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Identification and Screening of Iron Deficiency in Heart Failure

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Identification and Screening of Iron Deficiency in Heart Failure

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Dedication

This doctoral project is dedicated to the Nursing Department at West Chester University for assistance and support in the preparation of this manuscript.

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Abstract

Without prompt identification, screening and treatment of iron deficiency (ID), patients with heart failure (HF) will continue to struggle with poor health and higher health care utilization, impacting patient-centered and health care outcomes. This is particularly concerning in rural areas with limited access to services, especially for those who cannot easily leave the home for medical care. Currently, comorbid ID remains under-detected and under-treated yet current evidence supports treatment in patients with HF for the improvement of symptoms. It is not known if patients with all types of HF could benefit from oral iron in the home setting, but those patients at-risk must first be identified for screening and treatment purposes. The aim of this quality improvement project was to retrospectively review data to understand the impact of an algorithm to identify and to treat ID in this population. Descriptive data points were demographics, types of HF, anemia treatment and utilization but were not collected and analyzed for this DNP project due to a student contract impasse. Considerations and recommendations for future projects are discussed.

Keywords: heart failure, iron deficiency, rural, quality improvement

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Chapter 1
Introduction and Background

Background

Up to 50% of patients with heart failure (HF) may suffer from iron deficiency (ID) and can be unaware that this contributes to worsening symptoms and outcomes. Providers also do not have a reliable evidence-based process by which to identify these at-risk patients to ensure they receive optimal care and treatment of ID; specifically, those patients who live in rural counties in the mid-Atlantic region with limited access to care and to services may need enhanced oversight to reduce barriers to and gaps in care. Without prompt identification, screening and treatment of ID, patients with HF will continue to struggle with poor health and higher health care utilization, impacting patient-centered and health care outcomes.

Heart failure is a common diagnosis in the elderly population with rising prevalence and morbidity with increasing cost of care, both individually and organizationally. Heart failure readmissions are particularly costly to health systems in the current U.S. era of value-based payment models when hospitals can be penalized for readmissions within 30 days. It is a complex disorder with multiple contributing factors and many specialists should be involved in care decisions (Maddox et al., 2021).

Significance

Currently, comorbid ID remains under-detected and under-treated yet current evidence supports treatment in patients with HF for the improvement of symptoms (Silver &

Anker, 2021). Thus, international and U.S. cardiology organizations are focusing efforts at improving care through guideline-directed medical therapies among which is the treatment of ID (Maddox et al., 2021). A treatment algorithm exists for patients with ID in the outpatient setting. However, not all HF patients are captured in that setting, including those living at home in rural communities.

Multidisciplinary home-based programs for patients with chronic illness who live in rural counties have been developed by large health care systems to address this at-risk population. One innovative program has proven to be effective in reducing health care utilization. There have been reductions in hospital admissions among targeted home-based patients which translates to a healthier community. The ongoing challenge is to create proactive clinical interventions to favor outcomes, and not simply follow an acute response to HF decompensation with utilization of health care resources.

Traditionally, these home-based programs have strong institutional support. Hospital-based clinics often collaborate with outpatient providers to identify gaps in care in this home population and assist with treatment design utilizing evidence-based algorithms. From this collaboration, gaps in care for patients at home with HF who may have ID can be identified. Targeting these patients with an evidence-based process is often a clinical and organizational priority.

Treatment

Current evidence supports the use of intravenous (IV) iron in patients with a specific subtype of HF and ID to reduce poor outcomes (Anker et al., 2018; Jankowska et al., 2016). Clinical trials are ongoing; it is unknown if all patients with HF will need IV iron. Yet, there

are still unmet needs in current practice; treatment may not always be accessible to patients who live in rural areas with limited transportation to outpatient specialty practices or to clinics within hospitals. Furthermore, those at-risk patients may also be missing routine follow up visits with specialty providers on a regular basis, supporting the urgency to identify ID in patients in home-based programs. Such a program provides a critical safety net and is well- positioned to collaborate with a hospital-based clinic to facilitate iron administration in the home, if indicated.

The need for ID screening is high. Many patients from rural areas do not follow up with providers on a regular basis and may miss even basic blood work that can identify anemia. Thus, the at-risk patients with HF need to be identified, screened and treated for ID utilizing a standardized treatment algorithm. Patients are often treated with oral iron for 8 weeks, then laboratory testing is repeated until clinical targets are achieved. Some patients may receive IV iron; some patients could be excluded from treatment for other medical conditions.

Quality Improvement

Iron deficiency is not a benign condition to be ignored or minimized. In general, HF patients want to feel better, have fewer daily symptoms and stay out of the hospital. Improvement in symptoms is one key reason to administer iron (Maddox et al., 2021). It is not known how these rural patients with HF experience ID. There are current HF-specific assessments available to evaluate patient symptom burden related to ID, including exercise tolerance. Thus, utilization of a validated HF tool may be important to consider to improve patient-centered care and prognostication which are linked to outcome metrics.

