, single-center survey-based registry **Purpose:** To gain a deeper insight into patients' perception of CHF symptoms by analyzing compliance with nonpharmacological recommendations	**Sample:** Hospitalized patients diagnosed with CHF at least 3 months prior to inclusion (n=201). Group 1mild CHF (67) and Group 2 severe CHF (126) **Demographics:** mean age 58, white males **Setting:** Single-center acute care hospital. **Exclusion:** Younger than 18	**IV1:** Mild CHF (class I and II) **IV2:** Severe CHF (class III and IV) **DV1:** Knowledge of CHF **DV2:** Perception of symptoms of CHF **DV3:** Lifestyle changes	**Tools:** Survey with 12 questions about disease perception, symptoms, compliance, and QOL. **Validity/ Reliability:** Survey tool created for this study and not previously tested.	**Statistical Tests Used:** Lillefors and Shapiro-Wilk tests, ANOVA, *t*-tests, and Chi-square tests. Analyses conducted using STATISTICA 12 Statsoft software	**DV1:** Most patients believed CHF was curable with the severe CHF group noted to see the disease as incurable. **DV2:** Most patients considered chest pain, palpitations, and dyspnea as alarming symptoms. The least chosen symptoms were loss of appetite, cough, and vomiting. **DV3:** Most reported	**Level of Evidence:** Level II **Strengths:** Analyzing patient knowledge of disease and how this influences compliance with medical instructions **Weakness:** Use of a non-standardized survey **Feasibility:** Would need to include the support of nurses specialized in CHF to educate patients

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
			Attrition: Numbers not disclosed				lifestyle change was reduction of alcohol. Smoking cessation, diet change, and exercise was reported by one third of patients.	**Application:** Information gained to highlight the lack of communication between patients and health providers and the need to create multidisciplinary programs to fill in the gaps.
Cui et at., (2019), A nurse-led structured education program improves self-management skills and reduces hospital readmissions in patients with chronic heart failure: A	Inferred: Theory of Goal Attainment and Health Promotion Model	**Design:** Randomized control trial **Purpose:** Determine the efficacy of nurse-led education on the self-management, symptom control, and hospital readmission in patients with CHF in rural China.	**Sample:** Patients from an inland farming community (n = 96) **Demographics:** Primarily males with CHF, mean age 56 with EF 42%. **Setting:** Inpatient cardiology department at a	**IV1:** Structured education in hospital and after discharge **IV2:** No structured education at hospitalization or after discharge. Managed with current clinical guidelines	**Tools:** Self-management questionnaire **Validity/ Reliability:** Tool originally developed and tested for validity and reliability.	**Statistical Tests Used:** Fisher's exact *t*-test and independent *t*-test for numerical data Statistical Package for Social Sciences	**DV1:** Medication adherence was 15% in the intervention group vs 12% in the control group (p=0.008) **DV2:** Diet modifications were 11% versus 8%, with more patients from the intervention	**Level of Evidence:** Level I **Strengths:** Nurse-led educational interventions have an impact on the outcomes of CHF and the availability of nurses to assist in education **Weakness:** Conducted at a

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
randomized and controlled trial in China **Countries:** China **Funding:** Not disclosed **Bias:** None noted, declaration of interests disclosed			hospital in China **Exclusion:** Younger than 18, acute renal failure, major depression, and inability to participate in follow-up **Attrition:** All patients survived the 12 month follow up	**DV1:** Medication adherence **DV2:** Dietary modifications **DV3:** Symptom control		v16.0 was used	group conducting daily weight checks (91%). **DV3:** Symptom control was better with the intervention group 17% versus 13%.	single academic health system in China with rural subjects. **Feasibility:** Improved medication compliance and adherence to recommendations has shown to reduce readmission rates. **Application:** Structured educational interventions conducted during hospitalizations has been found to reduce readmission rates.
Kwok. (2021), Cost of inpatient heart failure care and 30-day	Inferred: Health Promotion Model	**Design:** Retrospective cohort study **Purpose:** To evaluate the costs	**Sample:** CHF patients (n = 2,645,336) **Demographics:** Median age 73,	**IV1:** Usual care of GDMT	**Tool:** Iranian heart failure QOL questionnaire. **Validity/**	**Statistical Tests Used:** Descriptive statistics and logistic	**DV1:** Higher % of patients on GDMT at 90 days 55% vs 2% for ARNI, 49% vs 4% for	**Level of Evidence**: Level I **Strengths**: Early

