Evaluation of Participation, Completion, and Barriers in Cardiac Rehabilitation: A Retrospective Data Analysis

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Abstract

Nature and Scope of the Project: Cardiac Rehabilitation (CR) is a program that patients are often referred to after having a cardiac related health event and has been shown to promote positive health outcomes. Barriers to participation increase the risk for poor patient outcomes. Objectives of this project were to identify barriers to participation in CR at an urban hospital, identify outcomes associated with CR participation and number of referrals to outside CR facilities, and evaluate patient interest in tele-CR.

Synthesis and Analysis of Supporting Literature: A solution to bypass barriers to CR participation is to utilize tele-CR. Kaiser Permanente found that most of its patients participating in tele-CR completed the full program, in comparison with non-tele-CR programs, and were associated with fewer negative outcomes (Wicklund, 2019).

Project Implementation: The project encompassed performing a retrospective data analysis of patients with a referral for CR at an urban hospital. A patient perception survey was also distributed at this hospital to assess interest in tele-CR. Challenges within this project included time associated with preparing and analyzing the large data set.

Evaluation Criteria: Evaluation criteria included identification of specific barriers to participation in CR within the hospital population. These patients were further assessed for rates of referral, subsequent cardiac hospitalizations and cardiac interventions, stress testing, and mortality. Additionally, patient perception surveys were gathered and evaluated to determine patient interest in tele-CR.

Outcomes: The most frequently noted barriers to CR participation included: “want/able to exercise at home,” “Covid-related concerns,” “interference with schedule,” and “health limitations.” Negative outcomes, specifically mortality rates, were found to be higher among

those who did not participate or complete CR. Furthermore, the study found patients had interest in tele-CR. Additionally, 44.2% of the hospital's eligible patients were referred to outside facilities for CR services.

Recommendations: The results of this study can be used for support in the development of a tele-CR program at the urban hospital. Additionally, this information can be utilized on a national level to advocate for continued Medicare coverage of telehealth, cross communication between electronic health records, and high speed internet access in vulnerable populations.

Cardiac Rehabilitation (CR) is a program in which patients participate after having a myocardial infarction or cardiac bypass surgery and for patients with frequent unstable angina, heart failure, and other select cardiac-related illnesses (Servey & Stephens, 2016). Participation in CR has proven to increase positive outcomes such as: decreasing the incidence of depression and reducing unplanned hospitalization, cardiovascular risk, and mortality rates (Servey & Stephens, 2016). Subsequently, CR has shown to increase functional capacity and quality of life in patients who participate (Servey & Stephens, 2016). Although CR has been proven to be beneficial for patients who qualify, barriers to CR participation are often present and have been determined to be extremely significant for patients who live in rural areas (Banner et al., 2019). For CR patients, poor attendance has been linked to geographic location, limited access to healthcare services, and transportation availability (Banner et al., 2019). Additionally, the Covid-19 pandemic has influenced the availability of healthcare and has negatively impacted patient outcomes across all aspects of the health spectrum.

One way to increase access to CR is by creating availability for telehealth. Telehealth has been shown to increase patients' access to healthcare via computers, mobile devices, and other healthcare technologies (Mayo Clinic Staff, 2017). This quality improvement project encompassed a retrospective data analysis to assess completion, barriers to participation, and reasons for early termination in patients once they have been discharged from an urban community hospital with a referral for CR. This analysis also investigated health outcomes of patients who participated in CR and patients who did not participate in CR, or those who terminated the program early by assessing mortality, cardiac-related rehospitalizations, and further cardiac diagnostic stress testing at this hospital for the selected patients. Additionally, the referral rate to outside CR facilities was evaluated to identify patient outcomes and the ability to

provide continuous care. Furthermore, the final aspect of this quality improvement project was the evaluation of a patient perspective survey, which asked patients' viewpoints in regards to their comfort levels surrounding telehealth and their interest in a tele-CR program.

Problem Identification and Available Knowledge

Cardiac Rehabilitation

Cardiac rehabilitation is a three-phase rehabilitation system that has shown to increase positive outcomes in patients who qualify and participate in this program (Servey & Stephens, 2016). Qualifying patients often have had a recent myocardial infarction, cardiac bypass surgery, or have been suffering from unstable angina, heart failure, and other select cardiac-related illnesses (Servey & Stephens, 2016). Phase one of CR is often completed in the hospital setting, whereas phase two is completed as an outpatient shortly after referral and consists of 36 sessions, which often spans approximately three months. Phase three is an extended outpatient program that offers extended monitoring and assistance (Mayo Clinic, 2022).

Throughout the CR program, eligible patients work with exercise physiologists, dietitians, registered nurses, psychologists, advanced practice providers, and physicians (Mayo Clinic, 2022) to utilize interventions aimed at stabilizing blood pressure, lipid level, and diabetes, as well as participate in counseling in emotional health, smoking cessation, and diet (Servey & Stephens, 2016). CR also aims to improve the patient's physical activity levels and overall quality of life (Servey & Stephens, 2016). Patient participation in CR has shown extensive benefits such as a decrease in the presence of depression, reduced unplanned hospitalizations, reduced cardiovascular risk, reduced mortality rates, as well as increased functional capacity and quality of life (Servey & Stephens, 2016).

Although CR has been beneficial to patients who qualify, and despite Medicare and other private insurance contributions of paying up to 36 sessions, patients and their providers continue to underutilize this program (Servey & Stephens, 2016). Currently, the average national participation in CR programs is very low, ranging from 19% to 34% (Ades et al., 2017). Barriers to CR participation are often present and have been shown to be extremely impactful, specifically to patients in rural areas (Banner et al., 2019). The inability of a referred patient to participate in CR programs can result in many adverse outcomes. Research has indicated that patients who are referred but do not participate in CR have an increased rate of all-cause mortality by 45% to 57% compared to those who participate in CR programs (American Heart Association [AHA], 2017). Additionally, nonparticipants have an increased rate of hospital readmission that is 31% higher than CR participants (AHA, 2017). Furthermore, it has been shown that nonparticipants spend an average of $640 more per year on health-related costs when compared to CR participants (AHA, 2017).

Million Hearts® 2022 is a national initiative that focuses on preventing one million heart attacks and strokes within five years (Centers for Disease Control and Prevention [CDC], 2019). Million Hearts® focuses on many topics in regard to cardiac health, including CR (CDC, 2019). Currently, the Million Hearts® Cardiac Rehabilitation Collaborative has created an initiative to improve CR participation in all populations to 70% by the year 2022 (Ades et al., 2017). The Million Hearts® Collaborative calculates that if CR participation can increase from the current average of 20% up to 70%, 25,000 lives would be saved, and up to 180,000 hospitalizations would be prevented annually (Ades et al., 2017).

Telehealth

Telehealth is an up-and-coming means of providing reliable healthcare to populations in an affordable manner (Rural Health Information Hub, 2019b). Telehealth increases the patients' access to healthcare via computers, mobile devices, and other healthcare technologies (Mayo Clinic Staff, 2017). The use of telehealth has also been shown to increase patient monitoring, communication, and timeliness of care in rural populations by means of remote patient monitoring, store and forward transmission, and mobile health communication (Rural Health Information Hub, 2019a). Remote monitoring has allowed telehealth programs to be successful due to the potential for personalization and outreach to large patient bases (Wicklund, 2019). Additionally, telehealth has proven to reduce barriers in health care delivery and access, such as distance and travel, by allowing health care delivery in the home (American Hospital Association, 2016).

Research has indicated that incorporating home-based CR programs increased patient participation from 6 % to 24.6 % (American College of Cardiology, 2018). Home-based CR participation has also been shown to increase the number of completed sessions to greater than three sessions from 5.1% to 16.6 %, and home-based CR participants were found less likely to drop out of the program than CR participants who attended on-site sessions (American College of Cardiology, 2018). Additionally, it has been shown that there is no statistically significant difference in all-cause mortality between home-based CR and in-person CR (Pecci & Ajmal, 2021).

In August 2019, Kaiser Permanente announced success in regards to CR programs that utilized telehealth (Wicklund, 2019). Prior to this study, there was little information in regards to the use of telehealth in CR. This study found that more than 87% of the patients who participated

in tele-CR completed the CR program, which according to the article, is a 74% improvement over traditional CR programs nationwide (Wicklund, 2019). Additionally, less than 2% of the participants returned to a hospital for further treatment, which is considerably less in comparison to the 10% to 15% national rehospitalization average (Wicklund, 2019).

Barriers

For CR patients, poor attendance has been shown to be linked to geographic location, limited access to healthcare services, transportation ability, and other community-specific barriers (Banner et al., 2019). Additionally, it has been shown that barriers appear to greatly impact rural communities whose populations are typically greater in age and have increased rates of chronic illnesses (Banner et al., 2019).

Cardiac rehabilitation programs are often located in hospitals, skilled nursing facilities, and rehabilitation centers and are more prevalent in urban settings (National Library of Medicine, 2020). Patients living in remote areas often have reduced access to specialty services, such as CR programs, due to their aforementioned locations (AlDossary et al., 2017). Due to the inflexible location of most CR programs, patients with decreased access to healthcare are found to have lower rates of participation (Servey & Stephens, 2016). Among 15 separate samples of rural veteran populations and their clinicians, it was found that the distance to health care centers was the greatest barrier to seeking healthcare (Buzza et al., 2011). The researchers found that the barrier related to distance was exacerbated by additional factors such as decreased health status, functional impairment, cost of travel, time constraints associated with travel, and balancing work and family life (Buzza et al., 2011).

Covid-19

The Covid-19 pandemic has also negatively impacted many aspects of healthcare, including CR (Pecci & Ajmal, 2021). Patient perceptions surrounding safety, as well as the temporary closure of CR programs, have contributed to nonparticipation in CR nationwide (Pecci & Ajmal, 2021). Due to the Covid-19 crisis, most of the exercise components of CR had shut down nationwide on at least a temporary basis, with approximately 2,685 programs closing, which has left hundreds of thousands of patients without access to CR services (Pecci & Ajmal, 2021). There has been minimal need to adjust the CR program since the 1950s; however, due to the Covid-19 pandemic, there has been a necessary transition to home-based CR as an equal option for in-person CR (Epstein et al., 2021). With the novel aspect of the Covid-19 pandemic, many studies have yet to be performed on the future of CR; however, increasing access to CR programs for patients who qualify can aid in reducing negative outcomes and improve overall health.

PICOT

In order to encourage the future development of a tele-CR program at the urban community hospital, a retrospective data analysis was performed. Additionally, a patient perception survey surrounding telehealth was dispersed and evaluated. Key questions that arose surrounded the evaluation of the retrospective data analysis of patients who qualify for CR at the urban community hospital from 9/1/2019 to 12/31/2020, what barriers to CR participation were most prevalent, and what were the associated health outcomes dependent on participation and nonparticipation/noncompletion for these patients? Additionally, among the patients who qualify for CR at the urban community hospital, was there a correlation between CR completion and having residence in an urban or rural community? Finally, did the current patient population who

would qualify for CR at the urban community hospital have interest in a tele-CR program, compared to in-person CR, if it were offered? Appendix A shows a fishbone diagram of frequent barriers associated with patient participation in CR.

Literature Review and Synthesis

Literature was gathered and reviewed in order to determine the need for, current barriers, and the current outcomes of tele-CR programs. Telehealth is an up-and-coming means of affordable healthcare while simultaneously improving the availability of services to patients in underserved areas. CR via telehealth is a newer concept, and research encompassing this topic is limited. The following literature review includes a narrative description of the search process as well as literature regarding the problem, theoretical and conceptual framework, implementation, interventions, and outcomes of current projects are discussed below. The following information can be further evaluated in Appendix B.

Narrative Description

Search Terms. ProQuest Nursing & Allied Health, PubMed, Google Scholar, and CINAHL were utilized in order to find the majority of research articles for this literature review. The database which yielded the most information was CINAHL. Search terms used for the acquisition of relevant information included: *telehealth, tele-cardiac rehabilitation, telehealth AND cardiac rehabilitation, cardiac rehabilitation, cardiac rehab, rural cardiac rehab(ilitation), rural barriers to healthcare, tele-cardiac rehab outcomes, Covid-19 AND cardiac rehab(ilitation), theory AND cardiac rehab(ilitation)* ,and *rural telehealth AND cardiac rehab(ilitation).* Advanced searches, including Boolean phrases, were frequently utilized in order to narrow results when necessary. A limitation to searching for tele-CR information included the aspect that it is more recently being researched in practice, and results were not always available.

Additionally, the available results were from smaller studies which is concerning for reproducibility and reliability.

Inclusion and Exclusion Criteria. The literature that was utilized included articles less than 10 years old if possible; however, priority was given to articles less than five years old. Chosen literature also included articles written in English, articles from reputable medical journals, and articles with an emphasis on rural and underserved populations. Exclusion criteria for chosen literature included articles greater than 10 years old, reviews of articles, and articles written in foreign languages with the inability to translate to English.

Significance and Barriers

Problem Identification. Many barriers exist with the participation of CR despite its positive outcomes including: physician referral and language barriers (Servey & Stephens, 2016), as well as patient proximity to CR centers (Buzza et al., 2011). Among 15 separate samples of rural veteran populations and their clinicians, it was found that distance to health care centers was the greatest barrier in seeking health care (Buzza et al., 2011). The authors found that the barrier of distance was exacerbated by additional factors such as decreased health status, functional impairment, cost of travel, and time constraints associated with travel and balancing work and family life (Buzza et al., 2011). Health status and age have also been shown to affect a patient's ability to drive and thus impacted their ability to travel (Buzza et al., 2011).

Significance. CR programs are focused on patients with cardiovascular disease and often begin in an inpatient setting and then expand to outpatient programs (Servey & Stephens, 2016). These programs emphasize exercise, nutrition, behavioral counseling, and immunization compliance in order to promote their overall goal of increased cardiac outcomes and emotional well-being (Servey & Stephens, 2016). It has been shown after years of research that there is an

inverse correlation between attendance of CR in patients with cardiovascular disease and mortality outcomes, as well as a positive correlation in a reduction in rehospitalizations (Servey & Stephens, 2016). Additionally, research supports decreased rates of depression and increased rates in functional capacity by increasing rates of peak oxygen consumption, weight loss, and lipid control in patients who attend CR (Servey & Stephens, 2016).

Further research has been performed in regards to the benefit of CR in patients who have had an ST-segment elevated myocardial infarction (STEMI). Patients who have had a STEMI are at much higher risk for adverse outcomes due to the severity of their heart attack. With that said, authors Zhang et al. (2018) found that STEMI patients who went through a CR program once their heart blockage was corrected had reduced rates of angina, hospital readmissions, and had an increased left ventricular ejection fraction. The authors also found that patients who participated in the CR program had an overall increased quality of life and increased capacity for physical activity (Zhang et al., 2018).

Implementation

Home-based CR programs have the ability to be successful on their own or in correlation with a facility-based program (Rohrbach et al., 2017). Offering a home-based CR program has the ability to promote success among patients who suffer from barriers such as distance and travel by improving access (Rohrbach et al., 2017). Improving access to CR programs via mobile technologies and tools offers the patient a more individualized rehabilitation program for each patient (Rohrbach et al., 2017). Although the fear of returning to exercise at home has been expressed by home-based CR attendants, eliminating barriers and creating more individualized programs still have the ability to increase enrollment in home-based CR programs and increase the overall number of participants and completion rates (Rohrbach et al., 2017). Additionally, the

cost of the traditional CR program in comparison to the tele-CR program is relatively similar (Rohrbach et al., 2017).