This project will utilize Donabedian's model of quality improvement following the structure, process, outcome (SPO) framework. This model is explained in depth in the literature review. There is usually strong institutional support for quality improvement, thus a process application would be a logical next step. To assess the effect of the process to identify, screen and treat patients with HF for ID, data need to be collected for analysis. Therefore, the aim of this quality improvement project will be to retrospectively review data to understand the impact of the process to identify and to treat this population. Descriptive data points including demographics, HF types and anemia treatment will be collected.

It is not known if patients with all types of HF could benefit from oral iron in the home setting, but those patients at-risk must first be identified for screening and treatment purposes. The data may support the development of a best-practice alert in the electronic health record for providers in home programs to assist in the quality care of patients with HF, alerting the care teams for routine blood work in patients with HF. In addition, symptom assessment related to HF and ID may not be currently collected. Thus, there may be a gap in monitoring of patient symptom burden, supporting the use of a validated tool in the home setting for additional metrics. Without this project, HF patients may not be screened for ID in a coordinated, timely way and may continue with disease progression and high health care expenditures.

Chapter 2

Literature Review

Overview

This chapter will include: an overview of the problem, a section of definitions and concepts, an explanation of the theoretical framework guiding this project, a review of the search strategy in the review of the literature, a critical appraisal of the current literature and a summary with identified gaps in the research and proposal of the current project.

Problem

Heart failure (HF) is a chronic illness with rising prevalence in the United States (U.S.) that utilizes high healthcare resources, greatly affects morbidity and mortality, and impacts quality of life, often later in life in persons with multiple comorbidities. In 2009, Djousse, Driver, & Gaziano estimated 1 in every 5 adults aged 40 years will develop HF in the future. Prevalence continues to rise over time with approximately 6 million American adults at or above age 20 being affected according to 2015-2018 data and is higher in women than men at or over the age of 80 years. The estimated direct cost of cardiovascular disease increased from $103.5 billion in 1996 to 1997 to $216 billion in 2016 to 2017 (Virani et al., 2021). Comorbidities are associated with increased symptom and functional burden, may contribute to the progression of disease and may impact prognosis. Currently, up to 50% of patients with HF have a comorbid diagnosis of iron deficiency (ID). To provide optimal care, clinicians must consider the treatment of this condition in addition to utilizing the most current evidence-based therapies in HF management (Maddox et al., 2021, von Haehling et al., 2019; Silver & Anker, 2021).

In 2013, organizational guidelines were developed to define objectives and to shape

the course of HF treatment utilizing the most current data. The most recent treatment guidelines from the American College of Cardiology (ACC), American Heart Association (AHA), and Heart Failure Society of America (HFSA) are updating this year to reflect current evidence in HF treatments and to enhance patient-centered care; guidelines and algorithms from 2017 are being been revised to include the most recent advances in guideline-directed medical therapy (GDMT) from the ACC Expert Consensus Decision Pathway (ECDP) for Optimization of Heart Failure Treatment with an updated list of pivotal issues in HF management, including care coordination and comorbidity treatment (Bozkurt et al., 2021; Maadox et al., 2021; Virani et al., 2021).

With underlying systemic inflammatory activation, patients with HF are at an increased risk of developing ID, and ID is related to impaired oxidative metabolism and decreased oxygen storage in myoglobin; additionally, the presence of ID is an independent predictor of worse survival. Furthermore, anemia prevalence in patients with more advanced HF is under detected and undertreated (Silver & Anker, 2021; von Haeling et al., 2019). Screening and identifying HF patients for ID using established clinical criteria and treating those patients with iron replacement is a current evidence-based strategy to improve patient and health system outcomes; however, there is no current established algorithm outlining the optimal time of screening for ID in patients with HF in the home setting. Thus, affected symptomatic patients may miss this critical intervention, potentially impacting patient and health system outcomes.

Definitions

According to the universal definition by the HFSA, HF is defined as a clinical syndrome with prior or current symptoms caused by a structural and/or functional cardiac abnormality and corroborated by an elevated B-type NS natriuretic peptide (BNP) or objective evidence of pulmonary or systemic congestion (Bozkurt et al., 2021). Heart failure is a complex clinical syndrome that impairs the ability of the lower heart chamber or ventricle to fill with or to eject blood and is a constellation of symptoms produced in response to cardiac dysfunction; as HF advances, remodeling of the ventricles impacts the ability of the heart to pump or fill effectively resulting in increased symptoms and worse outcomes (Yancy et al., 2013).