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
readmissions in the United States **Country**: United States **Funding**: Not disclosed **Bias**: None noted, declaration of interests disclosed		associated with inpatient hospitalization with CHF	Primarily white, males with Medicare insurance. **Setting:** Use of the US Nationwide Readmission Database **Exclusion:** December admission, elective admission, and those missing costs	**IV2:** High intensity care **DV1:** 30-day cost in US dollars. **DV2:** HF readmission and all-cause mortality	**Reliability:** All the tools used are reliable and authenticated by numerous previous studies.	regressions to identify predictors of cost Statistical analysis performed with Stata 14.0 software	BB, 84% vs 46% MRAs, **DV2:** HF readmission or all-cause death 74 (15·2%) high-intensity care group and 109 (23·3%) usual care group P value 0.0021	termination of study due to significance of treatment group on successful HF treatment. **Weakness**: No focus on comorbidities **Feasibility**: Ability to analyze data at the local level **Application**: Generalizable and applicable to multiple population and countries.
Chen et al., (2020), Effects of predischarge follow-up on self-care, readmission, sleep, and depression in patients	Inferred: Health Promotion Model	**Design:** Longitudinal, nonequivalent, two-group with pre and post test **Purpose:** Examine the effects of a predischarge educational	**Sample**: HF patients (n = 62). control group (n=34) intervention group (n=28) **Demographics:** Male sex with mean age of 56,	**IV1:** Patient group receiving tailored education and follow-ups. **IV2:** Patient group received routine	**Measures:** Self-Care of HF index, Pittsburg Sleep Quality Index, PHQ-9 **Validity/**	**Statistical Tests Used:** Chi-square and Mann-Whitney U tests, Analysis with linear mixed models	**DV1:** Intervention group showed differences at 1, 3, and 6 months. The effect did not persist after 6 months (F= 2.65, p= .035).	**Level of Evidence:** Level II **Strengths:** Multiple variables of HF examined. **Weakness:** Asian center

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
with heart failure. **Country:** Taiwan **Funding:** Ministry of Science and Technology **Bias:** No bias disclosed.		program combined with 1 year of post discharge follow-up on self-care behaviors, sleep quality, depression, and readmission.	Class II or III HF. **Setting:** Two large health centers in southern Taiwan **Exclusion: Exclusion:** Younger than 20. **Attrition:** 46 completed 1 year follow up with 15 withdrawals	predischarge HF education from direct care nurse only. **DV1:** Self-care maintenance and management **DV2:** Sleep quality **DV3:** Depression **DV4:** Readmission rate	**Reliability:** All the tools used are reliable and authenticated by numerous previous studies.	with scores estimated using logistic regression analysis. To avoid bias ITT and PP approaches were used. Analyses conducted using SAS 9.4 with significance value set at <.05	**DV2:** No significant difference in changes over time between the groups. **DV3:** No significant difference in changes over time between the groups. HF patients more likely to be depressed. **DV4:** Intervention group had 53% fewer readmissions with the average time to readmission longer in the intervention group.	study may not reflect the US population. Small sample size and high withdrawal rate. **Feasibility:** Patient education is critical to self-care behaviors and having a nurse-led intervention is more beneficial **Application:** Improvements in HF self-care is significant following predischarge teaching, in order to sustain the behavior, continued follow up and education is needed. Strategies to improve patient education in a