Project RESTORE also evaluated and compared tele-CR and traditional CR programs by utilizing a meta-analysis strategy (Milewski et al., 2019). This project was geared toward developing and implementing an effective tele-CR program for patients who have undergone cardiac revascularization procedures (Milewski et al., 2019). Project RESTORE is still being evaluated; however, it has been shown that traditional CR and tele-CR are at least equally effective, and tele-CR has also been favored to have better outcomes at times (Milewski et al., 2019). Tele-CR can easily be implemented by utilizing frequently used cell phones and other technical devices (Milewski et al., 2019).

Acceptance of telemedicine should also be taken into consideration when implementing a program such as tele-CR (Jansen-Kosterink et al., 2019). Implementing telemedicine programs tends to give the patient a sense of autonomy; however, other patients prefer to participate in rehabilitation programs as a part of a group (Jansen-Kosterink et al., 2019). Certain patients also find that instruction videos online make it easier to perform exercises correctly; however, others prefer having a trained professional correct their exercises in person (Jansen-Kosterink et al., 2019). Additionally, certain patients find it motivating to participate in telehealth programs at home, while others find motivation by participating with others (Jansen-Kosterink et al., 2019). It is important to address nongeneral preference factors for all patients when creating and implementing a tele-CR program in order to promote the successful completion of the program.

Interventions

Alternative approaches, like home-based CR programs, are becoming more popular in the realm of healthcare. Rohrbach et al. (2017) emphasized the referral process, the three phases of

CR, the patient-provider relationship, as well as tailoring the CR program to each individual patient (Rohrbach et al., 2017). In addressing the referral barrier, the authors utilized an automatic referral system by embedding the CR consult within the postcoronary bypass graft (CABG) and postpercutaneous intervention order sets (Rohrbach et al., 2017). Phase one of CR often takes place in the hospital and often encompasses patient interviews, goal setting, and cognitive, emotional, and physical evaluations (Rohrbach et al., 2017). Prior to phase two, the authors suggested an in-hospital exercise test in order to obtain a patient baseline as well as boost the patient's confidence in order to exercise at home (Rohrbach et al., 2017). During phases two and three, the patient received additional tools such as educational DVDs, a blood pressure cuff, resistance bands, a weight scale, a pedometer, and a journal for documenting vital signs, activity levels, and diet (Rohrbach et al., 2017). During the 12-week period, the patient had nine 30-minute telephone sessions, which consisted of education, individualized treatment plan development, and addressed concerns (Rohrbach et al., 2017). Including automatic CR referrals for qualifying patients helped to increase participation in the program. Home-based CR programs can also be added to the automatic referral process in order to increase access and participation in CR (Rohrbach et al., 2017).

Banner et al. (2019) addressed tele-CR in a rural community. Their implementation strategy consisted of one-on-one virtual chat sessions with a nurse case manager, exercise specialist, and dietician three times each for the duration of the program (Banner et al., 2019). The tele-CR program also consisted of weekly at-home educational slide show sessions with multiple choice quizzes, obtaining virtual data from exercise, blood tests, and group chat sessions (Banner et al., 2019). Patients who utilized this program found its interventions to be effective, accessible, and satisfactory (Banner et al., 2019).

Recently, Kaiser Permanente (2019) rolled out a virtual CR program that utilizes Samsung wearable technology. Patients met with a care team to create an individualized care plan prior to undergoing an eight-week virtual CR program. Patients received a Samsung smartwatch that was compatible with both Android and Apple smartphones (Kaiser Permanente, 2019). By utilizing this watch, patients were able to receive reminders as well as continuously upload data to their care team in regards to their health status (Kaiser Permanente, 2019). Patients would also meet with their care team once a week to discuss progress and go over educational material (Kaiser Permanente, 2019). If an emergency or concern were to arise, patients had access to their care manager 24 hours a day, seven days per week for the duration of the program (Kaiser Permanente, 2019). After graduating from the virtual CR program, patients were offered wellness coaches for up to 12 weeks to promote the continuation of healthy behaviors (Kaiser Permanente, 2019). This study was shown to have high satisfaction, participation, and completion rates (Kaiser Permanente, 2019).

Lastly, Milewski et al. (2019) designed a randomized trial called RESTORE, which utilized software to enable remote patient monitoring. Peripheral medical devices were also utilized, including electrocardiogram, heart rate, and blood pressure monitoring (Milewski et al., 2019). A central system and coordinating center were utilized to collect and analyze the data from patient monitoring devices and software in order to allow for rapid action based on algorithms to determine patient health (Milewski et al., 2019). The authors also used mobile applications for patient access and use in order to manage their virtual CR program (Milewski et al., 2019). This project is still under evaluation; however, its design shows promise.

Measures and Outcomes

Laustsen et al. (2020) found that in their study of 34 patients who participated in remote tele-CR, there was a significant increase in short-term peak oxygen uptake, as well as short- and long-term muscle endurance, muscle power, and muscle strength. The authors also found that health-related quality of life increased by 19% in physical component scores and by 17% in mental component scores (Laustsen et al., 2020). This study also demonstrated that tele-CR has positive short and long-term outcomes (Laustsen et al., 2020).

Kaiser Permanente (2019) discussed how their tele-CR study showed an 80% completion rate in comparison to the nation's current average of less than 50%. This study also showed that its tele-CR participants had a rehospitalization rate of less than 2% compared to the national average of 10% to 15% (Kaiser Permanente, 2019). Patient satisfaction was also deemed exceptional in this study (Kaiser Permanente, 2019). This study showed that tele-CR programs have the ability to increase completion rates, decrease unnecessary hospitalizations, and increase patient satisfaction and compliance (Kaiser Permanente, 2019).

Additional research by Wu et al. (2018) studied 1,195 patients who participated in either a hybrid CR program via telehealth or a traditional CR program. The authors found that participants in both groups had similar exercise tolerance, blood lipid levels, systolic and diastolic blood pressures, and health-related quality of life (Wu et al., 2018). This study concludes that tele-CR programs are at least comparable in terms of quality of outcomes to traditional CR programs. Bravo-Escobar et al. (2017) also found home-based CR to be comparable to in-person CR programs in terms of effectiveness. However, home-based tele-CR results suggested that it could increase the type and number of patients being treated as well as

tailored to the patients' lifestyles and needs which could ultimately increase adherence and completion rates (Bravo-Escobar et al., 2017).

Duan et al. (2018) performed a randomized control trial that compared an inactive control group with a tele-CR group. The tele-CR group underwent four weeks of exercise training and four weeks of dietary education (Duan et al., 2018). The authors of this study found that the tele-CR group had an increased perceived quality of life, social support, emotional health, self-efficacy, planning, and motivation (Duan et al., 2018).

Documented advantages to tele-CR included lack of necessary travel, ability to participate in the program independent of a treatment facility, utilization of instruction videos to correctly perform exercises, intrinsic and extrinsic motivation, online mentoring, utilization of online healthcare portals, decreased healthcare cost, gained digital skills, and care plan personalization (Jansen-Kosterink et al., 2019). Conversely, some patients are not intrinsically motivated and have a difficult time; online mentoring can appear impersonal, lack of digital skills, preference for group therapy, lack of time, technology anxiety, lack of social context, and sense of privacy infringement can all be seen as patient concerns for tele-CR and ultimately have a negative impact on patient outcomes (Jansen-Kosterink et al., 2019).

Lastly, Hwang et al. (2019) addressed the outcome of the cost when comparing traditional CR with tele-CR. This study found that the cost of participating in tele-CR programs was significantly lower than traditional CR programs (Hwang et al., 2019). The cost of tele-CR was found to be approximately $1,590 less than traditional CR over a six-month period (Hwang et al., 2019). This study also found that the quality-adjusted life years in both groups were similar, indicating that tele-CR has similar effectiveness as traditional CR (Hwang et al., 2019).

Organizational Project Information

The urban community hospital that was studied is a nonprofit regional health system that serves populations in a community of over 80,000 people in 17 counties in Northeastern Minnesota, Northwestern Wisconsin, and the Upper Peninsula of Michigan (Bridging Health Duluth, n.d.). This hospital provides many cardiovascular services, including cardiac catheterization, coronary interventions, cardiovascular surgery, heart valve surgery, and CR (American Hospital Directory, 2019). This hospital has received many awards for its cardiovascular programs, including gold recognition from the American Heart Association's Mission: Lifeline (Business North, 2019). Currently, this urban community hospital works hard to ensure that qualified patients are enrolled in CR programs and begins this process prior to hospital discharge.

In order to address barriers to CR at this hospital, correlation with multiple team members were necessary. The project mentor, who is a nurse practitioner within the cardiology department, assisted with the development of the project through a discussion regarding tele-CR and its importance in healthcare. The project advisor within the urban community hospital, program director of the urban community hospital's research department, helped to develop and adjust the project, gather data, and facilitate communication with the urban community hospital's Institutional Review Board (IRB). The hospital's IRB assisted in questions and adjustments within the project, and the hospital's cardiac unit supervisors and nurses assisted in distributing patient perception surveys. Additionally, the supervisor of cardiac diagnostics and CR at the urban community hospital assisted in communicating background information regarding the CR program at this facility. Lastly, an independent statistician assisted in providing statistical analysis of the retrospective data analysis.

In alignment with the urban community hospital's mission statement, "The Patient. Above All Else." (Fuse Duluth, 2022, para. 4), the proposed project was part of a larger plan designed to increase patients' access to health care. This specific project was aimed at introducing the inclusion of CR in telemedicine by assessing barriers to patient participation within the hospital's cardiac patients. The purpose of this health program was to identify barriers, participation, noncompletion, patient outcomes, and rate of outer agency referrals to CR programs. The mission of this proposed health program is "Identify patient barriers, referrals, and outcomes to CR participation and provide supportive evidence to encourage the development of a telehealth program in order to increase access to healthcare."

Gap Analysis

Approximately 65% of the patients hospitalized for cardiac illness at this urban community hospital reside in rural areas (Supervisor of cardiac diagnostics and CR at the urban community hospital, personal communication, June 11, 2020). Frequently, patients who are cared for in the cardiac unit at this hospital receive a referral for a CR program during their hospitalization. This urban community hospital has done an excellent job in the initiation of phase one of CR while patients are in the hospital with a cardiac-related illness; however, when patients are discharged, they are to continue to phase two CR at a location within this facility or obtain a referral to another location (Supervisor of cardiac diagnostics and CR at the urban community hospital, personal communication, June 11, 2020). Patients who have sought treatment at this facility often faced barriers to participation in programs such as CR. Based on the population this hospital serves, it can be assumed that certain barriers are more prevalent than others. However, it is unknown what the primary barriers to CR participation are at this facility.

Prior to the Covid-19 pandemic, CR through this urban community hospital was an on-site rehabilitation program (Supervisor of cardiac diagnostics and CR at the urban community hospital, personal communication, June 11, 2020). Due to the Covid-19 pandemic, CR at this hospital has transitioned to offer an optional electronic delivery system for patient education courses, which promotes remote participation (Supervisor of cardiac diagnostics and CR at the urban community hospital, personal communication, June 11, 2020); however, these education courses did not offer individualized planning and care at that time. Although there has been a transition toward patient participation in education at home, it remained a requirement to attend in-person exercise classes on the main hospital campus which resulted in referrals to programs in locations that were more accessible to these patients (Supervisor of cardiac diagnostics and CR at the urban community hospital, personal communication, June 11, 2020). In addition, the patient perspective surrounding the use of telehealth or willingness to participate in a tele-CR program through this hospital system was unknown.

Based on the aforementioned gaps, as noted in Appendix C, the urban community hospital's cardiology department could benefit from plans to provide an option for a tele-CR program. Tele-CR would allow patients to exercise at home, thus promoting access to CR program services for those with barriers to healthcare. Additionally, utilizing different technologies to offer remote access within the urban community hospital's CR could reduce the number of referrals to other programs and increase the ability for close follow-up of their patients.

Needs Assessment

The evaluated urban community hospital serves a large population who resides in rural communities. This project was aimed at finding supportive data and evidence to support the

creation of a tele-CR program at this facility. The urban community hospital currently offers an in-person format of CR, as well as the option of using a computer format to provide elements of the education component of CR. The urban community hospital has the potential to benefit immensely in regards to patient participation and completion of CR by addressing barriers to healthcare access and utilizing telehealth.

It will first be important to assess which barriers are most common among the urban community hospital's patient population and assess the impact of noncompletion of CR programs on patient outcomes by performing a retrospective data analysis. Once common barriers have been identified, individualized solutions to these barriers can be created. Many of the barriers associated with rurality can be addressed by offering a completely remote CR program encompassing individualized education, diet, medication, and psychological components, as well as home-based monitored exercise via telehealth. It is also important to consider the patient's perspective and determine their value in the ability to participate in a tele-CR program, which is currently unknown at this facility. Additionally, CR progress and completion assessments for patients at the urban community hospital who are referred to another CR program can be difficult to obtain due to noncommunicating electronic health records (EHR). Furthermore, the identification of the study's patient population, stakeholders and team members, cost, barriers, and goals, are necessary to develop and begin the project analysis, as listed in Appendix D. Implementation of the project in order to provide contributory evidence to support the adoption of a tele-CR program at the urban community hospital can ultimately offer improved continuity of care and close follow-up rather than referring the patient to an outside facility for CR services.

Strengths, Weaknesses, Opportunities, and Threats Analysis

This project has identified strengths, weaknesses, opportunities, and threats as noted in Appendix E. Strengths of this project include: quality of data, specificity of data, patient data protection, and quantity of retrospective data. Weaknesses include duration of time to complete the project, inability to evaluate participation or completion of CR at most outside facilities, large amounts of irrelevant data being included in the original data set, and low numbers of perception surveys handed out to patients, which lead to a low return rate. Opportunities this project provides include delivering supportive data to be used to encourage the future development of a tele-CR program and providing feedback to the cardiology team at the evaluated urban community hospital for their knowledge and use. Furthermore, opportunities of this project include use of the resulting data to advocate for the continued Medicare and Medicaid coverage of tele-CR past the end of 2022 and supporting the continued effort of expanding access to high-speed internet to underserved communities. Threats of this project include unintentional disclosure of patient information by patients not following directions on the patient perception survey, risk of hospital-wide computer software hackers and access to patient information, the risk that patients with a referral for CR were not included in the original data set and thus not included in the study, and the risk that staff at the urban community hospital may not be receptive to the results of this study.

Guiding Theoretical Framework and Change Theory

Conceptual frameworks, theories, and models help drive quality improvement. Change theories and conceptual frameworks which best relate to tele-CR have been discussed by Sankaran et al. (2015) and Horwood et al. (2015). The Fogg Behavior Model can be applied to the encouragement of a tele-CR program by stating that for a goal behavior to occur, the patient

must have the motivation, ability, and a trigger and that all three aspects must be present at the same time (Sankaran et al., 2015). Additionally, in order to be successful in a tele-CR program, the patient must maintain motivation over the duration of the program, which oftentimes is 36 sessions (Sankaran et al., 2015). This project focuses on the aspect of the patient's ability to participate in CR and their motivation to complete the CR program. Evaluation is done by identifying and addressing barriers to participation in order to create a solution by utilizing telehealth. Additionally, patient perception surveys addressed the patient's interest and motivation regarding participation in a tele-CR program. Going forward, this model can be utilized to assess other aspects of patient behavior surrounding a tele-CR program and other barriers to implementing such a program including: possession of necessary equipment, scheduling ability, and continuing to incorporate educational motivators to continue participation.