Heart failure can be classified by symptoms and by the ventricular ejection fraction (EF) which is documented as the percentage of blood pumped out of the heart during each contraction. Heart failure is defined for this project using the New York Heart Association (NYHA) four stages which focus on exercise capacity and symptomatic status which assists clinicians in providing the most appropriate GDMT. The NYHA class I patients have no symptoms at rest and can perform ordinary activities without any limitations; class II patients have mild symptoms with somewhat limited ability to exercise with no symptoms at rest; class III patients have moderate limitations in the ability to exercise and are comfortable only at rest; and class IV patients have symptoms at rest and cannot do any activities without discomfort.

A normal EF of the ventricle is > 55%. In HF, reduced EF to < 40% is defined as HF with reduced EF(HFrEF); HF with an EF between 40% to 49% is defined as mildly reduced EF (HFmrEF) and HF with preserved EF > 50% is shown as HFpEF (Bozkurt et al., 2021).

Although somewhat generalizable to all HF patients, the ECDP focuses on patients with chronic ambulatory HF with an EF of less than or equal to 40%. The ECDP reports an association of iron deficiency to heart failure outcomes and suggests clinicians may consider intravenous (IV) iron replacement for symptom improvement in this cohort.

Screening is utilized in a stable setting to look for an abnormality in this HF population as it significantly impacts underlying health issues and risks of progression (Silver & Anker, 2021). Iron deficiency in HF patients is defined by blood work obtained through a recent complete blood count (CBC) with hemoglobin (hgb) < 13 g/dl in males and < 12 g/dl in women. These criteria are supported by the World Health Organization. A serum ferritin level < 100 mcg/L or ferritin level between 100-299 mcg/L with transferrin saturation (TSat) < 20% (von Haehling et al., 2019) is also needed for diagnosis.

Patients to be enrolled in this project would receive care through a health system-supported home program (HP) which includes a physician, advanced practice provider/nurse practitioner (NP), a registered nurse (RN) and community health workers (CHW). This HP would serve a vulnerable rural population with limited access to and gaps in care. The health system would support\ a hospital-based clinic managed by a registered pharmacist (RPh); this clinic would collaboratively treat HF patients with confirmed ID with IV iron in the home providing follow up monitoring for 6 months, thus reducing a significant barrier to treatment for IV iron. The HP would follow an algorithm to screen and to treat patients with chronic stable HF and ID; chronic HF is defined as current euvolemic status with no hospitalization in past 3 months. Clinicians in the HP would determine the etiology of ID and refer to specialists as appropriate. If the patient with HF needs iron replacement, then

the physician or NP orders oral ferrous sulfate 325 mg daily for 8 weeks. If a patient would fail to tolerate dosing, to respond by improved symptoms or by target hemoglobin, or TSat < 20%, then the patient could be referred to the hospital clinic for IV iron infusion. However, if the patient has underlying comorbidities where initial oral iron supplementation is not appropriate, then the patient could be referred directly to the hospital clinic for home administration of IV iron (Silverberg et al., 2015).

Theoretical Framework

Quality improvement practices can reduce disparities in health outcomes among patients with ID and HF who live at home with restricted access to care and to treatment. Coordinated care can reduce hospitalizations, cost and improve quality of care; understanding and utilizing current organizational structural characteristics can shape health system processes to improve outcomes (Lawson & Yazdany, 2012; Liu et al., 2011). Thus, Donabedian's model for the assessment of health care quality and improvement utilizing a structure-process-outcome (SPO) framework will be employed in this project.

There may exist a gap in the process for detecting and treating patients with HF and ID enrolled in a rural HP. A large Mid-Atlantic health system should have the necessary organizational infrastructure to design and implement an evidence-based algorithm targeting vulnerable patients with HF and ID in a home setting using the electronic health record (EHR) for patient selection criteria with the integration and application of standardized processes which reflect evidence-based practices that may potentially influence outcomes. Improvement in care processes must be strongly linked to health outcomes to assure validity of quality metrics (Lawson & Yazdany, 2011). Retrospective data analysis for this project

may capture measurable elements of practice performance which can be applied to change the quality of care for this vulnerable population. Patient-centered outcomes should also be considered as a meaningful metric given the significant symptom burden of HF in patients with ID and the potential to influence utilization and prognostication.

Search Strategy

With the assistance of a hospital research librarian, the literature search was conducted through CINAHL, PubMed and Cochrane Library databases with English-only, peer-reviewed, full-text articles from January 2010 to September 2021 with the following keywords, phrases with the Boolean characters AND, OR: systolic, heart failure, iron deficiency, home, management. The search yielded 290 articles; after excluding acute heart failure and hospitalization, 40 articles were in European journals, 16 in European supplements, 11 in Journal of Cardiac Failure, 10 in Circulation, 8 in Heart, Lung and Circulation and 7 in Journal of the American College of Cardiology. Fifteen were included for the review. Literature that did not include trials were reviewed, including professional society guidelines and expert analyses. Manual reference list searches yielded another 7 articles for review.