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								quick and effective manner are needed.
Nair et al., (2020), Reducing all-cause 30-day hospital readmissions for patients presenting with acute heart failure exacerbations: A quality improvement initiative. **Country:** United States **Funding:** No funding sources disclosed **Bias:** No bias disclosed	Inferred: Orem's Self-Care Theory	**Design:** Retrospective data collection. **Purpose:** To evaluate to intervention of improvement in care transitioning post discharge and scheduled two-week follow-up	**Sample:** Patients with primary diagnosis of HF and non-elective admission in November 2017 & 2018 **Demographics:** not disclosed **Setting:** Single center, inpatient care. **Exclusion:** Patients younger than 18 years, on dialysis, not discharged to home. **Attrition:** NA due to retrospective study	**IV1** HF admissions from November 2017 (control group) **IV2:** HF admissions from November 2018 after implementation of scheduled follow-up and patient education consult (study group) **DV1:** Readmission in 30 days in 2017 **DV2:** Readmission in 30 days in 2018	**Tools:** Patient education material on HF exacerbation, lifestyle modifications, importance of medication compliance, and importance of follow-up attendance.	**Statistical Tests Used:** Multiple logistic regressions, linear regression models, and descriptive statistics Analysis performed with Stat 14.0	**DV1:** All-cause readmission rate of patients with HF 28% with only 30% having a scheduled follow up with PCP or cardiologist. **DV2:** 14% all-cause readmission rate with 56% keeping scheduled follow-up with PCP or cardiologist.	**Level of Evidence:** Level II **Strengths:** QI project aimed at testing an intervention. **Weakness:** Sample size not discussed, medication optimization not a variable but important education topic. **Feasibility:** Patient education is an integral part of discharge teaching. Targeted education with focused interaction can be pivotal in

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								reducing HF readmissions. **Application:** Targeted education is applicable to hospital systems but may need increased ratio of nursing staff to conduct education.
Gonzaga, (2018), Enhanced patient-centered educational program for HF self-care management in sub-acute settings **Country:** United States **Funding:** None disclosed	Expanded Chronic Care Model of 2003	**Design:** Single site, Prospective data collection **Purpose:** To implement and evaluate the effectiveness of patient centered educational program on self-care management among HF patients	**Sample:** (n= 34) 20 pretest participants, 14 posttest participants **Demographics:** English speaking HF patients, male and female participants **Setting:** Alaris Health, New Jersey **Exclusion:** Active	**IV1:** Provide patient-centered education for HF diagnosis **IV2:** Utilized SCHFI at self-care tool pre and post **DV1:** Pre-survey self-care maintenance **DV2:** Post-survey self-care maintenance	**Tools:** Self-care of HF Index V6.2 (SCHFI) **Validity/ Reliability:** Index survey is reliable and authenticated by numerous previous studies	**Statistical Tests Used:** Descriptive statistics, Wilcoxon matched-paired signed-rank, Pearson's correlation.	**DV1**: Self-care maintenance, self-care management, and self-confidence recording were lower pre educational intervention **DV2:** Self-care maintenance, self-care management, and self-confidence were found to be statistically	**Level of Evidence:** Level II **Strengths:** Results of study able to confirm health care tool was affective. **Weakness:** Single center with small sample size **Feasibility:** QI project would be easy to replicate and future research

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Bias: No bias disclosed			psychiatric conditions or illnesses, vulnerable populations **Attrition:** 6 participants due to long term care facility transfer	after patient educational consult			significant and clinically improved with the educational program	would be needed to assess whether improvements in mortality and quality of life can be achieved with self-care management alone. **Application:** The current study was able to demonstrate patients who received an educational consult resulted in an improvement of QOL and adherence to HF care management.
Khan et al., (2021), Trends in 30- and 90-day readmission	Inferred: Behavioral system model	**Design:** Single center, retrospective review. **Purpose:** To determine if WCD recordings	**Sample:** (n= 1353) European patients with low EF wearing a WCD for greater than 5 weeks	**IV1:** Day time and nighttime heart rate greater than 70 at first week of use	**Tools:** WCD with 3 electrodes and 3-axis accelerometer **Validity/**	**Statistical Tests Used:** Descriptive statistics, Paired *t* test, *t* test,	**DV1**: At beginning of study, 45% of patients were less than 70 during the daytime and	**Level of Evidence:** Level II **Strengths:** Large cohort of patients