The health belief model was also utilized to address reasons for nonattendance among CR participants (Horwood et al., 2015). The health belief model addressed the patient's own perception of their health. The authors compared patients with high attendance, low attendance, and nonattendance, while simultaneously evaluating each person's belief in their own health (Horwood et al., 2015). The results of this study were that high attendance patients had higher perceived social and physical benefits of participation in CR and had fewer overall barriers (Horwood et al., 2015). The patient's perception of their own health can serve as a significant barrier if they do not completely understand their diagnosis and choose not to participate in CR or complete the program early. This project assesses barriers to CR, including patients' perceptions, physical limitations, and social limitations. It is important with the evaluation of the

retrospective data analysis and encouragement for a tele-CR program that the physical and social benefits of patients who complete CR should be emphasized (Horwood et al., 2015).

Health Program Goals and Objectives

This health program had two primary goals. The first goal was to identify barriers to attending CR within the urban community hospital's patients who qualify. Within this goal, there was a need to identify patient outcomes of those who participated in CR, and those who did not participate in, or complete, CR by assessing for cardiac-related hospitalizations, cardiac stress testing, and death after CR referral. Furthermore, within this goal was the identification of patient interest in tele-CR participation if it were available to them. The second goal was to identify the number of referrals placed for CR in order for patients to attend at a location other than the urban community hospital and the ability to determine the completion of CR at those sites.

Goal 1

Identify barriers to attending CR within the urban community hospital's patients who qualify and evaluate outcomes of patients who participated, those who terminated prior to completion, and those who did not wish to participate in CR**.**

Objective 1

Identify barriers to participating in CR within the urban community hospital's patients by performing a retrospective data analysis and chart review**,** as well as determining patient interest in tele-CR via patient survey.

Implementation. Identifying barriers to CR participation is necessary in order to advocate for tele-CR. Showing barriers exist and clearly identifying them will help to encourage where barriers can be addressed. A retrospective data analysis and chart review were done for

patients who received a referral for CR from the urban community hospital between the dates of 9/1/2019 and 12/31/2020. Specific barriers to CR participation and completion, if identified, were documented in a restricted access spreadsheet which was located within the urban community hospital's data system. Additionally, 100 patient perception surveys were created, as noted in Appendix F, and given to staff on the cardiac unit to disburse to patients who were being discharged between 3/15/2020 and 5/1/2020 with a referral to CR. The patients were asked to anonymously and voluntarily disclose answers to questions, including whether their home is located in a rural or urban setting, comfort with telehealth, access to the internet, and interest in tele-CR. The surveys were returned on a volunteer basis and were reviewed to determine patient interest in tele-CR.

Outcome Measure and Evaluation. This objective was considered successful when the chart review was completed and statistically analyzed to determine trends in barriers to CR participation in patients at the urban community hospital. This objective was also completed when the patient surveys were returned, with a deadline of 5/1/2020.

Objective 2

Identify patient outcomes of those who participated in CR and those who did not participate in or complete CR by assessing for all-cause mortality, cardiac-related hospitalizations, and cardiac stress testing after CR referral.

Implementation. A retrospective data analysis was performed of patients who received a referral for CR from the urban community hospital within the dates of 9/1/2019 and 12/31/2020. A chart review was performed on these patients to assess for all-cause patient mortality, any cardiac-related hospitalization, stress test, or death following completion, termination, or refusal

of CR. This data was documented in a restricted access spreadsheet located within the urban community hospital's data system.

Outcome Measure and Evaluation. This objective was considered successful once the retrospective data analysis was completed and statistically analyzed to determine if there was a correlation between participation in CR and patient outcomes at the urban community hospital.

Goal 2

Identify the number of patients referred to CR at outside facilities and assess the ability to determine participation or completion of CR at those facilities**.**

Objective 1

Identify the number of CR referrals placed for patients to attend at a location other than the urban community hospital. Furthermore, evaluate the ability to determine participation and completion of CR at the outside facilities.

Implementation. A retrospective data analysis was performed on patients who received a referral for CR from the urban community hospital between 9/1/2019 and 12/31/2020. A chart review was performed on these patients to assess for participation in CR at the urban community hospital or if a referral was placed to a rural, urban cluster, or urban location. Patient-specific data were documented in a restricted access spreadsheet located within the urban community hospital's data system. The data were evaluated to identify the percentage of patients who were referred to an outside facility. The availability of documented CR completion rates for patients referred to an outside facility were gathered and documented.

Outcome Measure and Evaluation. This objective was considered complete after the retrospective data analysis was finalized, and the number of CR referrals placed to outside

facilities and availability of patient participation and completion of CR were statistically analyzed.

Gantt Chart

The project encompassed approximately 17 months, as noted in Appendix G. The primary item that was continually being addressed through the majority of the project was analysis and chart review of patients who qualified for CR at the urban community hospital, which encompassed 14 months. As displayed in Appendix G, once the chart review and analysis were completed, the data were deidentified and provided to a hired statistician with the stakeholders and IRB approval. The data was then analyzed and disseminated by the statistician and the author. While the chart review was being performed, collaboration between the author and the cardiac unit staff occurred regarding the distribution of patient surveys. This collaboration, as well as the time the surveys were distributed, lasted approximately five months. Additionally, during the time of the study, the author communicated with stakeholders, advisors, and the IRB to ensure the project's success.

Work Breakdown

Work breakdown was divided between the design, plan, intervention, and evaluation phases. The work breakdown can be seen in Appendix H.

Design Phase

The design phase consisted of project development surrounding a gap analysis covering CR and barriers to participation, evaluation, and outcomes. Key stakeholders were identified and included: the project mentor, the project advisor within the urban community hospital, the project advisor within St. Scholastica, as well as other team members, in addition to the author, as noted in Appendix I. Project scope, goals, and objectives were developed during this time. An

action plan was submitted to St. Scholastica advisors for approval to move forward with the creation and implementation of the project.

Plan Phase

Additional team members were identified during this phase and included information technologists at the urban community hospital, staff from the urban community hospital's research department, unit supervisors of the hospital's cardiac unit, cardiac unit nursing staff, a statistician, and institutional review boards at St. Scholastica and the urban community hospital.

Roles included team members who gathered requested patient information for further evaluation, technologists who assisted in username and profile creation for access to the hospital's EHR, and staff who handed out and explained the patient perception surveys to cardiac patients. The statistician assisted in the evaluation of the data that was gathered from the retrospective data analysis.

The project plan was created, which included: receiving approval from the urban community hospital's IRB, plan the requisition of patient data, organization and pairing down of the data once it was obtained, thorough chart review, de-identifying patient information, and sending the de-identified data to the hired statistician for further statistical analysis of results. Additionally, patient perception surveys were created and a timeline for distribution was developed with the supervisors of the cardiac unit. The project plan and Gantt chart were developed as noted in Appendix G and Appendix H, which encompassed patient data evaluation from September 1, 2019, to December 31, 2020.

Tools and Data Collection Process. The project planned to utilize tools such as a standard laptop, printer, Microsoft Word, Microsoft Excel, Meditech Expanse, Microsoft Office Mail, Citrix software, Mobile Pass software, Gmail, a protected folder within the urban

community hospital's research department, Intellectus statistical website, patient perception surveys, retrospective data analyses collection tool, and Zoom. Detailed use of tools during the course of the project can be found in Appendix J. Collaboration between the author, and St. Scholastica's IRB and the urban community hospital's IRB was performed in order to obtain approval for implementing the project. Once approval was obtained, specific patient data was planned to be requested from the urban community hospital's research department staff and was to be kept in a protected folder for the duration of the project. Data were planned to be collected from patient healthcare records within Meditech Expanse and were transferred to the Excel spreadsheet within the protected folder for further evaluation and dissemination. The Intellectus statistical software was planned to be used to further analyze results.

Plans for Patient Data Analysis. Once the data had been collected, organized, and de-identified, the Excel spreadsheet was planned to be sent to the hired statistician for further dissemination of results. The results were to be statistically analyzed for outcome, relevance, and confidence.

Resources, Budget, and Timeline. Resources that were utilized include the above-mentioned technologies and patient documentation, as well as the United States Postal Service for purchase of postage and mailing of patient surveys, Amazon for purchase of paper, printer ink, and envelopes, and Dunkin' Donuts for purchase of doughnuts to provide to cardiac unit staff in gratitude for their assistance. The planned budget for this project was approximately $1,200, which included the hourly wage of the statistician, postage stamps, paper, printer ink, envelopes, and the gift of doughnuts for the cardiac unit staff for assisting with the survey distribution. Itemized breakdown of the project's finances can be found in Table 1, which can be

found within the budget section. The timeline for this project is as shown in Appendix G, which began in December 2020 and was completed in May 2022.

Intervention Phase

During the intervention phase, the plan was acted upon. The use of Citrix and Mobile Pass allowed the author to access patient information safely from computers located at the urban community hospital, as well as the author's personal computer. Frequent communication between the author, the project advisor within the urban community hospital, and the project mentor occurred during the intervention phase to ensure timeliness and discuss barriers. The statistician was updated frequently regarding the progress of the data analysis to ensure they were given an anticipated date for obtaining the data for review.

Results Phase

The results phase encompassed the review of the retrospective data analysis and patient perception surveys. The results were analyzed for trends and summarized in detail within the results section of this paper. The results are necessary for the evaluation and dissemination of outcomes.

Evaluation Phase

The evaluation phase encompassed a thorough review and write-up of the results of the project. Discussion regarding outcomes and findings will be explored during this time. Additionally, a discussion of the results is to be provided to stakeholders during this time.

Communication Matrix

Communication between the author and stakeholders frequently occurred during the project, as seen in Appendix K. During the design, plan, and implementation phases, the majority of communication between the author and stakeholders was done via email, telephone, and

Zoom. During the aforementioned phases, simple communication with stakeholders occurred by email more frequently to allow for ease, and more complex and in-depth conversations took place by phone or zoom and were dependent on the stakeholder's preference. Additionally, one in-person meeting occurred during the planning phase. Communication during the results and evaluation phases occurred by email due to decreased need for in-depth communication, with the exception of the presentation of results to the urban community hospital and the urban community hospital's research department, which are planned to occur via email, zoom, or in person.

Logic Model

The logic model, as seen in Appendix L, shows how the project developed by assessing the process and the outcome goals. Inputs for this project included funding, stakeholder knowledge, patient participation, St. Scholastica and the urban community hospital's IRB approval, patient survey materials, U.S. Postal Service, the technology used for patient data analysis, and the technology used to document the results of the data. Activities included the creation of a patient perception survey, creating copies of the patient perception survey for distribution, collection of patient perception surveys, thorough chart review of patients who qualified for CR from 9/1/2019 to 12/31/2020, and evaluation and dissemination of results of the patient surveys and charts. Outputs included the patient perception survey results, retrospective data analysis results regarding patient barriers to CR participation, mortality rates, rates of negative outcomes, and referral rates for CR to an outside facility. Outcomes for this project encompassed the results found in the outputs and included: the creation of a doctoral paper, the creation of a three minute thesis, the creation of a poster, and presenting the information to stakeholders involved in the project. Additional outcomes that could arise from this project

include the implementation of a remote tele-CR program at the urban community hospital and encouragement for increased access to tele-CR.

Budget

The estimated cost and revenue of the project were predicted during the plan and implementation phases of the project. There is no revenue to be gathered during the project timeline. The total cost of the project was estimated to be approximately $1,157.82. Further itemization of the project spending can be seen in Table 1, which shows the cost of each resource.

The creation and distribution of the 100 patient perception surveys cost approximately $182.82. Further breakdown of the direct cost of the creation of the patient perception surveys can be seen in Table 1. The Indirect costs associated with the distribution and collection of the patient surveys included: doughnuts that were purchased from Dunkin' Donuts for approximately $35.00 as a gift for the staff at the urban community hospital's cardiac unit for their help in distributing the patient surveys. Additionally, the estimated cost of gas used for transportation was $5.00. Gas was used to drive to pick up supplies, pick up doughnuts for cardiac unit staff, bring the patient surveys to the urban community hospital's cardiac unit for distribution, and to pick up the completed surveys from the urban community hospital.

There was no cost associated with acquiring and evaluating patient data. Utilization of Citrix, Mobile Pass, Meditech Expanse, and Excel spreadsheet was at no cost to the author. However, there was a cost associated with hiring a statistician to evaluate and disseminate results. The hourly rate of the statistician was $32.50 per hour. It is estimated that it would take 30 hours of work to complete the evaluation of data, as well as complete training associated with

The Collaborative Institutional Training Initiative, as requested by the urban community hospital's IRB. This equates to $975.00 paid to the statistician for their work.

Table 1

Estimated Project Budget

Resource	Cost
Statistician Wage	**$975.00**
Doughnuts (gift)	**$35.00**
Gas	**$5.00**
Survey Creation	**$182.82**
Cost Breakdown of Survey Creation:	
Paper	$4.47
Envelopes	$9.99
XL Ink Cartridge	$51.89
Address Labels	$7.99
Paper Clips	$5.99
Manila Envelopes	$3.99
Staples	$3.50
100 Postage Stamps	$55.00
Total Estimated Budget	**1,157.82**

Note. Table 1 provides a detailed breakdown of the estimated budget of the project.

Methodology and Analysis

Aim

The aim of this project was to perform multiple analyses of patients with referrals to CR at the urban community hospital in order to help alleviate barriers to CR participation and provide supportive evidence to encourage the future development of a tele-CR program. Barriers to CR participation, patient outcomes, referral rates, and patient perceptions of tele-CR were evaluated to support the project's aim.

Measures

Analysis of the patient information collected during this study encompassed four primary foci. First, determining the most common barriers to CR participation was addressed. Data were

collected from patients' EHRs using a retrospective data analysis from 9/1/2019 to 12/31/2020 to determine the most prevalent barriers to CR participation in the urban community hospital's patient population. Barriers to participation must be addressed in order to promote future participation in health programs. Patients were divided into two groups; the rural/urban cluster group and the urban group. This measure evaluated the rural/urban cluster group, the urban group, and both groups for the following outcomes. For each group, barriers to CR attendance or completion for patients who had received a referral for CR from the urban community hospital were evaluated to identify the top three causes for the full duration of the study. Barriers were further evaluated for the impact of the Covid-19 pandemic on patient participation by assessing the top three barriers six months before the Covid-19 lockdown and six months after the Covid-19 lockdown.

Second, the project assessed the rate of patient outcomes associated with participation and nonparticipation or noncompletion of CR for patients who received a referral or CR from the urban community hospital. The rural/urban cluster and urban patient groups were evaluated for all-cause mortality, cardiac-related rehospitalizations, subsequent stress tests, and subsequent cardiac intervention after their CR referral by using a retrospective data analysis encompassing the aforementioned study dates. This measure was used to determine if there was a correlation between negative outcomes and completion of CR within the urban community hospital's study participants. Providing a correlation between patient health outcomes related to CR participation has the potential to provide strong supportive evidence to encourage the development of a tele-CR program, which can assist with patient participation in CR.

Third, the project assessed the rate of referrals that were made to CR facilities other than the urban community hospital. Evaluation of referral rates was performed using the retrospective

data analysis within the aforementioned study dates in order to quantify how many patients within the study participated in CR at the urban community hospital and how many patients participated in CR at another location. This measure also evaluated the ability to monitor patient CR progress once they had received a referral to another facility. Information from this measure can be utilized to advocate for the continuum of care and retention of patients within the urban community hospital's CR program by potentially offering CR via telehealth.