Critical Appraisal of the Literature

It is important to understand the fundamentals of iron replacement when reviewing data. Iron deficit is calculated by Ganzoni's formula published in 1970 and is weight based. The calculated result is usually 1,000 mg or higher in most cases and IV iron dosages are usually administered at a dose to replenish iron stores. Small amounts of iron are absorbed in the gut and up to 40% of patients experience side effects affecting adherence;

replenishment of iron stores usually takes 2 to 6 months, thus the majority of the early studies utilized IV iron preparations (von Haehling et al., 2019).

As ID is linked to cardiac function, the past several decades has seen an increasing interest in the study of anemia and ID in HF patients as prevalence continues to rise. The first studies in 1990s such as the Reduction of Events by Darbepoetin Alfa in Heart Failure Trial (RED-HF) clinical trial examined exercise tolerance in patients in Tel Aviv. Using iron sucrose and subcutaneous erythropoietin, the findings showed no mortality benefit and an increased rate of serious thromboembolic events using target peripheral hemoglobin > 13 g/dl in patients receiving darbepoetin-alfa than in patients receiving the placebo. After the published results, the use of erythrocyte-stimulating agents in trials declined (von Haehling et al., 2019).

Studies with controlled trials continued with varying enrollment, length of duration, classes of HF, hemoglobin criteria and iron preparation. Several early studies had very low enrollment. The Effects of Intravenous Iron Sucrose on Exercise Tolerance in Anemic and Nonanemic Patients with Symptomatic Chronic Heart Failure and Iron Deficiency Study (FERRIC-HF) with 35 patients used NYHA class II-III patients with EF < 45 % and hgb < 12.5 in the anemic group with iron sucrose given 200mg weekly until ferritin > 500 ng/ml. Patients completed the study in 16 weeks. Toblli et al. published a randomized control study in 2007 including 40 patients with EF < 35 % and NYHA class II-IV and hemoglobin < 12.5 g/dl, and the total iron given was 1000 mg of iron sucrose over 5 weeks. Primary endpoint was change in BNP and inflammatory markers by clinical laboratory testing; however, larger studies with statistical significance were needed.

Several studies recruited significant numbers of patients and were later included in two meta-analyses. The first large-scale, double-blind, placebo-controlled multicenter trial of ferric carboxymaltose (FCM) in patients with chronic HF, known as Ferinject Assessment in Patients with Iron Deficiency and Chronic Heart Failure (FAIR-HF) Trial, was published in 2009; 459 patients with NYHA class II and EF < 40% or class III with LVEF and EF < 45% with hgb > 9.5 g/dl and < 13.5 g/dl were treated in the correction phase of ID using 200mg weekly doses followed by a maintenance phase with monthly FCM doses. Outcomes were improved quality of life and exercise tolerance. These findings supported the use of IV iron with recommendations to consider FCM for ID in HF patients in the 2012 European Society of Cardiology guidelines.

The second large-scale trial of FCM in HF patients was known as the Ferric Carboxymaltose Evaluation on Performance in Patients with Iron Deficiency in Combination with Chronic Heart Failure Study (CONFIRM-HF) which enrolled 304 patients with similar HF class and EF to those in FAIR-HF trial, with duration of 52 weeks. Patients received between 500 mg and 2,000 mg of FCM or placebo in first weeks then received 500mg of FCM in weeks 12, 24, and 36 if ferritin and or TSat still reflected ID. Outcomes showed increase in 6-minute walking distance from baseline to 24 weeks that was maintained to week 52.

The first meta-analysis of IV iron use in HF patients was published in the European Journal of Heart Failure by Jankowska et al. in 2016. This review included 5 clinical studies with total enrollment of 851 patients, 509 of whom received iron sucrose or FCM. This analysis showed IV iron was found to reduce the risk of hospitalization for patients with

HFrEF. The study also supported a reduction in NYHA functional class, increase in 6-minute walk test and improved quality of life scores using different assessment tools.

The second meta-analysis was published by Anker et al. in 2018, also in the European Journal of Heart Failure. Patient data were extracted from 4 random-controlled trials comparing FCM with placebo in HFrEF patients with ID. This analysis of 839 patients, of whom 504 were randomized to FCM, showed patients on FCM had lower rates of recurrent cardiovascular hospitalizations and cardiovascular mortality which suggested the beneficial effects of IV iron treatment in HF patients. This analysis led the development of the prospective FAIR-HF II trial which is ongoing with target enrollment of 1,200 HF patients.