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
rates for heart failure **Country:** United States **Funding:** None used **Bias:** No bias disclosed		provided a feasible method to assess resting heart rate as well as heart rate during activity of daily living in order to determine if guideline-directed heart rate targets are being achieved in HF patients' post-hospitalization.	**Demographics:** Median age 58, Males with HF, with 73 wear days **Setting:** University Hospital Regensburg, Germany **Attrition:** NA due retrospective study	**IV2:** Day and night heart rate greater than 70 at last week of use **DV1:** Percentage of patients with resting heart rate below 70 during first week of use. **DV2:** Percentage of patients with resting heart rate below 70 at week of use. **Definitions:** Rest is 30 minutes or greater of less than 60 milligravity accelerometer recording, Daytime from 7 am to Midnight, Nighttime from	**Reliability:** Tool being validated with this study.		60% at nighttime, Day time average heart rate 72.5 and night 68.1, $p < 0.0001$. **DV2:** By the end of the study these numbers were 57% at daytime and 72% during the nighttime. Day time heart rate 69.0 and 64.3 at night, $p < 0.000$ Regardless of time of day, 12% of patients had a resting heart rate greater than 90 at the beginning, in the end 8% had heart rates greater than 90.	**Weakness:** Study did not include dosage of BB, only heart rate was considered and not rhythm (atrial fibrillation), **Feasibility:** The study demonstrates the value of WCD use as a monitoring tool to optimize GDMT, can serve as a reminder to practitioners to use the information available in a device commonly worn by their patients. **Application:** The current study was able to illustrate that in patients

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
				midnight to 7am.				utilizing the WCD, resting heart rates could be reliably measured. Heart rate can be a marker of BB response and for every 5 beat reduction there is an 18% reduction in death risk. Remote heart rate monitoring can reliably help to titrate GDMT.
Asthana et al., (2018), Heart failure education in the emergency department markedly reduces readmissions in un- and under-	Inferred: Health promotion model	**Design:** Open label, intervention study with a parallel observational control group **Purpose:** The purpose of this study was to evaluate the efficacy of a structured, educational	**Sample:** (n= 94) Patients with known previous HF diagnosis. Intervention (n = 45) Control (n = 49) who were un- or under-insured. **Demographics:** Median age 58,	**IV1:** Education intervention before seeing physician in ED and a 30 day follow up phone call **IV2:** Standard ED care **DV1:** Change in number of	**Tools:** Standardized educational information given orally on HF mechanisms, medications, signs and symptoms on HF at a 5th grade comprehension level Follow-up phone call	**Statistical Tests Used:** non-parametric Wilcoxon signed rank test. Stratified analysis with nonparametric covariable	**DV1:** Intervention patients experienced a 47.8% and 45.3% decrease in ED revisits (P = 0.02 & P b 0.001), and 60.0% and 47.4% decrease in hospital readmissions (P	**Level of Evidence:** Level II **Strengths:** Group of patients who can benefit from self-management strategies. **Weakness:** Very specific

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
insured patients. **Country:** United States, **Funding:** No funding received **Bias:** No bias disclosed		intervention targeted towards un- and under-insured ED patients.	African-American males **Exclusion:** Patients with unstable conditions or incarcerated. **Setting:** Single ED site in the United States **Attrition:** No patients lost to follow up	HF-specific ED revisits. **DV2:** DAOH over 365 days.		adjustment, Wilcoxon rank-sum test, Kaplan-Meier time-to-event, Pearson's chi-squared test JMP Pro 11 statistical software.	= 0.049 & P = 0.007) in the 30 and 90 days pre- versus post-intervention. Control patients had no change in hospital readmissions or 30-day ED revisits experienced a 36.6% increase in 90-day ED revisits (P = 0.03). **DV2:** Intervention group reported 59.2% improvement in DAOH versus control patients (P = 0.03)	patient population, not a randomized controlled study with the possibility of mismatches between treatment groups. **Feasibility:** Low-cost high benefit ratio with an impactful intervention. **Application:** Majority of HF readmission patients enter through the ED, allowing an early intervention to prevent future visits.
DeVore et al., (2021), Effect of a hospital and	Inferred: Health promotion model	**Design:** Cluster randomized trial **Purpose:** To evaluate if a	**Sample:** Acute HFrEF patients (n=5647). Intervention	**IV1:** Usual care group. **IV1:** QI intervention	**Tools:** Site-level clinician education	Wilcoxon rank-sum test for continuous	**DV1:** Intervention group time to first HF	**Level of Evidence:** Level I