Lastly, the project assessed the percentage of patients at the urban community hospital who would be interested in participating in a tele-CR program if it were available. A patient perception survey was created, as noted in Appendix F, and distributed to patients who qualified for a CR referral upon discharge from the urban community hospital's cardiac unit. The patient provided answers to the survey, as shown in Appendix M, and returned the survey to the author via a prestamped and preaddressed envelope. The author evaluated patient interest in a tele-CR program if it were available with the purpose of using hospital-specific patient information to provide supportive evidence to encourage the future development of a tele-CR program at the urban community hospital.

Tools

A breakdown of the tools and instruments utilized to evaluate the measures of this project is shown in Appendix J, and includes a retrospective data Excel spreadsheet and a patient perception survey. Additional tools and instruments used were listed within the plan section. The Excel spreadsheet contained patient information that was provided to the author by the urban community hospital's research department staff for patients who qualified for CR at the urban community hospital. The spreadsheet was used for further data collection and review in the retrospective data analysis to determine the above-mentioned measures. Additionally, a patient

perception survey tool, as found in Appendix F, was created by the author and utilized in the collection of a poll of interest in tele-CR, as well as other patient-specific data.

Methods

The completeness and accuracy of the project were evaluated by the author and the project advisor within the urban community hospital. Statistical analyses were performed by the hired statistician as well as the author to ensure accuracy of the results. Furthermore, author bias was frequently assessed while collecting patient information to ensure that results would not become skewed.

Return on Investment

The project estimated a cost of $1,157.82, which encompassed supplies needed for the creation and distribution of the patient perception survey, hourly compensation for the statistician, and incentive for the cardiac unit staff for their assistance in the patient survey distribution. A further breakdown of costs can be found in Table 1. No incentive was provided to patients to complete the survey aside from the knowledge that they would be contributing to the research. During the entirety of the project, the funding was provided by the author.

The projected return on investment can be found in Table 2. The calculated return on investment will use the average national cost per CR session of $103.00, in which some insurances will help pay (Ritchey et al., 2020). Moreover, calculations do not include costs associated with the management of a CR program, such as staff wages and cost of utilities. The return on investment was calculated using the iSixSigma return on investment equation (Schweighardt, 2022). Utilizing the national cost average, if the patient completed all 36 sessions, this would equate to approximately $3,708.00 in cost per patient for the entirety of the CR program. There is currently minimal information regarding billing costs associated with tele-

CR, aside from the aspect that it can be found to be similar to the cost of in-person CR (Kraal et al., 2017). Assuming the hospital has the ability to bill a similar cost for tele-CR, this could increase their revenue by $3,708 per person. For example, if the urban community hospital has 100 patients who participate in CR per year at its hospital location and refers 100 patients to other CR facilities, the return on investment of this project could be extremely significant. If 100 of the previously referred patients are able to participate in tele-CR through the urban community hospital and each patient's cost of CR participation is $3,708, then the potential return on investment could be as much as a total of $31,925.70 for the 100 additional patients.

Table 2

Estimated Return on Investment per 100 New Patients

Cost Item	**iSixSigma Calculation Return on Investment= [(Financial value-Project cost)/Project cost]x100**	**Cost Value**
Cost of the project		$1,157.82
Average national cost of CR per session		$103.00
Average national cost per person for 36 CR sessions		$3,708
Patient cost associated with an increase of 100 CR patients per year	[($370,000-$1,157.82)/$1,157.82]x100	$31,925.70

Note: This table shows the calculation of return on investment of the project if 100 new patients were to participate in CR per year.

Further consideration can be made regarding the cost associated with cardiac rehospitalization after referral. Data has shown there is a 31% increase in hospital readmissions associated with non-CR participation for qualifying patients (AHA, 2017). Table 3 shows the following example. The average national cost of patient rehospitalization after cardiac intervention equates to $8,037.00, which may or may not be paid by the patient or their insurance (Cowper et al., 2019). Nationally, between 19% and 34% of patients who are referred to CR will

participate (AHA, 2017). For the sake of analysis, an average of the percentages will be taken to equal 26.5%. If the prior numbers are used, and a total of 200 patients encompassed the 26.5% of patients who participated in CR either at the urban community hospital or were referred to participate elsewhere, this would mean that approximately 754 patients were referred but did not participate in CR. If 31% of those patients ended up readmitted, this would account for about 233 patients. Assuming all 233 patients would be rehospitalized at the urban community hospital at a cost of $8,037.00 per person, this would account for $1,827,621.00 in cost. Payment of the total cost burden may be the responsibility of the patient, their insurance, or the hospital. The potential of nonpayment by the patient or their insurance exists, and if this occurs, the hospital could potentially be responsible for the cost of patient rehospitalization. Implementing tele-CR has the potential to significantly increase the number of participants, which could facilitate a decrease in readmission rates and subsequent costs in addition to the return on investment.

Table 3

Cost of Rehospitalization Example

National Average Calculations	**Patient Numbers and Cost**
Total patients	954 patients
26.5% rate of CR participation	200 patients
73.5% average rate of CR nonparticipation	754 patients
31% readmission rate for CR nonparticipants	233 patients
National average cost of patient rehospitalization after cardiac intervention	$8,037.00
Potential total cost of readmission for CR nonparticipants based on example	$1,827,621.00

Note: This table shows an example of the potential cost to patients, insurance, and to the hospital for patient readmissions based on national average calculations.

Preimplementation

The retrospective data analysis and patient perception surveys were anticipated to be analyzed quantitatively, as they both hold nominal type data. During the evaluation of the retrospective data analysis, the data were evaluated retrospectively using patient information that had been gathered from the urban community hospital's EHR. Patient data regarding if their residence and location of CR participation was located in an urban, urban cluster, or rural location was identified, and patients were split into two groups; the urban group and the urban cluster/rural group. These groups were used to identify and compare their rates of CR participation and completion, barriers to participation, outcomes, and rates of referral using nominal measurement strategies. Using the patient perception survey, the primary question of focus within the survey was to identify patient interest in tele-CR using a yes or no question, which was considered nominal.

Descriptive data analysis methods, including the calculation of percentages, were used to understand outcomes within the data for all interventions. Additionally, the effect of time as a variable was included by analyzing the completion and participation rates, barriers, outcomes, and referrals surrounding the Covid-19 lockdown date of 3/13/2020. March 13, 2020 was chosen as the date of lockdown due to the declaration of the national state of emergency by the President of the United States on this date (CDC, 2022). Using the Covid-19 lockdown date allowed for the identification of changes in the aforementioned outcomes by comparing patient data six months prior to this date, six months after this date, and comparing the data encompassing the entirety of the study dates.

Implementation

Potential challenges in plans for implementation included identifying personal bias and ensuring neutral verbiage and analysis of patient information. Challenges associated with the retrospective data analysis also included finding information within the patients' EHRs and not being able to access certain information once a patient had begun rehabilitation at another facility. Challenges associated with the patient perception survey included patient willingness to participate, as well as the distribution of the patient surveys in a very busy hospital unit. Additional challenges included the aspect that nominal measurement often provides the least amount of information out of the statistical evaluation tools.

Postimplementation

Information collected from the retrospective data analysis included summative data. The data set included a discrete number of variables with nominal values, which would be best interpreted quantitatively via descriptive analysis. The retrospective data analysis consisted of a cohort study that utilized a thorough patient chart review. Results of the retrospective data analysis were best presented in frequencies, percentages, and mean calculations. This study was evaluated descriptively, as it was evaluating trends surrounding barriers to CR participation, outcomes of patients who have or have not participated or completed CR, and referral rates to outside CR facilities for patients at the urban community hospital. Furthermore, a retrospective analysis was chosen to avoid patient bias, as the patient's decisions and events had already occurred prior to the start of the study.

The patient perception survey asked nominal scale, ordinal scale, ratio scale, and fill in the blank questions to evaluate patient location, barriers to CR participation, and demographics. However, the aim of the patient perception survey was to perform a descriptive survey analysis

using poll research regarding patient interest in participation in a tele-CR program for quantitative evaluation. The results were evaluated via descriptive analysis, as the purpose of the patient perception survey implementation was to identify a trend regarding patient interest in tele-CR.

Intervention Plans

Project goals, objectives, and interventions were reviewed prior to project approval by the IRBs at St. Scholastica and the urban community hospital. Anticipated start dates for each aspect of the project were planned during the approval process. Once IRB approval was obtained from both organizations, the project began, as shown in Appendix G.

IRB/Ethical Considerations

The IRB is a group at each organization whose role is to protect human subjects in research (Lapid et al., 2019). The IRB is in charge of reviewing, approving, denying, and monitoring research within their organization (Lapid et al., 2019). All individuals who perform research that involves human subjects require approval from an IRB before moving forward with their project (Lapid et al., 2019).

The author submitted a formal application to St. Scholastica's and the urban community hospital's IRB to receive project approval. Within the application, the author encompassed information regarding the principal investigators, the title of the project, project description and aim, and justification of the need for the research. The project application also encompassed a description of the participants and how they were selected, the procedure description, and a description of the risk to the participants and the reduction of those risks. In addition to the IRB applications, a mentor letter of support was created by the stakeholder and provided to both institutions.

This project received the approval of the St. Scholastica IRB, as well as the urban community hospital's IRB. St. Scholastica's initial IRB approval document can be found in Appendix N. Further adjustment of the project occurred once the author began communicating with the urban community hospital's IRB, which resulted in two separate project amendment submissions to St. Scholastica's IRB. Approval for the most recent amendment application can be seen in Appendix O. Once approval was granted from St. Scholastica's IRB, the author submitted a formal application to the urban community hospital's IRB for approval.

Risks and Benefits

Risks associated with this project included patient breach of privacy associated with the patient perception survey and the retrospective data analysis. Vulnerable patients within this study include: elderly individuals, individuals with chronic health conditions, individuals with barriers to healthcare, individuals with income inequality, and potentially uninsured individuals ("Vulnerable Populations: Who are They?,"2006). Breach of patient privacy within the patient perception survey could occur if the patient were to write their name or address anywhere on the return envelope or on the survey itself. To prevent this, the author placed a sticker over the return address area of the return envelope that stated "no return address necessary," and did not include any areas on the survey for the participant to write their name or any identifying information. The patients would be considered voluntary, and consent for participation would be indicated by submitting a completed survey.

Regarding the retrospective data analysis, patient consent could not be obtained. The author completed a waiver of consent and Health Insurance Portability and Accountability Act (HIPAA) authorization form created by the urban community hospitals IRB to ensure the safety and privacy of patient information. Once patient information was obtained by the author, it was

kept in a secure folder within the urban community hospital's research department computer system that had strict access permission only by the author and the project advisor within the urban community hospital. Furthermore, this folder could only be accessed by using the urban community hospital's computer system.

Benefits regarding participation included providing information in order to identify perspectives, barriers, and outcomes regarding CR and the potential advocation for a tele-CR program. This information in turn, would potentially increase access to healthcare in the future at the urban community hospital.

Ethics

Ethical considerations for this project included patient confidentiality, informed consent, anonymity, and pressure to participate (Fisher, 2020). The author ensured that the project was in compliance with the American Nurses Association and that patient confidentiality and anonymity were compliant with HIPAA using the above-mentioned measures. Furthermore, informed consent was presented to patients who were given the patient perception survey. The patient perception survey consent form, found in Appendix P, included information regarding an invitation to participate, the study purpose, study procedure, risks of participation, benefits to participation, and contact information for the author, advisor, department chair, IRB chair at St. Scholastica, and dean of nursing if the participant were to have questions. This form also requested that the participants refrain from providing any personal information or signatures. The submission of the survey signified that the patient had read and agreed to participate in the project. Participation in this aspect of the study was on a voluntary basis to eliminate any pressure to participate.

Regarding the retrospective data analysis, patient consent was not able to be obtained. The author completed a Waiver of Consent and HIPAA Authorization form for review and approval from the urban community hospital's IRB. Once approved, requested patient data was provided to the author to further analyze and remained within a secure folder. After the collection of the data was complete, all patient information and identifiers were removed from the data set in order to maintain confidentiality.

Implementation

The project began once approval from both IRBs was obtained. Changes to the original project resulted in the delay of the urban community hospital's IRB approval until 3/11/2021. Communication with the project advisor within the urban community hospital regarding itemized data to be requested and collected, creation and distribution of patient surveys, and IRB requests occurred frequently between 1/1/2021 and 3/11/2021. During that time, communication regarding updates to the project were discussed with the project mentor. Leadership on the cardiac unit were also contacted regarding the distribution of the patient survey for approval, as well as initial distribution date, prior to IRB approval.

Patient-specific data was requested and was gathered by 2/3/2021, but was not accessed by the author until IRB approval was obtained. Once IRB approval was obtained, the patient perception survey packets were created, which included the patient survey, the informed consent form, and a prestamped and preaddressed envelope with a return address to the urban community hospital's research department to maintain the author's privacy. Patient survey distribution began on 3/15/2021. Due to the delayed start date, the survey distribution was completed on 5/1/2021.

The author performed patient data collection and analysis from 3/12/21 through 3/15/2022. During the initial stages of data collection and evaluation, discussion was had with

the project advisor within the urban community hospital, and both institutions' IRBs regarding the inclusion of a statistician in the evaluation of research to ensure the accuracy of results. An IRB amendment to include a statistician was submitted and approved by both IRBs by 5/7/2021. After the collection and evaluation of data by the author occurred, the information was de-identified and approved by the project advisor within the urban community hospital to share with the hired statistician, who performed a thorough analysis of the data.

Each step of the project was monitored by the author to ensure the project's goals and objectives were continually being addressed. However, due to project adjustments and the complexities of the retrospective data set, the GANTT chart required adjustment from its original timeline. The updated GANTT chart is noted in Appendix G. Influencing factors to the project included adjustment of the project, a large number of patients to be analyzed in the retrospective data analysis, time associated with the completion of the retrospective data analysis, willingness of cardiac unit staff to disperse surveys, and patient interest in participation in the survey analysis.

Results and Data Collection

Retrospective Data Analysis

Data Acquisition and Organization

Patient information was requested by the author and gathered by the urban community hospital's research department staff. Information was requested for patients with International Classification of Disease codes (ICD-10) which correlated with CR. ICD-10 codes that were requested included: Z95.1 (coronary artery bypass surgery), Z95.2 (presence of prosthetic heart valve), Z98.61 (Coronary stenting), Z95.5 (presence of coronary angioplasty implant or graft), I21.3 (MI, STEMI), I21.4 (MI, Non-STEMI), I20.9 (Angina Pectoris), and I50.22 (Heart

Failure). Additional information requested included: patient name, patient address, patient city, patient zip code, patient geocode, patient medical record number, patient account number, date of birth, admission date, discharge date, date of death if applicable, orders for cardiac rehabilitation, cardiac referral outside of the hospital, readmission date, orders for a stress test, completion of phase one CR, completion of phase two CR, and completion of phase three CR.

Data that was returned to the author included patients with the requested ICD-10 codes, as well as many other noncardiac-related ICD-10 codes. Each patient encounter had the following information provided: patient account number, account admittance date, account discharge date, account primary diagnosis code, patient name, patient medical record number, patient date of birth, patient address, patient city, and patient zip code. Additional information included in the data set discussed if the patient had passed away, date of death if applicable, cardiac rehab order set, and stress test order. The data set returned to the author included the results of 6,153 patient encounters. Patient encounters were labeled numerically, and the original document was saved for reference once alteration of the spreadsheet began. ICD-10 codes were identified using a Google search, and noncardiac-related codes without referral to CR were removed.