Recommendation by the ACC to consider IV iron replacement in patients with NYHA class II and III with ID to improve functional status and quality of life was included in 2017 updated guidelines with level IIb evidence (Yancy et al., 2017). The ACC does not mention a certain IV iron preparation but the European guidelines advocate only for the use of FCM. It is noted that the same manufacturer of FCM sponsored the FAIR-HF and CONFIRM-HF trials (Ghafourian et al, 2020). Currently, ACC guidelines in 2021 support the administration of IV iron for symptom improvement in patients with HFrEF and ID (Maddox et al, 2021). Thus, it is important to include patient assessment in the treatment of ID.

Studies of oral iron use in HF patients with ID are very limited. This may represent funding and recruitment issues. The first oral iron study was in 2013, known as Short Term Oral Iron Supplementation in Systolic Heart Failure Patients Suffering from Iron Deficiency Anemia (IRON 5), that randomized patients to one of three groups: one was given oral

ferrous sulfate therapy and one was given IV iron sucrose or placebo; oral iron was given for 8 weeks and IV iron over 5 weeks. The study ended early with only 23 patients in the database. The second trial with oral iron was between 2014-2015 in 23 US sites, known as the Oral Iron Repletion Effects on Oxygen Uptake in Heart Failure (IRONOUT HF) study, of 225 randomized HF patients with EF < 40% with ID who were given oral iron polysaccharide 150mg twice a day over 16 weeks with no significant increase in peak oxygen uptake or improved 6-minute walk test. Although mildly increased serum ferritin and TSat levels were noted, those findings were not considered sufficient to recommend oral dosing in ID treatment (Lewis et al., 2017).

Research gaps

Additional studies are being designed and conducted to evaluate the benefits of different iron preparations and in different HF types. It is not known if HF patients with HFpEF respond to IV iron with similar findings in HFrEF patients. In review of the current studies, there is a wide variation of EF criteria, hgb measurements, BNP collection, duration of study, and dosages of iron (McDonagh, 2016).

In the recent expert analysis of anemia and HF by Silver and Anker (2021), the authors acknowledge the need for a stronger definition of anemia and ID in HF and better measurement of ID with ongoing efforts to detect and to treat ID. Patients with HF are not being identified and targeted for treatment which has far-reaching implications. Thus, efforts to reduce current gaps in awareness of anemia prevalence in HF must be a priority in practice. As researchers continue to look for best evidence, utilization of the current HF guidelines will continue to inform practice and to improve awareness and care. However,

we must be certain to include measurement of patient-related outcomes such as life quality and days out of the hospital. These health system metrics are needed to accurately capture meaningful data.

It is vitally important to document patient outcomes, especially if those outcomes are targets of treatment. The quality-of-life parameters of each HF tool were not fully explored in the studies. The majority of studies utilized several assessment tools but the full explanation of response variations was not reviewed. Several tools were mentioned such as the Kansas City Cardiomyopathy Questionnaire, Patient Global Assessment, and Minnesota Living with Heart Failure Questionnaire, all of which are validated and useful tools to assess HF symptom burden and quality of life measures. More research is needed to understand how to integrate these tools into clinical practice and to assess the impact on patient care (Spertus et al, 2015; Yee et al., 2019).

Purpose of Project

There is a need to explore the scope of undetected and untreated patients with HF and ID in the rural home setting (Silver & Anker, 2021). Untreated ID impacts patient quality of life experiences and can worsen disease burden. This project will examine the screening and treatment process of patients with HF and comorbid ID. It will be limited to those currently enrolled in a rural HP who are agreeable to take iron supplements and to utilize home phlebotomy for standardized blood work collection. The findings will be described by a retrospective analysis to understand trends in demographics, HF class, referrals to hospital clinic, and health care utilization with practice implications and recommendations.

Donabedian's model is a natural fit for this quality improvement project. There is

generally strong infrastructure within a large health system to support the process development of a refined algorithm. The oral and IV iron would be covered by patient insurance; IV iron could be ordered and administered at home by a hospital clinic pharmacist in contact with HP providers, greatly reducing a well-known barrier to access. This project could lead to a best-practice protocol to formalize detection, screening and treatment of HF patients with ID to improve system and practice awareness and outcomes.

Chapter 3

Methodology

Quality Improvement Framework

Donabedian's theoretical framework for quality improvement (QI) initiatives will be applied for this project, using the SPO approach. The aim of this QI project is to analyze the process by which patients with HF and ID are identified and treated using an algorithm with current best-practices to shape outcomes. In this project, the structure is well-established by institutional support; thus, the process, if correctly implemented, should lead to a positive outcome, such as target hemoglobin and best practice advice in the electronic health record for patients enrolled in home-based program.