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
postdischarge quality improvement intervention on clinical outcomes and quality of care for patients with heart failure with reduced ejection fraction: The CONNECT-HF randomized clinical trial. **Country:** United States and Canada **Funding:** Novartis **Bias:** No bias disclosed		hospital intervention focused on HF education can improve outcomes and quality of care for patients with HFrEF.	(n=2675) Control (n=2972) **Demographics:** Median age 62, white males with EF <40% and class II HF **Exclusion:** Previous heart transplant, dialysis patients, and those with a terminal illness **Setting:** 161 hospital sites in United States **Attrition:** 1001patients lost to follow up, 99 patients discontinued intervention.	**DV1:** Rate of rehospitalization or death. **DV2:** Quality of care scores with use of GDMT, anticoagulants, device implants **Definitions:**		variables and χ^2 or Fisher exact test for categorical variables. Analyses conducted using SAS version 9.4 and R (R CORE Team 2019) statistical software.	rehospitalization, deaths or both 38.6% Control group 39.2% **DV2:** Quality of care metrics 42.1% intervention group, 45.5% in the usual care group. Measure improved over time to 44.3% in intervention group and 44.6% in usual care. No significant differences.	**Strengths:** Site level clinician education with QI action plan with specific activities to ensure consistent messaging on HF care. Significant patient participants. **Weakness:** Study enrolled only HFrEF patients. **Feasibility:** 72% of hospitals have preexisting QI teams focused on HF education making the ability to refine and evaluate education programs available

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								Application: Ongoing challenges to improve care for HF patients remains. GDMT use rates remain insufficient. Care models continue to need evaluation and improvement
Mebazaa et al., (2022), Safety, tolerability and efficacy of up-titration of guideline-directed medical therapies for acute heart failure (STRONG-HF): a multinational, open-label,	Inferred: Systems model	**Design:** Open-label, randomized, parallel-group trial **Purpose:** To assess the safety and efficacy of rapid up-titration of treatments before discharge from an acute HF admission and during the following weeks compared with usual care	**Sample:** (*n*= 1078) Patients admitted acute HF, not treated with GDMT, high intensity care (*n*=542), usual care (*n*=536) **Demographics:** Median age 63, white males with acute non-ischemic HF **Exclusion:** Intolerance to	**IV1:** Intensive HF care with GDMT **IV2:** Usual care **DV1:** Readmission for HF in 180 days **DV2:** All-cause death by day 180	**Tools:** BP, HR, New York Heart Association class, weight, and NT-proBNP **Validity/ Reliability:** All the tools used are reliable and authenticated by numerous previous studies	χ^2 test of the difference, adjusted risk ratio, ANCOVA,	**DV1:** The primary endpoint at 180 days was observed in 74 (15·2% down-weighted adjusted Kaplan-Meier estimate) of 506 patients in the high-intensity care group and 109 (23·3%) of 502 patients in the usual care group	**Level of Evidence:** Level II **Strengths:** Patient sample size that included a wide range of patients with ischemic and non-ischemic HF from multiple countries making the findings more generalizable,