Once nonrelevant data was removed from the spreadsheet, 1,295 patients remained for further analysis. The author utilized Meditech Expanse to evaluate CR notes, exercise physiologist notes, physician notes, and CR referral information for each patient. Patient data were gathered, including the intervention which led to CR referral, the date of the intervention, participation in phase one CR while in the hospital, if the patient chose to participate in phase two CR, if the patient participated at the urban community hospital, or if the patient received a referral to participate in phase two at an urban, urban cluster, or rural location. Additionally, the

patient chart was evaluated to determine if the patient started phase two CR, how many sessions they completed, and if they completed phase two CR. If the patient did not participate or did not complete phase two CR identification of the barrier to participation was investigated and documented. If any of the prior information was unable to be identified within the patient chart, it was listed as "unknown." Furthermore, each patient was evaluated for their follow-up with the hospital's cardiology providers, if stress testing was performed after their original intervention, subsequent cardiac-related hospitalizations, subsequent cardiac intervention, as well as all-cause mortality.

Inclusion and Exclusion Criteria

A thorough chart review was performed for each patient to assess for the aforementioned data surrounding CR. Inclusion criteria included: patients at the urban community hospital with a referral for CR, patients whose first CR session occurred after 9/1/2019, and patients whose first CR session began prior to 12/31/2020. Exclusion criteria consisted of: patients who had received a referral for CR during a hospitalization and had passed away prior to hospital discharge, patients who had not received a referral for CR, and patients who began CR prior to 9/1/2019 or after 12/31/2020.

Additionally, staged interventions were counted as one referral, bypass surgery that resulted from an angiogram counted as one referral, and angiograms that resulted in valve replacement surgery counted as one referral. Furthermore, cardiac-related hospitalizations were defined as inpatient and included: hospitalizations listed with cardiac-specific diagnoses, respiratory illnesses that were related to cardiac illness, hypotension, hypertension, electrolyte abnormalities, syncope, and claudication or weakness after an angiogram. Hospitalizations for pacemaker placement, cardioversion, peripheral vascular surgery, admission to the rehab unit

within the urban community hospital, and admission to a swing bed after discharge were not included. Likewise, stress testing was evaluated and counted as a subsequent outcome only if it occurred after the cardiac intervention that led to the CR referral. Stress testing that led to a cardiac intervention or was outside of the study dates was not included in the study.

Evaluation of Patient Data

After a thorough chart review, the study population was narrowed down to 551 qualifying subjects based on inclusion and exclusion criteria, as well as receiving a CR referral. In order to assess the project's outcomes, each of the remaining patients' reasons for nonparticipation or noncompletion of CR was put into one of eight categories. These categories included: "health limitations," "want/able to exercise at home," "interference with schedule," "Covid-related concerns," "transportation-related," "cost," and "unknown." The unknown category was listed for those who were referred to CR, and often due to electronic health record limitations, were not able to be further assessed for completion or participation in CR. The category of "N/A" was assigned to patients who had completed CR and was not included in the barrier analysis.

Stress testing was also evaluated surrounding the patient's intervention date. A column was created to indicate a correlation between the patient's stress testing and their cardiac intervention, if applicable. Identification of the patient's stress test date surrounding their intervention was done to determine if the patient's stress test led to their cardiac intervention or if the stress test was performed after the intervention. Stress tests performed after cardiac intervention or CR referral could indicate continued symptoms or other adverse outcomes. Stress tests that led to cardiac interventions were removed from the analysis.

The patient intervention date was evaluated and was changed to the term "pre," "post," or "post >6mo." Any interventions performed between 9/1/2019 and 3/13/2020 were assigned the

term “pre”. Any interventions performed between 3/14/2020 and 9/13/2020 were assigned the term “post”. Additionally, interventions between 9/14/2020 and 12/31/2020 were assigned the term “post >6mo”. The patient city was changed to either “urban*,” “urban,” “urban cluster,” or “rural” based on their home location. “Urban*” was assigned to patients living in the urban community hospital’s city, and “urban” was assigned to patients living in a city with a population greater than 50,000 people (Health Resource & Services Administration, 2021). Patients living in an area containing 2,501 to 49,999 people were assigned the term “urban cluster,” and patients living in an area with a population of less than 2,500 people were given the term “rural” (Health Resource & Services Administration, 2021). An additional column indicating if the patient lived in a residence within the urban community hospital’s state was created, and each patient was assigned either “yes” or “no” for this section.

The data was then de-identified for patient protection and further review. Patient age was de-identified by using the patient’s age as of 12/31/2020, and was put in categories of age “30 to 39,” “40 to 49,” “50 to 59,” “60 to 69,” “70 to 79,” “80 to 88,” “and >89.” The patient’s name was then changed to identify if they were male or female by listing the letter “M,” indicating male, and “F” indicating female. Once age and gender de-identification were completed, the patient’s name, account number, medical record number, account admit date, account discharge date, account primary diagnosis code and notes, date of birth, address, city, city zip code, date of death if applicable, rehab order set, and stress test order set columns were removed in order to protect patient identification.

After the patient data was de-identified, the spreadsheet was sent to the project advisor within the urban community hospital for approval to share with the author’s statistician. Once approval was obtained, the author and the statistician analyzed the data and provided results.

Results

Results of the retrospective data analysis split the patients into two groups based on their location of CR participation; the rural/urban cluster group and the urban group. Patients referred to outside facilities were most frequently listed in the rural/urban cluster group. This group was difficult to determine barriers due to the inability to investigate outside provider notes. The term "unknown" was listed under patients in which data was not able to be collected. Data were evaluated using descriptive statistical analysis using an ordinal ranking of barriers to CR participation and nominal value percentages of patient outcomes and interest in CR.

Barriers

The data were evaluated to identify the top three most common barriers to participation and completion of CR in each group six months before the Covid-19 lockdown, six months after the Covid-19 lockdown, and for the total duration of the study. Additionally, the top three barriers to CR participation and completion were evaluated for all patients in the study six months before Covid-19 lockdown, six months after the Covid-19 lockdown, and for the total duration of the study. The results from the evaluation of patient barriers to CR participation can be noted in Table 4.

In the rural/urban cluster group, "unknown" was the top listed barrier in all time categories. After "unknown" was removed from the results, the top three barriers in each category can be found in Table 4. The three most common barriers six months before the Covid-19 lockdown included: "want/able to exercise at home" (n = 12), "Covid-related concerns" (n = 12), and "health limitations" (n = 6). Six months after the Covid-19 lockdown, the top three barriers included: "want/able to exercise at home" (n = 12), "Covid-related concerns" (n = 10),

and “health limitations” (*n* = 7). For the full duration of the study, the top three barriers remained the same as the pre and post-Covid-19 lockdown information.

In the urban group, the term “unknown” was surprisingly listed as the top barrier in all timeframes. Once this was removed, the top three barriers six months before Covid-19 lockdown included: “Interference with schedule” (*n* = 20), “want/able to exercise at home” (*n* = 13), and “Covid-related concerns” (*n* = 14). Six months after the Covid-19 lock down the top three barriers were: “Covid-related concerns” (*n* = 11), “interference with schedule” (*n* = 7), and “want/able to exercise at home” (*n* = 7). The top three barriers in this group for the full duration of the study included: “want/able to exercise at home” (*n* = 29), “Covid-related concerns” (*n* = 27), and “interference with schedule” (*n* = 23). The results from this group can be further reviewed in Table 4.

Data regarding barriers to the total patient population can be found in Table 4. After “unknown” was removed as the top barrier in all categories, the top three barriers to CR participation six months before the Covid-19 lockdown included: “want/able to exercise at home” (*n* = 32), “Covid-related concerns” (*n* = 25), and “interference with schedule” (*n* = 20). Barriers for the entire cohort six months after the Covid-19 lockdown included: “want/able to exercise at home” (*n* = 21), “Covid-related concerns” (*n* = 20), and “health limitations” (*n* = 19). The top three barriers for the entire cohort for the full duration of the study included: “want/able to exercise at home” (*n* = 51), “Covid-related concerns” (*n* = 46), and “health limitations” (*n* = 36).

Table 4

Results of Barrier Identification

Time	Rural/Urban Cluster	Urban	Total
Pre-Covid-19 Lockdown	Want/able to exercise at home (12 patients)	Interference with schedule (12 patients)	Want/able to exercise at home (22 patients)
	Covid-related concerns (12 patients)	Want/able to exercise at home (10 patients)	Covid-related concerns (19 patients)
	Health Limitations (6 patients)	Covid-related concerns. (7 patients)	Interference with schedule (15 patients)
Post-Covid-19 lockdown	Want/able to exercise at home (20 patients)	Covid-related concerns (11 patients)	Want/able to exercise at home (29 patients)
	Covid-related concerns (13 patients)	Want/able to exercise at home (7 patients)	Covid-related concerns (27 patients)
	Health limitations (14 patients)	Interference with schedule (7 patients)	Health limitations (23 patients)
Total	Want/able to exercise at home (32 patients)	Covid-related concerns (21 patients)	Want/able to exercise at home (51 patients)
	Covid-related concerns (25 patients)	Interference with schedule (20 patients)	Covid-related concerns (46 patients)
	Health limitations (20 patients)	Want/able to exercise at home (19 patients)	Health limitations (36 patients)

Note. This table displays the top three barriers in each population group after the unknown category had been removed. The number of patients who identified as having each barrier is displayed below the barrier. Each group was evaluated for barriers pre-Covid-19 lockdown, post-Covid-19 lockdown, and for the total duration of the study, which included data from the pre-Covid-19 lockdown, post-Covid-19 lockdown, and post > 6 months' time periods.

Rate of Participation

Patient rates of CR participation were calculated based on the total study population and are listed in Table 5. The rates of participation were divided into pre-Covid-19 lockdown, post-Covid-19 lockdown, and total study duration categories. Due to the large number of patients that were not able to be evaluated due to noncommunicating EHRs, these patients were assigned an unknown status and were presumed to have initiated a CR program. Patients with unknown

status were included in the rate of participation category due to presumed participation, as they did not have CR refusal documented in their EHR. Additionally, patients with documented completion of CR were the only patients listed under the completed category. Calculation of completion rates included patients with an unknown status in the total number of patients in each category.

Pre-Covid-19 lockdown, the total patient participation rate was 66% (*n* = 181). Of the participants, the rate of assigned unknown status was 35% (*n* = 86), and the completion rate was 27% (*n* = 48). Post-Covid-19 lockdown, the total patient participation was 71.2% (*n* = 139). Of the participants, the rate of assigned unknown status was 48.9% (*n* = 68). The completion rate for CR participants in this group was 30.9% (*n* = 43). Furthermore, for the full duration of the study, the patient participation rate was 72.6% (*n* = 400). Of the total participants, the rate of unknown patient status was 35.2% (*n* = 194). Completion rates for those who participated in CR for the full duration of the study were found to be 29% (*n* = 116).

Table 5

Rates of CR Participation, Completion, and Unknown Completion Status

Participation Timeframe for Entire Study Population	Rate of Participation (Including Unknown)	Rate of Unknown	Completion Rate
Pre-Covid-19 lockdown	66% (*n* = 181)	35% (*n* = 86)	27% (*n* = 48)
Post-Covid-19 lockdown	71.2% (*n* = 139)	48.9% (*n* = 68)	30.9% (*n* = 43)
Total duration of study	72.6% (*n* = 400)	35.2% (*n* = 194)	29% (*n* = 116)

Note. Table 5 evaluates rates of CR participation, completion, and rates of unknown completion status in the study's total patient population for the entire duration of the study. The number of unknown patients were included in the rate of participation due to the absence of indication of CR refusal. Additionally, only patients who had documented CR completion within their EHR were included in the completed category.

Negative Outcomes

Negative outcomes were calculated for the rural/urban cluster group, the urban group, and a group that included patients who received a referral for CR but chose not to participate. Patients in these groups were identified as having a negative outcome if they had a subsequent stress test after their CR referral, were hospitalized for a cardiac illness after their CR referral, had a subsequent cardiac intervention, or had passed away after their CR referral. The groups were further divided into patients who completed CR, patients who did not complete CR, patients in which the author was not able to determine patient participation or completion in CR, and those who did not participate in CR. Negative outcomes rates were calculated for the above-mentioned groups, as well as for the total cohort. The results of the outcome analysis can be found in Table 6 and were calculated based on the full duration of the study.

Rural/urban Cluster Group. The rural/urban cluster group population was difficult to assess due to noncommunicating EHR data. The total number of patients in the rural/urban cluster group who did not participate in CR equaled $n = 19$. Approximately 21% ($n = 4$) of the 19 total rural/urban cluster patients who did not participate in CR were found to have at least one of the negative outcomes mentioned above. The total number of patients in the rural/urban cluster group who completed CR equaled $n = 33$. Approximately 15.6% ($n = 5$) of the 33 total rural/urban cluster patients who completed CR were found to have experienced at least one negative outcome during the study. Furthermore, the total number of patients in the rural/urban cluster group in which the author was unable to determine completion or participation of CR was $n = 178$. Approximately 23.6% ($n = 42$) of the 178 rural/urban cluster patients with unknown completion or participation status of CR were found to have experienced at least one negative outcome during the study.

Urban Group. The total number of patients within the urban group who did not participate or complete CR was *n* = 72. Approximately 37.5% (*n* = 27) of the 72 urban patients who did not participate in CR experienced at least one negative outcome during the study. The total number of patients within the urban group who completed CR equaled *n* = 82. Approximately 23.2% (*n* = 19) of the 82 urban patients who completed CR were found to have experienced at least one negative outcome during the study. Additionally, the total number of patients in this group in which the author was not able to determine participation or completion of CR was *n* = 16. Approximately 43.75% (*n* = 7) of the 16 urban patients in which the author was unable to determine CR participation or completion experienced at least one negative outcome during the study.

Nonparticipant Group. The total number of patients who chose not to participate in CR, regardless of their home location, equaled *n* = 151. It was found that approximately 37.8% (*n* = 57) of the 151 patients who chose not to participate in CR experienced at least one negative outcome throughout the duration of the study.

Total Study Population. Total rates were calculated to include all groups for the full duration of the study. The total number of patients from all groups who did not complete CR equaled *n* = 242. Approximately 36.4% (*n* = 88) of the 242 patients from all groups who did not complete CR were noted to experience at least one negative outcome during the study. The total number of patients from all groups who completed CR equaled *n* = 115. Approximately 20.9% (*n* = 24) of the 115 patients from all groups who completed CR had experienced at least one negative outcome during the study. Furthermore, the total number of patients from all groups whom the author could not determine CR participation or completion status equaled *n* = 194. Approximately 25.3% (*n* = 49) of the 194 total patients whom the author was not able to

determine CR participation or completion had experienced at least one negative outcome during the study. The total patient cohort, regardless of CR participation, had a total *n* = 551. The rate of experiencing at least one negative outcome within the total population of 551 patients was 29.2% (*n* = 161).

All-Cause Mortality. All-cause mortality rates were calculated for patients with consideration for their participation and completion of CR and can also be noted in Table 6. All-cause mortality rates were calculated based on the total number of patients in each group and within each category that were used in the negative outcomes analysis. Patients within the rural/urban cluster patients who did not complete CR had an all-cause mortality rate of 5.3% (*n* = 1). Patients within the rural/urban cluster group who had completed CR had an all-cause mortality rate of 0% (*n* = 0). Patients in the rural/urban cluster group in which the author was not able to determine patient CR participation or completion had an all-cause mortality rate of 4.5% (*n* = 8).