Many patients have a diagnosis of HF which is leading cause of hospital admissions, emergency room utilization, and reduced quality of life. An institution-supported program would provide the structure for this project; there is generally strong emphasis on innovation in large health systems to utilize current evidence to inform practice. A multi-disciplinary, home-based program for patients enrolled with serious and chronic illnesses is an ideal setting with the goal to improve access to services and to reduce utilization.

Setting

This QI project will focus on patients enrolled in a rural mid-Atlantic HP from August 2021 through March 2022. The HP covers several counties where access to care may be limited and health literacy may be low. The HP employs a multi-disciplinary team of medical providers, nursing staff, social workers, and dietician.

This QI project is supported by the health system administration, HP leadership and the regional clinicians; site support for this project will be obtained by the HP medical

director and health system nursing research council (see Appendix A). The medical director is responsible for the QI project workflow design and implementation in collaboration with the hospital-based clinic. Working closely with the information technology (IT) team for the health system, the HP project clinical team is assisted with data support including patient identification in the EHR and clinical indicators. The health system uses a biomedical statistician for data analysis who would be recruited for this project to assure data accuracy and patient confidentiality.

For this project, several hundred patients would be eligible with a diagnosis of HF; however, a much smaller number have defined anemia. The cost of this project for staffing will be supported by the HP administration, and patient medication and blood work are covered by health insurance. Mobile phlebotomy would be utilized for access to patients at home and for consistency in laboratory reporting. Home infusion of IV iron would also be covered by insurance and supported by the health system infrastructure.

Sample

Prior to August 2021, identified patients with HF and ID were treated by the hospital clinic utilizing their evidence-based algorithm; after which time, the HP medical director worked with health system IT to identify patients with HF in all covered counties of the HP who did not have a CBC in the past year and were also identified to be iron deficient by blood testing. Following an algorithm, patients to be included for this project must be over the age of 18 years with an established diagnosis of HF in chronic, not acute or decompensated, condition with anemia and iron deficiency. All patients must have health insurance. Patients to be excluded are those with an active malignancy or other comorbid

conditions, such as kidney failure, which put them in an unstable, high-risk category for urgent referral or specialist treatment. Also, patients may refuse to accept oral or IV iron.

Ethical Considerations

Informed consent will not be required as these patients are participating in a QI project and not research. On November 1, 2021, the Institutional Review Board (IRB) of the health system approved this project for QI (see Appendix B). All patients who meet criteria will be offered treatment or referral, as indicated. To protect patient data in the EHR, only project participants will have secure access to patient data related to the project and data will be de-identified during collection for statistical purposes; all laboratory testing and clinical notes in the EHR will be available to all pertinent parties related to patient care. After data collection, analysis and project completion, all de-identified data logs will be destroyed according to institutional and federal guidelines.

Methods

Patients are identified by the HP algorithm. The HP approach differs from the hospital clinic algorithm in that all HF patients are included, not only patients with HFrEF, who are usually included in clinical trials and targeted in guidelines. However, more research is needed. Thus, those patients with all types of HF, with anemia and defined iron deficiency, would be offered oral iron sulfate 325mg daily for 8 weeks, after discussion between the individual clinician and the patient for the most appropriate and patient-centered care. Some patients might receive IV iron if it is determined to be the most appropriate treatment. Patients would be discharged from treatment when target hemoglobin is reached by blood analysis.

Data collection

After obtaining a student organizational contract, data are reviewed retrospectively to analyze the effect of the process to identify, screen and treat patients with HF and ID at home with oral or IV iron to target hemoglobin. Data will be obtained from the EHR by the project medical director and select support staff, minimizing the risk of error in computation. Data will be reviewed for completeness. There is no tool to score. Data will be secured in a desktop computer and locked office accessible only by project staff. West Chester University Institutional Review Board submission and acceptance will be secured (see Appendix C).

Data Analysis

To analyze the results, the data will be de-identified and entered in an Excel spreadsheet. Descriptive statistics will be analyzed with the assistance and supervision of a biostatistician who is employed by the organization or by statisticians in training under supervision. Dissemination of findings will be presented to the organization and to West Chester University faculty after securing a student contract. Practice implications and recommendations for improvement and for future nursing research will be detailed.

Chapter 4
Results

Data Collection

The results of data collection and analysis for this quality improvement project were planned by a retrospective analysis of demographics, clinical data and utilization markers over 8 months to show the effect of a process to influence outcomes in patients enrolled in a rural home program with HF and ID. All patients were diagnosed with HF, and the majority of target populations met criteria for anemia with the exception of patients with no blood work in past year. The HP medical director, HP pharmacist and advanced practice providers were responsible for ordering and interpreting blood work, ordering oral iron, placing referrals to the anemia clinic or other specialists, and for follow up.