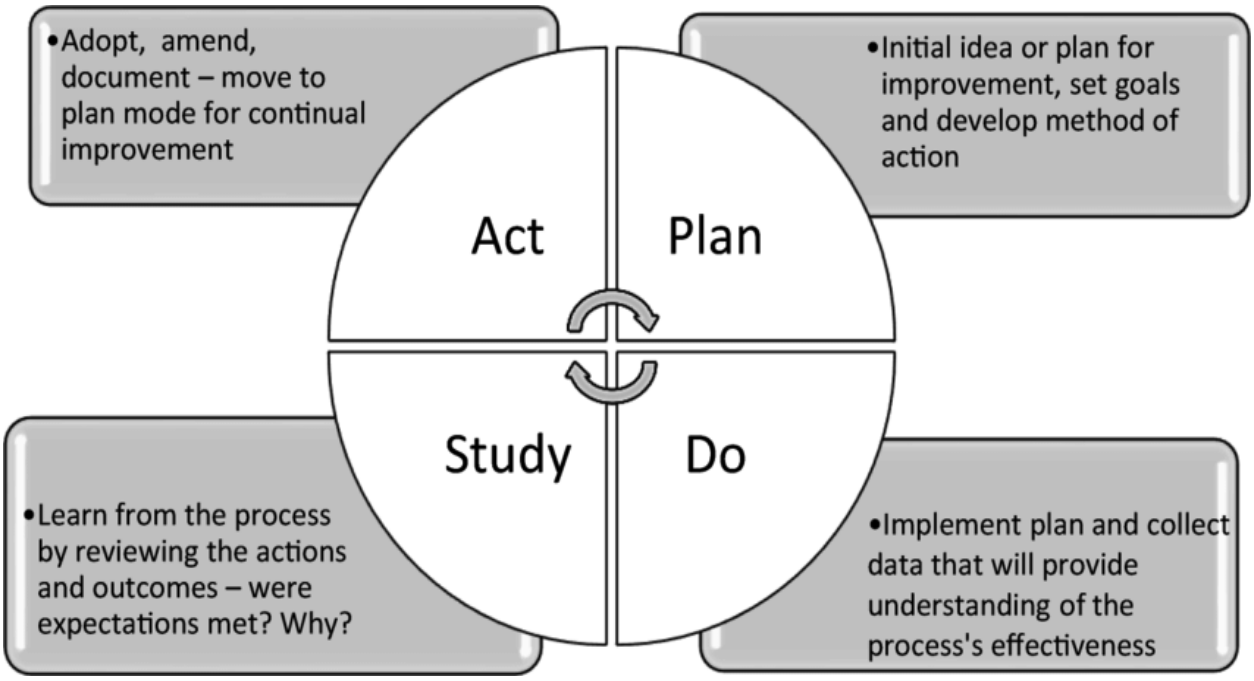
Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
randomized, trial **Country:** Germany **Funding:** Heart Initiative by Roche Diagnostics International **Bias:** No bias disclosed, declaration of interests disclosed			BBs, ACEi, or ARBs **Setting:** 87 hospitals and 14 countries **Attrition:** Intervention 32 failed to follow up, 17 died on or before day 180, 5 discontinued, 25 terminated. Control 34 failed to follow up, 18 died on or before day 180, 3 discontinued, 23 terminated				**DV2:** CV death by day 180 32/506 intervention group and 44/502 in control group (p=0.19)	**Weakness:** Unblinded study, SGLT2 inhibitors not used **Feasibility:** Findings demonstrate how important optimal GDMT can be to patients when done in a rapid sequence. **Application:** As a result of this trial, rapid up-titration of GDMT with follow-up and monitoring, during and early after discharge from a HF hospital admission is safe and results in a reduction of HF readmissions or all-cause deaths

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								and improves patients' quality of life within 180 days.

Appendix B

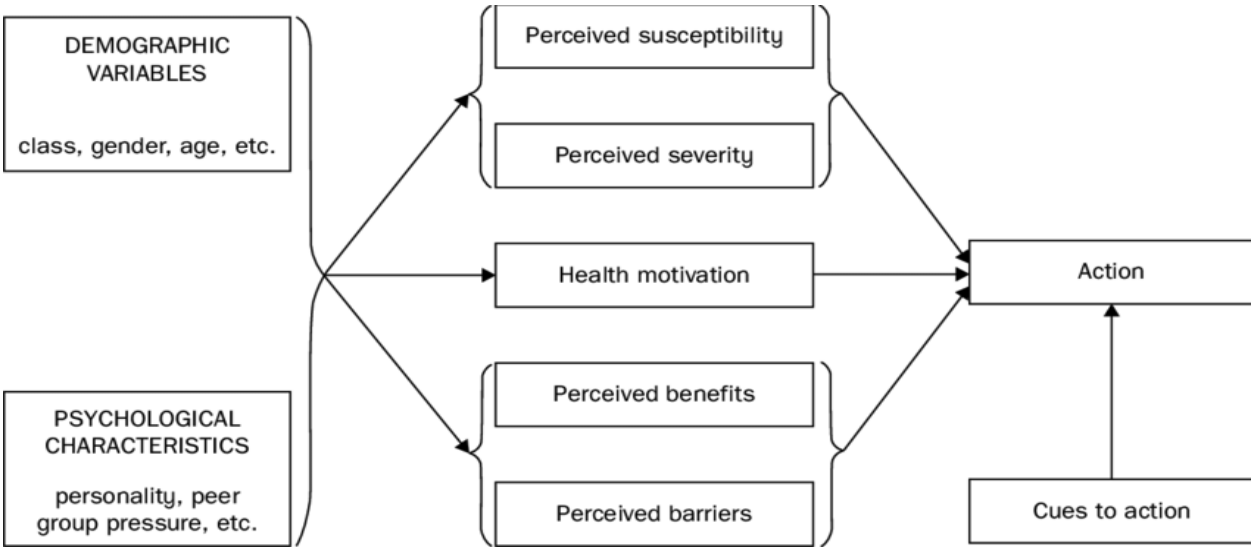
Models and Frameworks

Figure B1
Plan-Do-Study-Act Model



Taylor et al. (2014)