Patients who completed CR in the urban group had an all-cause mortality rate of 2.4% (*n* = 2). The study also found that patients in the urban group who did not complete CR had an all-cause mortality rate of 11.1% (*n* = 8). Furthermore, patients in the urban group in which the author was not able to determine participation or completion of the CR program had an all-cause mortality rate of 31.25% (*n* = 5). Additionally, patients who chose not to enroll or participate in CR had an all-cause mortality rate of 19.9% (*n* = 30).

Totals for the entire patient cohort were calculated, and it was found that patients who did not participate or complete CR had an all-cause mortality rate of 16.1% (*n* = 39). Patients who completed CR had an all-cause mortality rate of 1.7% (*n* = 2). Patients with unknown CR participation or completion status had an all-cause mortality rate of 6.7% (*n* = 49). Furthermore,

the all-cause mortality rate of the entire cohort, regardless of participation, was found to be 9.8% (*n* = 54).

Referral Rate

The rate of referral was calculated to determine the number of patients who were referred to participate in CR at other facilities, as well as to determine the ability to identify CR participation and completion statuses of the patients who were referred to outside facilities.

The total patient population of the study was 551 patients. Patients who chose not to participate in CR equaled 27.4% (*n* = 151), 27% (*n* = 149) of the total patients within the study participated in CR at the urban community hospital, 44.8% (*n* = 247) of the total patients received a referral to participate in CR at another location, and 0.07% (*n* = 4) of the total patients were listed as unknown for their CR location. Patient participation and referral rate to CR at the urban community hospital and other CR locations, listed in Appendix Q, shows the outcomes in a pie chart for ease.

The patients who received a referral for CR participation at another facility (*n* = 247) were further evaluated for the ability to measure participation and completion rates. Patients who were referred to another CR facility had noncompletion rates of 9.7% (*n* = 24), completion rates of 14.2% (*n* = 35), and unknown rates of completion or participation of 76.1% (*n* = 188).

Table 6

Rates of Negative Health Outcomes and Mortality Rates for Patients Within the Study

	Urban patients who completed CR	Urban patients who did not complete CR	Urban patients with unknown CR completion	Rural/urban cluster patients who completed CR	Rural/urban cluster patients who did not complete CR	Rural/urban cluster patients with unknown CR completion	Patients who did not enroll or participate in CR	Patients who completed CR for the total cohort.	Patients who did not complete CR for the total cohort	Patients with unknown CR completion for the total cohort	Total patient Cohort
Patients who have experienced at least one negative outcome	19	27	7	5	4	42	57	24	88	49	161
Patients who have not experienced any negative outcomes	63	45	9	28	15	136	94	91	154	145	390
Total patients within the group	82	72	16	33	19	178	151	115	242	194	551
Rate of negative outcomes	23.20%	37.50%	43.75%	15.60%	21%	23.60%	37.80%	20.90%	36.40%	25.30%	29.20%
Patients who have passed away regardless of cause	2	8	5	0	1	8	30	2	39	49	54
Rate of mortality	2.40%	11.10%	31.25%	0%	5.30%	4.50%	19.90%	1.70%	16.10%	6.70%	9.80%

Note. Rates of negative health outcomes and mortality were calculated in the urban group, rural/urban cluster group, and total patient cohort. Further calculations were made to identify a potential correlation between CR participation and noncompletion or nonparticipation, with rates of negative outcomes, including mortality.

Patient Perception Surveys

Patients included in this study were those who had been discharged from the urban community hospital's cardiac unit with an order for CR. Patients who were excluded were those who were not hospitalized on the cardiac unit for a cardiac related illness. One hundred patient survey packets were created and given to cardiac unit staff for distribution. The packets consisted of a consent form, the survey, and a prestamped and preaddressed envelope. Questions from the patients or staff could be answered by the author at any time. The envelopes were addressed to the urban community hospital's research department to maintain the privacy of the author. At the end of the distribution period, the author collected the returned surveys from the urban community hospital's research department for further evaluation and review.

A total of 18 surveys were distributed between 3/15/2021 and 5/1/2021. Four of the 18 surveys were returned. The results of the survey data can be found in Appendix M. The main focus of the survey was to determine interest in tele-CR if it were to be available to patients at the urban community hospital. All four patients who returned their surveys stated that they would be interested in a tele-CR program, which equates to a 100% interest among participating patients.

Discussion of Data/Outcomes Interpretation

Data was evaluated based on the outcomes of the study in order to encourage the development a tele-CR program at the urban community hospital. Additionally, the project's outcomes can be used on a larger scale to advocate for the use of communicating electronic health records, supporting the need for high-speed internet access in areas with limited access to healthcare, and insurance coverage of tele-rehab programs throughout the nation.

Goals and Objectives

The project goal regarding the identification of barriers to CR participation was successful in that it provided hospital-specific patient information for both urban as well as rural and urban cluster locations, as listed in Table 4.

Barriers. The most common barriers were identified surrounding the Covid-19 lockdown date in order to evaluate the impact of the Covid-19 pandemic on participation in CR. Patient barriers to CR participation were placed into seven categories. These included: "health limitations," "want/able to exercise at home," "interference with schedule," "Covid-related concerns," "transportation related," "cost," and "unknown." For the purpose of discussion, the top three barriers are listed in order of highest patient response to the lowest. "Unknown" was assigned to the patients whose barriers, if any, could not be identified. The unknown barrier was removed to allow for dissemination and identification of the most common barriers. Discussion regarding patient information access will be discussed later in this section.

For the rural/urban cluster group, the top three barriers were "want/able to exercise at home," "Covid-related concerns," and "health limitations" for the timeframes that encompassed pre-Covid-19 lockdown, post-Covid-19 lockdown, and total duration of the study. During the Pre-Covid lockdown timeframe, the barriers of "want /able to exercise at home" and "Covid-related concerns" had been tied in order of importance to patients. Of the seven total categories of barriers, the rural/urban cluster group remained consistent in their perceived barriers to CR participation. Furthermore, Covid-19 concerns remained in their top three barriers in all timeframes.

The urban group's top three barriers pre-Covid-19 lockdown were "want/able to exercise at home," "Covid-related concerns," and "health limitations." Subsequently, after the Covid-19

lockdown, the top three barriers changed in their order of importance to patients and were: "Covid-related concerns," "want/able to exercise at home," and then "interference with schedule." The post-Covid lockdown order remained consistent with the most common barriers to CR participation for the entirety of the study. These results indicate that there are four barriers that are most common within the urban group. During the Covid-19 lockdown, the urban patients' priorities changed, showing that Covid-related concerns were of high importance to this group.

For both groups combined, the most documented barriers included: "want/able to exercise at home," "Covid-related concerns," "interference with schedule," and "health limitations" for pre-Covid lockdown, post-Covid lockdown, and for the entire duration of the study. The results of the total cohort support the individual group results indicating that patient barriers remain consistent.

Participation Rate. Evaluation of the participation rate in CR for the entire study population was shown to be 72.6% for those who received a referral for CR from the urban community hospital. The rate of unknown participation was 35.2%, and the completion rate for CR in the total study population was 29%. These rates are higher than the national average rate of participation, which is 10% to 15% (Kaiser Permanente, 2019). Million Hearts® Cardiac Rehabilitation Collaborative has a goal of increasing CR participation to 70% nationally by the year 2022. Based on the results of the retrospective data analysis, the urban community hospital has already met the goal benchmark of the Million Hearts® Cardiac Rehabilitation Collaborative. By further increasing access to CR programs via telehealth, the urban community hospital has the potential to exponentially surpass the CR participation and completion national benchmarks.

Patient Outcomes. Patient outcomes were evaluated regarding their CR location being rural/urban cluster or urban, their CR participation or completion status, and the presence of any negative outcomes. Negative outcomes in this study included: subsequent stress testing after CR referral, subsequent cardiac hospitalization after CR referral, subsequent cardiac intervention after CR referral, and rate of mortality. The results of the outcome analysis can be found in Table 6 and were calculated based on the full duration of the study.

The results were analyzed for the negative outcomes and mortality rates after the patients with unknown CR completion statuses were removed. Negative outcomes were found to occur at a higher rate of frequency in patients who did not participate in CR or did not complete their CR program within the urban and the rural/urban cluster groups. Negative outcomes were also noted to be higher within the total study population in patients who did not participate or complete CR. This data follows national trends and supports the use of CR to support the overall health of patients who qualify. Mortality rates, as noted in Table 6, indicate that there is an association between CR participation and decreased mortality rates in all groups within this study's population. These results are consistent with national data regarding the benefits of CR as mentioned above.

Rates of Referral. Rates of patient CR referral within this study can be found in Appendix Q. The urban community hospital referred almost 45% of the 551 total patients to outside facilities within the region. Of these patients, 76% were not able to be assessed for participation or completion of their CR program. Inability to determine CR completion or participation in patients who had been referred to other facilities was frequently due to noncommunicating EHRs. This equates to 188 patients, or 34% of the entire study population, who were not able to have complete continuum of care by staff at the urban community hospital.

Patient Survey. The patient perception survey wielded a very low return rate; however, when assessing the number of surveys distributed, the return rate was 22%. Of the four patients that returned their patient survey, all had an interest in a tele-CR program. Additionally, the patients surveyed were from areas proximal to the urban community hospital and at larger distances from the urban community hospital, as noted in Appendix M.

Study Limitations

Multiple limitations were present through the duration of the study. First, when patient data was requested by the author for evaluation, many patients with noncardiac-related ICD-10 codes were included in the study set. Furthermore, the ICD-10 code meanings were not present, which presented the author with identification of each in order to eliminate nonrelevant data. Additionally, as the author was performing chart review on the remaining patients, additional cardiac interventions and CR referrals were identified which were not listed in the original data set. Due to these challenges, missing data may not have been included in the data set and time necessary for evaluation of the data set was exponentially increased.

The analysis of the retrospective data analysis also revealed a substantial number of unknown data points, primarily in the patients who had been referred to other facilities, due to noncommunicating EHRs. The author relied on physician or provider notes within the urban community hospital to determine if the patient participated in or completed CR. Due to prioritization of patient illness processes, CR participation and completion was not always documented. If these patients could have been identified as participating, completing, or not completing, it could have helped to create stronger results regarding patient outcomes.

Interpretation for Urban Community Hospital

The data collected and evaluated during this study supports the completion of the objectives of this study. The patients at the urban community hospital have maintained consistency in their most common barriers for all groups in this study. The barriers associated with the patients at the urban community hospital have consistency surrounding the desire to exercise remotely, worries regarding the Covid-19 pandemic, scheduling conflicts, and health limitations or disabilities which prevent them from participating in CR. The support of a tele-CR program at the urban community hospital has the potential to benefit its patients by addressing all of the patients' barriers. Incorporating a tele-CR program can allow the patient to exercise at home, encourage safety during the pandemic, and allow for scheduling flexibility.

Mortality rates and outcomes associated with participation and nonparticipation support the encouragement of CR participation for all patients who receive a qualifying diagnosis. Encouraging a tele-CR program at the urban community hospital has the potential to create ease surrounding patient participation in tele-rehab programs.

Additionally, patient referral to outside facilities is noted to show decreased access to their records by urban community hospital staff. Inability to monitor patient participation and progress in CR programs greatly impacts the continuum of care for its patients. One could also argue that maintaining patient participation at the urban community hospital within a tele-CR program rather than referring them to another facility could implicate financial benefits to the urban community hospital. Furthermore, results from the patients who participated in the patient perception survey indicated that there is an interest in tele-CR within the patient population at the urban community hospital.

Implication for Study Nationwide

During the course of the study, it was noted that external location EHR communication presented a significant barrier to obtaining data. Currently, certain EHR programs, such as EPIC, allow for interfacility communication. Not all facilities utilize such programming, and subsequently, rely on fax, mail, or e-mail, which appears antiquated in today's era of technological advances. When evaluating the data set, 34% of the patients that were referred to outside CR facilities were not able to be electronically monitored in their course of CR treatment by staff at the urban community hospital. This patient population serves as a small glimpse of the total patients who receive care at this hospital who may also receive referrals to outside facilities. The results of this study could be utilized to help promote a national movement to facilitate a means of electronic communication between non-like EHR systems to promote continuum of care and positive patient outcomes.

Additionally, this study has the potential to be utilized to promote the ease of access to reliable high speed internet in rural and underserved communities. Approximately 72% of rural Americans have internet access, which is a noted improvement within the last 10 years (Vogels, 2021). In a 2018 survey, 24% of rural Americans stated that they felt that access to high speed internet was a large problem (Vogels, 2021). Access to the internet in rural communities has been slowly improving, but it has a long way to go. Internet access is crucial to the incorporation of telehealth in communities. The data obtained in this research supports the use of telehealth, specifically in CR. The support provided by this research can subsequently provide support for additional resources that are necessary, such as internet access, for those who live in underserved populations.

Lastly, there is a national barrier of cost to CR participation, as well as telehealth participation. A challenge to cost has been insurance reimbursement to hospitals regarding telehealth, including tele-CR. Insurance reimbursement is impacted by Medicare and Medicaid, as well as other private insurances (Kuehn, 2020). Due to the legislative acts by the U.S. Congress surrounding the Covid-19 pandemic, Medicare coverage of home telehealth services was extended until the end of the year 2022 (Minnesota Medical Association, 2022). The extension of telehealth coverage can benefit rural patients, in particular, because it allows for coverage of approved telehealth services while the patient is able to remain at home rather than travel to the nearest healthcare facility (Minnesota Medical Association, 2022). The data from this project could be found useful for the advocation of continued Medicare and insurance coverage of home telehealth programs, including tele-CR.

Dissemination

The details of this project and the full results will be provided to the urban community hospital's IRB, as well as to the project advisor within the urban community hospital and the urban community hospital's research department. Additionally, the information will also be provided to the project mentor and the director of the cardiology department to support future practice. Furthermore, the project paper will be submitted to the Sigma Repository along with a completed poster that encompasses the entirety of the project. Aspects of the project are also anticipated to be submitted for publishing in an academic journal. The journal is to be chosen by St. Scholastica advisors and staff.

Conclusion

Participation in CR has proven to increase positive patient health outcomes and quality of life for those who participate (Servey & Stephens, 2016)., 2016). Although CR has been proven

to be beneficial for patients who qualify, barriers to CR participation are often present and have led to decreased rates of participation in CR (Servey & Stephens, 2016). Nonparticipation in CR has been shown increased rates of all-cause mortality, hospital readmission, and health related costs compared to patients who participate in CR (AHA, 2017). One means of addressing barriers and access to CR programs is by means of telehealth (Mayo Clinic Staff, 2017).

A retrospective data analysis was performed to evaluate barriers, rates of negative patient outcomes, and rates of referrals to other CR facilities for patients at an urban community hospital. The project further assessed for differences in these outcomes for the urban community hospital's by evaluating results based on location of CR participation, rurality of home location, ability to monitor patient CR progress at outside facilities, and the impact of the Covid-19 pandemic on patient participation. Additionally, a survey of the urban community hospital's patients' perception surrounding interest in tele-CR was evaluated. The purpose of the study was to provide supportive hospital-specific data to the urban community hospital to help support the development of a future tele-CR program.