The medical director and clinical team met regularly to discuss the current monthly findings, to review progress and to address issues. It became clear that a more refined anemia algorithm was needed and a health system-employed hematologist was consulted for project discussion, specifically to define which patients should not receive iron and when a referral to hematology was needed. This refined algorithm is being developed.

For the quality improvement project, the data points included sex, hemoglobin measurement, treatment with oral iron, referrals to hospital clinic for IV iron, length of treatment and health system utilization. The health system supported the analysis by collaborating with an information technologist and statistician employed by the organization but who were not involved in daily project oversight. Anticipated process outcomes were favorable to support the use of this algorithm to identify and treat patients in the home program.

Data Analysis

This project was initially supported by the organization and by the HP leadership; however, data analysis was not completed as anticipated due to a student contract impasse which prevented the computation, analysis, and reporting of organizational data. The HP medical director for the QI project will review data and present to the organization which may lead to a research project. In follow up, an institutional review board application may be submitted to evaluate the outcomes further in a formal cohort study.

This project could also lead to an EHR-supported best practice advice for clinicians treating HF patients enrolled in the HP to ensure patients are properly identified, screened and treated for ID at least on an annual basis which can be measured. Additionally, a patient-centered symptom assessment tool for HF patients could also be utilized to assess the effect of ID-related symptom burden in patients at home. This tool could also be shared with the outpatient cardiology teams for deployment and system-wide outcomes measurement.

Chapter 5

Discussion

Review

Heart failure is a common diagnosis with high morbidity in the U.S. and professional organizations have developed guidelines to target therapeutics. Outcomes, both patient-centered and organizational, are affected. To reduce hospital readmissions related to HF, organizations across the US are tasked with investigating novel approaches to care.

As HF is linked to underlying systemic inflammation, certain comorbid diagnoses have the potential to impact the disease trajectory. Anemia with iron deficiency can worsen symptom burden and clinical outcomes in patients with HF yet ID continues to be under-recognized and under-treated. It is not known how often a patient should be assessed for ID. Clinical trials are ongoing to determine best evidence; the majority of trials targeted patients with HFrEF and utilized IV iron which may not always be practical or available to the community at-large. However, trials with oral iron were limited in number and enrollment. Thus, rural homebound patients may be even further limited in treatment options; it is imperative to identify and to treat those at risk to improve outcomes and quality of life, especially in vulnerable populations who lack access to care and to treatment.

Findings

This project is supported by Donabedian's SPO framework and outcomes should reflect the validity of the structure and process being applied. The setting within this organization with rural home-based patients and the use of a clinical algorithm from late 2021 should have led to outcomes which supported identification and screening for ID in

patients with HF. However, the process could not be fully assessed by descriptive data as planned due to a student contract impasse. It is known that HF patients in a rural HP were identified as being anemic and iron deficient. In application of the algorithm, appropriate patients were evaluated. Full treatment with iron takes several months for repletion.

The most recent literature findings and clinical guidelines support repletion of iron in HF patients with ID for symptom management. There is limited evidence for oral iron in ID with HF but studies are ongoing. It is not known how many patients were successfully treated with oral iron and for which types of HF and how many were referred to the hospital clinic to arrange IV iron at home. Yet, patients were identified for screening; this project may demonstrate the need for an algorithm to consistently identify those vulnerable patients who may miss routine screening of and treatment for ID.

Implications for Practice, Education and Policy

This clinical algorithm could be important for HP clinicians to have a process by which to identify at-risk patients; the development of a best practice alert in the EHR could prompt a clinician to order routine blood work at least annually for any patient with HF who has not had blood work in past year to identify anemia, after which the algorithm could be followed for ID treatment. Patient education can be tailored to treatment adherence and to reporting of side effects, a frequent cause of treatment failure with oral iron. Home program nurses involved in patient care could make weekly phone calls to assess for side effects and the HP pharmacist can track adherence also by monthly refills, if covered by insurance and not purchased out of pocket.

Worsening HF symptoms are important for assessment and for treatment. Patients

must also be aware of worrisome symptoms to report for ID to be detected. Patient education with an evidence-based HF tool such as the Kansas City Cardiomyopathy Questionnaire (KCCM) can empower patients to self-report and may be helpful to employ in the home setting and in HF clinics for data measurement. However, it would need to be approved by the health system and employed HF specialists before system-wide deployment; IT could link it to the EHR for data tracking. Nurses and CHW could introduce the KCCM at home for completion and to answer questions in person and later follow up with a 6-minute walking test every month to assess exercise tolerance with ID. The KCCM could be added to each clinical progress note with findings that can be retrieved later in the EHR for outcomes measurement; furthermore, the HP staff and outpatient palliative care and HF teams can draft a policy to use the KCCM for symptom burden and quality of life assessment with all HF patients, adding to health system outcomes data.