Figure B2
Health Belief Model



Conner & Norman (2015)

Appendix C

Approval Letters

Figure C1
Arizona State University IRB Letter

EXEMPTION GRANTED

Nancy Denke
EDSON: DNP
-
Nancy.Denke@asu.edu

Dear Nancy Denke:

On 1/25/2024 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Impact of Heart Failure Education on Medical Treatment and Readmission Rates
Investigator:	Nancy Denke
IRB ID:	STUDY00018790
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Data Use Agreement, Category: Other; • Nemmers Citi training, Category: Other; • Nemmers Citi training, Category: Other; • NemmersKA-ASU IRB Social Behavioral Protocol_1.docx, Category: IRB Protocol;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (4) Secondary research on data or specimens (no consent required) on 10/31/2023.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

Appendix C

Figure C2

Site IRB Exemption Letter

HONORHEALTH™

DATE:	09/30/2023
TO:	KaryAnne Nemmers
FROM:	HonorHealth IRB (HIRB)
PROJECT TITLE:	Impact of heart failure inpatient education on adherence to medical therapy and readmission rates.
STUDY #:	IRB-23-0095
SUBMISSION TYPE:	Initial Application
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	09/29/2023
REVIEW CATEGORY:	Exemption category 45 CFR 46.104(d) (4) Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met: (i) The identifiable private information or identifiable biospecimens are publicly available; (ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects; (iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of 'health care operations' or 'research' as those terms are defined at 45 CFR 164.501 or for 'public health activities and purposes' as described under 45 CFR 164.512(b); or (iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.

Thank you for your submission of NEW PROJECT materials for this project. The HonorHealth Institutional Review Board has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

The following items were included in the review of this submission:

Type	Description	Version #	Date
Document	Chart Audit templateHH Retrospective.docx	1	08/16/2023
Protocol	honor health methods.docx	1	08/18/2023

We will retain a copy of this correspondence within our records.

If you have any questions, please contact Julie Washington at 480-323-3071 or jwashington@honorhealth.com. Please include your project title and study number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within HonorHealth IRB (HIRB)'s records.

Appendix D

Project Results: Descriptive Summary

Table D1
Sample Demographics

Summary Statistics for Age in Years

Variable	*M*	*SD*	*n*	Min	Max	*Mdn*
AGE_IN_YEARS	71.41	11.24	39	46.00	92.00	71.00

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Frequency Table for Gender, Ethnicity, and Insurance Status

Variable	*n*	*%*
GENDER		
MALE	27	69.23
FEMALE	12	30.77
ETHNICITY		
WHITE	31	79.49
BLACK	4	10.26
HISPANIC	1	2.56
ASIAN/OTHER	3	7.69
INSURANCE_STATUS		
MEDICARE	30	76.92
MEDICAID	3	7.69
PRIVATE	6	15.38

Note. Due to rounding errors, percentages may not equal 100%.

Summary Statistics Table for Ejection Fraction at Baseline and Follow Up

Variable	*M*	*SD*	*n*	Min	Max
BASELINE EF	40.92	14.31	39	13.00	79.00
FOLLOW UP EF	35.53	11.59	39	15.00	64.00

Frequency Table for Heart Failure Type

Variable	*n*	*%*
Heart Failure reduced Ejection Fraction	25	64.10
Heart Failure preserved Ejection Fraction	14	35.90

Note. Due to rounding errors, percentages may not equal 100%.

Appendix E

Project Results: Readmission Date

Table E1
Readmission Results

Frequency Table for HF Education Consultation

Variable	*n*	*%*
HF CONSULT COMPLETED		
YES	18	46.15
NO	21	53.85

Note. Due to rounding errors, percentages may not equal 100%.