Results of the study showed common barriers between study groups that focused on wanting to exercise at home, concerns surrounding Covid-19, interference with the patient's schedule, and health limitations that prevented participation. Additionally, the rate of patient participation and completion of CR at the urban community hospital were noted to be above the national average. The study also found that there was a noted correlation between negative outcomes and nonparticipation in CR within the study population. Furthermore, 44.8% of patients who participated in CR within this study were referred to another CR facility, and of those patients, 76.1% could not be further evaluated for CR progress due to noncommunicating

EHRs. Lastly, patients at the urban community hospital showed interest in tele-CR participation based on survey results.

The information gathered from this project has the potential to be utilized within the urban hospital healthcare system for further evaluation or for the potential for the creation of a tele-CR program. Additionally, this information can be utilized on a national level to advocate for communicating health record systems, access to high speed internet for patients in underserved communities, and to encourage the continuation of Medicare and Medicaid coverage for telehealth services.

References

Ades, P., Keteyian, S., Wright, J., Hamm, L., Lui, K., Newlin, K., Shepard, D., & Thomas, R. (2017). Increasing cardiac rehabilitation participation from 20% to 70%: A road map from the Million Hearts cardiac rehabilitation collaborative. *Mayo Clinic Proceedings*, *92*(2), 234–242. https://doi.org/10.1016/j.mayocp.2016.10.014

AlDossary, S., Martin-Khan, M. G., Bradford, N. K., Armfield, N. R., & Smith, A. C. (2017). The development of a telemedicine planning framework based on needs assessment. *Journal of Medical Systems*, *41*(5), Article 74. https://doi.org/10.1007/s10916-017-0709-4

American College of Cardiology. (2018, February 18). Research shows home-based cardiac rehab increases participation. *American College of Cardiology*. https://www.acc.org/latest-in-cardiology/articles/2018/02/02/15/31/research-shows-home-based-cardiac-rehab-increases-participation

American Heart Association. (2017). *Cardiac rehabilitation putting more patients on the road to recovery*. https://www.heart.org/-/media/Files/About-Us/Policy-Research/Fact-Sheets/Clinical-and-Post-Clinical-Care/FACTS-Cardiac-Rehab.pdf

American Hospital Association. (2016). *Telehealth: Helping hospitals deliver cost-effective care.* https://www.aha.org/system/ files/content/16/16telehealthissuebrief.pdf

American Hospital Directory. (2019). Saint Luke's Hospital. https://www.ahd.com/free_profile/240047/Saint_Luke's_Hospital/Duluth/Minnesota/

Vulnerable populations: Who are they? (2006). American Journal of Managed Care. *12*(13), S348-S352. https://www.ajmc.com/view/nov06-2390ps348-s352

Banner, D., Kandola, D., Bates, J., Horvat, D., Ignaszewski, A., Singer, J., & Lear, S. A. (2019). Patient experiences of undertaking a virtual cardiac rehabilitation program. *Canadian Journal of Cardiovascular Nursing*, *29*(2), 6–14.

Bravo-Escobar, R., González-Represas, A., Gómez-González, A. M., Montiel-Trujillo, A., Aguilar-Jimenez, R., Carrasco-Ruíz, R., & Salinas-Sánchez, P. (2017). Effectiveness and safety of a home-based cardiac rehabilitation programme of mixed surveillance in patients with ischemic heart disease at moderate cardiovascular risk: A randomized, controlled clinical trial. *BMC Cardiovascular Disorders*, *17*, Article 66. https://doi.org/10.1186/s12872-017-0499-0

Bridging Health Duluth. (n.d.). *Working together for a healthy Duluth: 2020-2022 community health needs assessment.* https://ghci.us/wp-content/uploads/2019/06/CHNA.CHIP-FY2020-2022-Duluth.pdf

Business North. (2019). *St. Luke's earns two awards*. http://www.businessnorth.com/news makers/st-lukes-earns-two-awards/article_ce742930-9c1d-11e9-8012-97e873ebecf2.html

Buzza, C., Ono, S. S., Turvey, C., Wittrock, S., Noble, M., Reddy, G., Kaboli, M., & Reisinger, H. S. (2011). Distance is relative: Unpacking a principal barrier in rural healthcare. *Journal of General Internal Medicine, 26*(2), 648-654. https://doi.org/10.1007/s11606-011-1762-1

Centers for Disease Control and Prevention. (2019). *Million Hearts®*. https://millionhearts.hhs.gov/index.html

Centers for Disease Control and Prevention. (2022). *CDC museum Covid-19 timeline.* https://www.cdc.gov/museum/timeline/covid19.html

Cowper, P. A., Knight, J. D., Davidson-Ray, L., Peterson., E. D., Wang, T. Y., & Mark, D. B. (2019). Acute and 1-year hospitalization costs for acute myocardial infarction treated with percutaneous coronary intervention: Results from the TRANSLATE-ACS registry. *Journal of the American Heart Association*, *8*(8). https://doi.org/10.1161/JAHA.118.011322

Duan, Y. P., Liang, W., Guo, L., Wienert, J., Si, G. Y., & Lippke, S. (2018). Evaluation of a web-based intervention for multiple health behavior changes in patients with coronary heart disease in home-based rehabilitation: Pilot randomized controlled trial. *Journal of Medical Internet Research*, *20*(11). https://doi.org/10.2196/12052

Epstein, E., Patel, N., Maysent, K., & Taub, P. (2021). Cardiac rehab in the COVID era and beyond: mHealth and other novel opportunities. *Current Cardiology Reports*, *23*(42). https://doi.org/10.1007/s11886-021-01482-7

Fisher, S. (2020). *Ethical issues to consider when conducting survey research.* Qualtrics XM. https://www.qualtrics.com/blog/ethical-issues-for-online-surveys/

Fuse Duluth. (2022). *Community partners.* https://fuseduluth.com/community-partners/

Health Resource & Services Administration. (2021). *Defining rural population.* https://www.hrsa.gov/rural-health/about-us/definition/index.html

Horwood, H., Williams, M. J. A., & Mandic, S. (2015). Examining motivations and barriers for attending maintenance community-based cardiac rehabilitation using the health-belief model. *Heart, Lung & Circulation*, *24*(10), 980–987. https://doi.org/10.1016/j.hlc.2015.03.023

Hwang, R., Morris, N. R., Mandrusiak, A., Bruning, J., Peters, R., Korczyk, D., & Russell, T. (2019). Cost-utility analysis of home-based telerehabilitation compared with centre-based rehabilitation in patients with heart failure. *Heart, Lung and Circulation*, *28*(12), 1795–1803. https://doi.org/10.1016/j.hlc.2018.11.010

Jansen-Kosterink, S., Dekker-van Weering, M., & van Velsen, L. (2019). Patient acceptance of a telemedicine service for rehabilitation care: A focus group study. *International Journal of Medical Informatics*, *125*, 22–29. https://doi.org/10.1016/j.ijmedinf.2019.01.011

Kaiser Permanente. (2019). *Reducing secondary cardiac events with virtual cardiac rehab*. https://about.kaiserpermanente.org/our-story/news/announcements/-reducing-secondary-cardiac-events-with-virtual-cardiac-rehab

Kraal, J. J., Van den Akker-Van Marle, M. E., Abu-Hanna, A., Stut, W., Peek, N., Kemps, H. M. (2017). Clinical and cost-effectiveness of home-based cardiac rehabilitation compared to conventional, centre-based cardiac rehabilitation: Results of the FIT@Home study. *European Journal of Preventive Cardiology*, *24*(12), 1260-1273. https://doi.org/10.1177/2047487317710803

Kuehn, B. M. (2020). Pandemic intensifies push for home-based cardiac rehabilitation options. *American Heart Association: Circulation*, *142*(8). https://doi.org/10.1161/CIRCULATIONAHA.120.051769

Lapid, M. I., Clarke, B. L., & Wright, R. S. (2019). Institutional review boards: What clinician researchers need to know. *Mayo Clinic Proceedings. 94*(3), 515-525. https://www.mayoclinicproceedings.org/article/S0025-6196(19)30089-8/fulltext

Laustsen, S., Oestergaard, L. G., van Tulder, M., Hjortdal, V. E., & Petersen, A. K. (2020). Telemonitored exercise-based cardiac rehabilitation improves physical capacity and health-related quality of life. *Journal of Telemedicine & Telecare, 26*(1/2), 36–44. https://doi.org/10.1177/1357633X18792808

Mayo Clinic. (2022). *Cardiac rehabilitation program.* https://www.mayoclinic.org/departments-centers/cardiac-rehabilitation-program/overview/ovc-20442302

Mayo Clinic Staff. (2017). Telehealth: Technology meets healthcare. *Mayo Clinic.* https://www.mayoclinic.org/healthy-lifestyle/consumer-health/in-depth/telehealth/art-20044878

Milewski, K., Małecki, A., Orszulik-Baron, D., Kachel, M., Hirnle, P., Orczyk, M., Dunal, R., Mikołajowski, G., Janas, A., Nowak, Z., Kozak, K., Roskiewicz, W., Wińska, K. N., Izworski, A., Rybicki, A., Buszman, P. P., Piotrowicz, R., & Buszman, P. E. (2019). The use of modern telemedicine technologies in an innovative optimal cardiac rehabilitation program for patients after myocardial revascularization: Concept and design of RESTORE, a randomized clinical trial. *Cardiology Journal*, *26*(5), 594–603. https://doi.org/10.5603/CJ.a2018.0157

Minnesota Medical Association. (2022). *Congress extends Medicare coverage for telehealth services.* https://www.mnmed.org/news-and-publications/News/Congress-Extends-Medicare-Coverage-for-Telehealth

National Library of Medicine. (2020, January 27). *Cardiac rehabilitation*. Medline Plus. https://medlineplus.gov/ency/patientinstructions/000791.htm

Pecci, C., & Ajmal, M. (2021). Cardiac rehab in the COVID-19 pandemic. *The American Journal of Medicine, 134*(5), 559-560. https://doi.org/10.1016 /j.amjmed.2021.01.007

Ritchey, M., D., Maresh, S., McNeely, J., Shaffer, T., Jackson, S. L., Keteyian, S. J., Brawner, C. A., Whooley M. A., Chang, T., Stolp, H., Schieb, L., & Wright, J. (2020). Tracking cardiac rehabilitation participation and completion among Medicare beneficiaries to inform the efforts of a national initiative. *Circulation: Cardiovascular Quality and Outcomes*, *13*(1). https://doi.org/10.1161/CIRCOUTCOMES.119.005902

Rohrbach, G., Schopfer, D. W., Krishnamurthi, N., Pabst, M., Bettencourt, M., Loomis, J., & Whooley, M. A. (2017). The design and implementation of a home-based cardiac rehabilitation program. *Federal Practitioner: For the Health Care Professionals of the VA, DoD, and PHS*, *34*(5), 34–39. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6370433/

Rural Health Information Hub. (2019a). *Minnesota*. https://www.ruralhealthinfo.org/states/minnesota

Rural Health Information Hub. (2019b). *Telehealth use in rural healthcare.* https://www.ruralhealthinfo.org/topics/telehealth

Sankaran, S., Dendale, P., Luyten, K., & Coninx, K. (2015). *Applying behavior change theories for a cardiac rehabilitation application*. http://krisluyten.net/research/publications/bhci-persuasion2015/BehaviorChangeTheories-Sankaran2015.pdf

Schweighardt, C. (2022). *Calculating ROI to realize project value.* Isixsigma. https://www.isixsigma.com/implementation/financial-analysis/calculating-roi-realize-project-value/

Servey, J. T., & Stephens, M. (2016). Cardiac rehabilitation: Improving function and reducing risk. *American Family Physician*, *94*(1), 37–43. https://www.aafp.org/afp/2016/0701/p37.html

Vogels, E. A. (2021). *Some digital divides persist between rural, urban, and suburban America.* https://www.pewresearch.org/fact-tank/2021/08/19/some-digital-divides-persist-between-rural-urban-and-suburban-america/

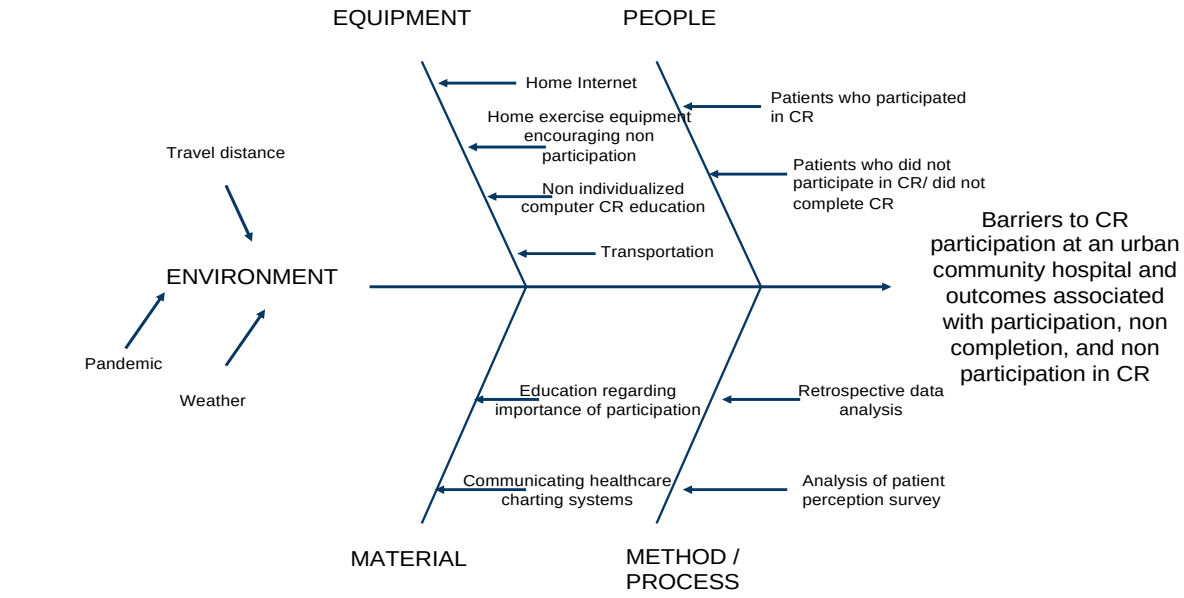
Wicklund, E. (2019). Kaiser, Samsung tout success of telehealth in cardiac rehab program. *mHealth Intelligence*. https://mhealthintelligence.com/news/kaiser-samsung-tout-success-of-telehealth-in-cardiac-rehab-program

Wu, C., Li, Y., & Chen, J. (2018). Hybrid versus traditional cardiac rehabilitation models: A systematic review and meta-analysis. *Kardiologia Polska*, *76*(12), 1717–1724. https://doi.org/10.5603/kp.a2018.0175

Zhang, Y., Cao, H., Jiang, P., & Tang, H. (2018). Cardiac rehabilitation in acute myocardial infarction patients after percutaneous coronary intervention: A community-based study. *Medicine*, *97*(8). https://doi.org/10.1097/MD.0000000000009785

Appendix A

PICOT Fishbone Diagram



Appendix B

Literature Review Matrix

Reference	Purpose	Design	Methodology/ Sample Population	Intervention	Findings, Results, & Conclusion	Notes
Ades, P., Keteyian, S., Wright, J., Hamm, L., Lui, K., Newlin, K., Shepard, D., & Thomas, R. (2017). Increasing cardiac rehabilitation participation from 20% to 70%: A road map from the million hearts cardiac rehabilitation collaborative. *Mayo Clinic Proceedings*, *92*(2), 234–242. https://doi.org/10.1016/j.mayocp.2016.10.014. 2016.10.014	This article evaluated the importance of cardiac rehab, as well as the importance of improving participation rates in the future. The article also provided a map of a conceptual framework to promote an increase of participation in cardiac rehab from 20% to 70% .	Retrospective evaluation	The sample population were patients who qualify for cardiac rehabilitation. No specific population or research study is performed in this article	Data collection and projection of statistics	The authors provided data in regards to the future impact of increasing patient compliance and participation in cardiac rehab programs. Additionally, the authors identified a conceptual framework of increasing cardiac rehab adherence, cardiac rehab enrollment, and cardiac rehab referral as important in order to increase participation rates from the current 20% up to 70%.	This article did not evaluate research at this point, however it was written by experts and identified the importance of cardiac rehab adherence and future outcomes.