Future Research

A prospective cohort study with a similar HF population for comparison would be necessary to study the impact of identification and treatment of ID for statistical significance. Clinical trials in the U.S. are ongoing to determine which types of HF respond to treatment and the clinical significance of treatments. It is not known how frequently patients with HF should be assessed for ID and which treatments should be offered for clinical benefit. More research is needed in patient-centered care with HF treatment and in utilization of evidence-based HF assessment tools for outcomes measurements.

Limitations

Only active patients from the HP over several months were included in this project.

Patients from a rural area in the mid-Atlantic region may not be representative of HF patients with ID in other rural areas of U.S. The HF patients in this project had the unique support and infrastructure of a multi-disciplinary HP and a hospital-based clinic through which to administer IV iron at home that may not be available or possible in other U.S. regions.

Conclusion

Although this quality improvement project was not completed through data analysis, the anticipated outcomes of this project reinforce the importance of a standardized process by which rural HF patients in a home setting are identified for anemia then screened and treated for ID to reduce utilization and to reach target clinical goals. It is based on a validated SPO framework. This is an important project to consider for advanced practice clinicians who serve in rural areas to reduce poor outcomes by impacting disease progression and for researchers to add to the clinical body of knowledge to improve care and outcomes. It brings awareness to an area of under-detection that has far-reaching implications for health systems and patient-centered outcomes. Nurses continue to play a pivotal role in reducing disparities, improving care trends, and advancing health.

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Appendix A

Nursing Research Council

M.C. 01-51
100 North Academy Avenue
Danville, PA 17822
570-214-8077
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October 18, 2021
Dear Anne,
Please accept this Tracking Number 2021-15 as verification of the Nursing Research Council's (NRC's) review of the research proposal**:** "Retrospective Analysis: Review of Geisinger Anemic Clinic Project to Reduce Iron Deficiency in Patients with Comorbid Systolic Heart Failure Enrolled in Geisinger at Home"**.**
The study was reviewed and approved by the Nursing Research Council on, October 18, 2021. The IRB requires the following be completed for all nursing research proposals:
-Enter the tracking number **2021-15** in IRIS when creating your study.
The NRC would like to be informed of your results as well as any feedback about conducting this research study. Please submit a summary of your findings, their implications for nursing, and your plan for dissemination to nrc@geisinger.edu.

Please contact me with any questions.

Thank you,

SarahEvans,DNPMSNRN
GaleShalongoDNP,MSN,RN
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Appendix B

Geisinger Institutional Review Board (GIRB)
FWA # 00000063 IRB# 00008345
100 N. Academy Avenue
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570-271-8663
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IRB Determination Notice
Activity Does Not Meet the Definition "Research"

November 01, 2021
Houssam Abdul-Al, MD
GMC - Medicine Administration

IRB **#: 2021-0885 (Geisinger at Home Anemia Project)**, entitled **Retrospective Analysis: Review of Geisinger Anemia Clinic Project to Reduce Iron Deficiency in Patients with Comorbid Systolic Heart Failure Enrolled in Geisinger at Home**

RE: Initial Review Submission Form, 10/28/2021 04:47:22 PM EDT
Dear Houssam Abdul-Al, MD:
The above proposal was reviewed on by Geisinger IRB staff/member(s).
From the information you have provided, the proposal does not meet the definition of *Research* as defined in 45 CFR 46.102(d): *a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge*. Therefore, this proposal is not subject to human subjects research regulations and does not require oversight by Geisinger Institutional Review Board (GIRB). This means you do not need to submit your proposal to the IRB for further review/approval. However, this proposal may be subject to other non-research regulations, institutional policies or requirements.
If APPLICABLE: **Case reports** of 3 or less individuals are not research. However, Geisinger has other requirements that must be completed prior to submitting case report(s) for external presentation or publication:
 It is important to adhere to any applicable publication guidelines for informed consent.
 We recommend that you obtain permission from the patient(s) to use their information to generate your case report(s) using the *CONSENT FOR THE PUBLICATION OF MEDICAL IMAGES, RESULTS, AND CLINICAL INFORMATION IN A MEDICAL JOURNAL*.

Appendix C

IRB #: IRB-FY2022-139
Title: Retrospective Analysis: Review of Geisinger Anemia Clinic Project to Reduce Iron Deficiency in Patients with
Comorbid Systolic Heart Failure Enrolled in Geisinger at Home

Creation Date: 11-6-2021
End Date: 5-6-2022
Status: Approved
Principal Investigator: Cheryl Schlamb
Review Board: West Chester University Institutional Review Board
Sponsor:

Study History

Submission Type Initial Review Type Exempt Decision Exempt

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