Frequency Table for HF Readmissions by Time Period

Variable	*n*	*%*
0 to 30 day HF READMISSION		
NO	24	61.54
YES	15	38.46
31 to 90 day HF READMISSION		
NO	23	58.97
YES	16	41.03
91 to 120 day HF READMISSION		
NO	32	82.05
YES	7	17.95

Note. Due to rounding errors, percentages may not equal 100%.

Observed and Expected Frequencies for HF Readmission and Time Period 1

	0 to 30 Days HF READMISSION				
HF CONSULT	NO	YES	χ^2	*df*	*p*
CONSULT	10[11.08]	8[6.92]	0.51	1	.477
NO CONSULT	14[12.92]	7[8.08]			

Observed and Expected Frequencies for HF Readmission and Time Period 2

	31 to 91 Days HF READMISSION				
HF CONSULT	NO	YES	χ^2	*df*	*p*
CONSULT	12[10.62]	6[7.38]	0.82	1	.366
NO CONSULT	11[12.38]	10[8.62]			

Observed and Expected Frequencies for HF Readmission and Time Period 3

	91 to 120 Days HF READMISSION				
HF CONSULT	NO	YES	χ^2	*df*	*p*
CONSULT	17[14.77]	1[3.23]	3.49	1	.062
NO CONSULT	15[17.23]	6[3.77]			

Appendix F

Project Results: GDMT Results

Table F1
GDMT Results

Frequency Table for Level of GDMT by Time Period

Variable	*n*	*%*
0 to 30 days GDMT LEVEL		
MONO	12	30.77
DUAL	14	35.90
TRIPLE	10	25.64
QUAD	1	2.56
NONE	2	5.13
31 to 90 days GDMT LEVEL		
MONO	12	30.77
DUAL	15	38.46
TRIPLE	7	17.95
QUAD	4	10.26
NONE	1	2.56
91 to 120 days GDMT LEVEL		
MONO	13	33.33
DUAL	12	30.77
TRIPLE	6	15.38
QUAD	6	15.38
NONE	2	5.13

Note. Due to rounding errors, percentages may not equal 100%.

Observed and Expected Frequencies of Consult compared with GDMT Level of Administration

	HF CONSULT				
0 to 30 days GDMT LEVEL	YES	NO	χ^2	*df*	*p*
NONE	1[0.92]	1[1.08]	2.80	4	.591
MONO	4[5.54]	8[6.46]			
DUAL	6[6.46]	8[7.54]			
TRIPLE	6[4.62]	4[5.38]			
QUAD	1[0.46]	0[0.54]			

Note. Values formatted as Observed [Expected].

Observed and Expected Frequencies of Consult compared with GDMT Level of Administration

	HF CONSULT				
31 to 90 days GDMT LEVEL	YES	NO	χ^2	*df*	*p*
NONE	1[0.46]	0[0.54]	2.86	4	.581
MONO	5[5.54]	7[6.46]			
DUAL	6[6.92]	9[8.08]			
TRIPLE	3[3.23]	4[3.77]			
QUAD	3[1.85]	1[2.15]			

Note. Values formatted as Observed [Expected].

Observed and Expected Frequencies of Consult compared with GDMT Level of Administration

	HF CONSULT				
91 to 120 days GDMT LEVEL	YES	NO	χ^2	*df*	*p*
NONE	1[0.92]	1[1.08]	0.85	4	.931
MONO	7[6.00]	6[7.00]			
DUAL	5[5.54]	7[6.46]			
TRIPLE	2[2.77]	4[3.23]			
QUAD	3[2.77]	3[3.23]			

Note. Values formatted as Observed [Expected].

Appendix G

Project Results: Ejection Fraction Results

Table G1

Ejection Fraction Results

Two-Tailed Paired Samples t-Test for the Difference Between Baseline EF and EF at follow-up

BASELINE EF		FOLLOW UP EF				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
40.92	14.31	35.53	11.59	2.80	.008	0.45

Note. N = 39. Degrees of Freedom for the *t*-statistic = 38. *d* represents Cohen's *d.*

Summary Statistics Table for Intention-To-Treat

Variable	*M*	*SD*	*n*	Min	Max	*Mdn*
FOLLOW UP EF	28.87	19.42	39	0.00	64.00	32.00

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.