Banner, D., Kandola, D., Bates, J., Horvat, D., Ignaszewski, A., Singer, J., & Lear, S. A. (2019).Patient experiences of undertaking a virtual cardiac rehabilitation program. *Canadian Journal of Cardiovascular Nursing*, *29*(2), 6–14.	The purpose of this study was to increase access to cardiac rehabilitation to populations in underserved areas by means of virtual cardiac rehabilitation. Additionally, the study measured the satisfaction, clinical improvements, as well as overall evaluation of virtual cardiac rehabilitation methods.	Quantitative interview	Patients included in this study had undergone a recent revascularization procedure or had a diagnosis of acute coronary syndrome. Rural patients were determined and chosen based on geographic isolation of their home. Patients were chosen on a randomized basis. Twenty-two people were randomly chosen to participate. Only 19 people completed the full interview process.	The interventions in this article were the virtual cardiac rehab program, as well as data collection method of the interview process.	The authors found that patients who participated in the virtual cardiac rehab program had high success rates, experienced clinical improvements and had high rates of satisfaction. The authors also found that patients appreciated the aspect of decreased need in travel for health care access.	The authors had 19 full responses out of the 22 original participants. Lack of time and decreased computer literacy were associated with decreased compliance with the virtual cardiac rehab program. The authors also discussed that they only interviewed participants in the virtual cardiac rehab program and did not interview participants of the traditional program which could overall

						influence bias.

Bravo-Escobar, R., González-Represas, A., Gómez-González, A. M., Montiel-Trujillo, A., Aguilar-Jimenez, R., Carrasco-Ruíz, R., & Salinas-Sánchez, P. (2017). Effectiveness and safety of a home-based cardiac rehabilitation programme of mixed surveillance in patients with ischemic heart disease at moderate cardiovascular risk: A randomized, controlled clinical trial. *BMC Cardiovascular Disorders, 17*, Article 66. https://doi.org/10.1186/s12872-017-0499-0	The purpose of this study was to examine the safety and outcomes of patients undergoing home based cardiac rehab programs vs. traditional cardiac rehabilitation programs in patients with increased cardiovascular risk.	Randomized control trial	A total of 28 patients with stable heart disease were randomly split into groups of 14. One group were assigned to complete the traditional cardiac rehabilitation program, and the other group was assigned to the home-based cardiac rehabilitation program.	The intervention was completing either the traditional cardiac rehabilitation program or the home-based cardiac rehabilitation program.	The home-based cardiac rehabilitation program was found to be as safe and effective as the traditional cardiac rehabilitation program. However, patients in the traditional program stated better feelings of quality of life.	This randomized control trial was based on 28 patients in Spain. There may be cultural differences to consider in these outcomes.

Buzza, C., Ono, S. S., Turvey, C., Wittrock, S., Noble, M., Reddy, G., Kaboli, M., & Reisinger, H. S. (2011). Distance is relative: Unpacking a principal barrier in rural healthcare. *Journal of General Internal Medicine*, *26*(2), 648-654. https://doi.org/10.1007/s11606-011-1762-1	The purpose of this study was to address and identify factors related to distance, which negatively impact access to care for rural patients.	Mixed-method approach. The authors utilized in depth interviews, focus groups, and surveys.	The sample utilized in this article were veterans in rural areas, health care providers, as well a staff from health care facilities.	Interviews, focus groups, and surveys in regards to access to health care for both the patients and providers.	This research supported prior discussion that distance is considered the most important barrier to health care access.	Limitations of this study were that the only population studied in this article were veterans who utilize the VA.

Duan, Y. P., Liang, W., Guo, L., Wienert, J., Si, G. Y., & Lippke, S. (2018). Evaluation of a web-based intervention for multiple health behavior changes in patients with coronary heart disease in home-based rehabilitation: Pilot randomized controlled trial. *Journal of Medical Internet Research*, *20*(11). https://doi.org/10.2196/12052	The purpose of this study was to evaluate the outcomes of a web-based cardiac rehab program by assessing the effectiveness of physical activity, lifestyle changes, consumption of fruit and vegetables, social-cognitive results, and health outcomes.	Randomized control trial	Participants included in this study were patients with coronary disease and were chosen from the cardiac rehabilitation center in China. 114 patients were chosen to be a part of this study. Patients were randomly chosen to be a part of an intervention group or a control group.	Web-based assessments and data collection were gathered at the beginning of the intervention, as well as at the end of the eight week intervention.	Patients in the web-based rehab program did better in terms of physical activity, and fruit and vegetable consumption in comparison to the control group. This indicated that the acceptance and incorporation of a healthy lifestyle was more prominent in the web-based group.	This research was performed in China, where there could be cultural differences as well as difference in perception in comparison to the population in the United States.

Horwood, H., Williams, M. J. A., & Mandic, Horwood, H., Williams, M. J. A., & Mandic, S. (2015). Examining motivations and barriers for attending maintenance community-based cardiac rehabilitation using the health-belief model. *Heart, Lung & Circulation*, *24*(10), 980–987. https://doi.org/10.1016/j.hlc.2015.03.023	The purpose of this article was to evaluate barriers to cardiac rehab in patients who qualify as well as addressing their perceptions by using the health-belief mode.	Quantitative interview	patients included in this study were part of a community based cardiac rehabilitation program	The intervention was the interview given to patients who had high attendance, low attendance, or did not attend.	The authors found that patients with high attendance levels felt that they had higher social and physical benefits from cardiac rehab, and additionally felt that they had fewer barriers.	This was a study which relied on questionnaires which has a high rate of showing bias from patients. The sample size was only 44 patients, which is relatively low.

Hwang, R., Morris, N. R., Mandrusiak, A., Bruning, J., Peters, R., Korczyk, D., & Russell, T. (2019). Cost-utility analysis of home-based telerehabilitation compared with centre-based rehabilitation in patients with heart failure. *Heart, Lung and Circulation*, *28*(12), 1795–1803. https://doi.org/10.1016/j.hlc.2018.11.010	The purpose of this study was to evaluate the difference in cost of a tele-cardiac rehab program in comparison to a traditional cardiac rehab program.	Randomized control trial	53 participants were included in this study. Participants in this study were participating in a tele-cardiac rehab program or a traditional program. Cost evaluation of each program was analyzed by obtaining data from health records. Cost evaluation included hospital readmission due to heart failure, cost of personnel, and cost of equipment.	The intervention in this study was the participation in one of the two cardiac rehab programs, as well as data collection from the health records of the patients. Additionally, a health questionnaire (EQ-5D) was used in this study.	This article found that the cost associated with tele-cardiac rehab was approximately $1,590 less than the traditional rehab program over a six month period. Additionally, the study found that there was not a significant difference noted between the two groups in terms of quality-adjusted life years.	This study was not performed in the United States. There may be a difference in cost associated with tele-cardiac rehab and traditional cardiac rehab in different countries. Additionally, the study used a very small sample size. This study should be repeated in the United States and with larger numbers of participants in order to obtain more significant and reliable data.

Jansen-Kosterink, S., Dekker-van Weering, M., & van Velsen, L. (2019). Patient acceptance of a telemedicine service for rehabilitation care: A focus group study. *International Journal of Medical Informatics*, *125*(2019), 22–29. https://doi.org/10.1016/j.ijmedinf.2019.01.011	The purpose of this study was to evaluate end-user acceptance of telemedicine during rehabilitation.	Focus Group Interview	188 patients were divided into 22 focus groups who were interviewed on their perceptions of rehabilitation services via telemedicine	The intervention in this study was the patient interview which was meant to determine what influences or deters the patient's acceptance of telemedicine rehabilitation	Acceptance factors included: exercising from home, ability to work on one's recovery without worrying about scheduling, and improved quality of instruction due to provided videos. Barriers listed were: lack of motivation, finding communication impersonal, lack of physical space. Overall acceptance prevailed, but there were definite concerns in terms of barriers.	This study was based on interview questions which could be perceived as biased.

Kaiser Permanente. (2019). *Reducing secondary cardiac events with virtual cardiac rehab*. https://about. kaiserpermanente.org/ our-story/news/announcements/-reducing-secondary-cardiac-events-with-virtual-cardiac-rehab	This article provided an overview of Kaiser Permanente's virtual cardiac rehabilitation program. The article included success rates as well as details in regards to how the program operates. A prior research article has been written in regards to outcomes research of this program, but has very limited access and is not able to be evaluated at this time. This article provided some of the benchmark data from that study.	Description analysis, as well as retrospective evaluation.	Patients included in this article were participants of the virtual cardiac rehabilitation program as well as the national average population statistics in regards to cardiac rehab programs.	The intervention in this article was the implementation of a virtual cardiac rehab program by utilizing Samsung watch technology and 24 hour available tele-resources.	The virtual cardiac rehab program by Kaiser Permanente has shown an astonishing 80% completion rate among patients as well as decreased cardiac hospital admission rates and overall satisfaction.	This is not the original research article which evaluated the virtual cardiac rehab program started by Kaiser Permanente. The original article is only available for audiences with a paid subscription . Data from the original research is provided within this article. This information has a high potentiation for bias since it was obtained from the Kaiser Permanente website.

Laustsen, S., Oestergaard, L. G., van Tulder, M., Hjortdal, V. E., & Petersen, A. K. (2020).Telemonitored exercise-based cardiac rehabilitation improves physical capacity and health-related quality of life. *Journal of Telemedicine & Telecare*, *26*(1/2), 36–44. https://doi.org/ 10.1177/1357633X18792808	The purpose of this research was to determine the impact that cardiac rehabilitation had on the improvement of physical capacity, health-related quality of life, muscle power, and muscle strength.	Retrospective study	Inclusion criteria included patients with moderate risk for ischemic heart and heart valve disease.	Participation and evaluation of patients who participated in a referred 12-week telemonitored cardiac rehabilitation program. Patients were to exercise for 60 minutes, three times weekly. Interventions also included communication and follow up via telemedicine with their physiotherapists or training staff.	This research showed that exercise in which people have a choice in activity, improved all of the outcome measures for both short and long term of this study, except for peak oxygen uptake after following up at 12 months.	This was a University driven research study. If this were a hospital driven research study, different outcomes may have been possible. Expansion of this research is warranted to see if outcomes are similar in different areas of the nation.

Milewski, K., Małecki, A., Orszulik-Baron, D., Kachel, M., Hirnle, P., Orczyk, M., Dunal, R., Mikołajowski, G., Janas, A., Nowak, Z., Kozak, K., Roskiewicz, W., Wińska, K. N., Izworski, A., Rybicki, A., Buszman, P. P., Piotrowicz, R., & Buszman, P. E. (2019). The use of modern telemedicine technologies in an innovative optimal cardiac rehabilitation program for patients after myocardial revascularization: Concept and design of RESTORE, a randomized clinical trial. *Cardiology Journal*, *26*(5), 594–603. https://doi.org/10.5603/CJ.a2018.0157	The purpose of this research was to compare the success rate of tele cardiac rehab with standard cardiac rehab in terms of patient outcomes and all cause patient mortality rates.	Meta-analysis	Inclusion criteria included being between the age of 18 and 70 years old, having completed angiography for stable angina, unstable angina, or NSTEMI, have the ability to use tele-resources, and being eligible for cardiac rehab. Exclusion criteria included patients with ejection fraction less than 40%, myocardial infarction with ST segment elevation, suboptimal myocardial revascularization, acute heart failure, dual antiplatelet therapy that can't be maintained for one year, and history of hemorrhagic stroke.	Meta-analyses studies compared outcomes of patients who underwent tele-cardiac rehab with patients who completed traditional cardiac rehab.	The authors found that tele-cardiac rehab and traditional cardiac rehab were equally effective, with tele cardiac rehab showing more superiority in terms of positive patient outcomes.	The study utilized a small sample size and did not follow up with patients on a long term basis.

Rohrbach, G., Schopfer, D. W., Krishnamurthi, N., Pabst, M., Bettencourt, M., Loomis, J., & Whooley, M. A. (2017). The design and implementation of a home-based cardiac rehabilitation program. *Federal Practitioner: For the Health Care Professionals of the VA, DoD, and PHS*, *34*(5), 34–39. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6370433/	The purpose of this study was to address systematic barriers, as well as the barrier distance in relation of health care access by implementing and evaluating a home based cardiac rehab program.	Meta-analysis	Inclusion criteria for home based cardiac rehab included: "having an acute myocardial infarction, coronary artery bypass surgery, obstructive coronary artery disease with or without percutaneous coronary intervention, stable angina, cardiac valve repair/replacement, cardiac transplantation, and congestive heart failure." Exclusion criteria included: "having staged or cutaneous coronary intervention with significant remaining lesion, decompensated heart failure, unstable angina, history of no sustained or sustained ventricular tachycardia or ventricular	Evaluation of prior studies to determine that a home based cardiac rehab program is a suitable alternative for traditional cardiac rehab.	The authors found that home based cardiac rehab programs are suitable for certain populations. Home based cardiac rehab programs helped to alleviate barriers such as distance and access to healthcare and that it will be a valuable addition to rehab programs.	This article evaluated and gathered data from other studies in order to determine the usefulness and effectiveness of home based cardiac rehab. The authors did not necessarily perform any individual research of their own. This is a highly opinion based article.

			fibrillation, history of recurrently syncope, symptomatic valvular disease, severe hypertension, dementia, discharge to long-term skilled nursing facility, significant movement disorder, atrial arrhythmia without rate control, or certain heart blocks without a pacemaker.”			

Sankaran, S., Dendale, P., Luyten, K., & Coninx, K. (2015). *Applying behavior change theories for a cardiac rehabilitation application*. http://krisluyten.net/research/publications/bhci-persuasion2015/BehaviorChangeTheories-Sankaran2015.pdf	This article discussed the incorporation of the fogg-behavior model, persuasive systems design mode, and behavior wizard model in evaluating the aspect and success of tele-cardiac rehab.	Framework evaluation	The sample population consisted of patients with coronary artery disease and the authors evaluation of their needs based on framework designs.	Application of theoretical models in the evaluation of cardiac rehab patients.	This article delved into the fogg-behavior model, persuasive systems design model, and the behavior wizard model in the evaluation of cardiac rehab. The authors found all of these models pertinent in the participation of cardiac rehabilitation.	This is in PDF format and very brief. Information could have been omitted or left out.

Servey, J. T., & Stephens, M. (2016). Cardiac rehabilitation: Improving function and reducing risk. *American Family Physician*, *94*(1), 37–43. https://www.aafp.org/afp/2016/0701/p37.html	The purpose of this article was to provide information in regards to the importance of cardiac rehabilitation. This article also provided an explanation of each aspect of cardiac rehabilitation and their importance in the overall program as well.	Retrospective overview of the standardized cardiac rehab program	The sample of patients utilized in this article were patients who qualified for cardiac rehabilitation.	The intervention of this article was to evaluate and discuss the importance of cardiac rehab in positive patient outcomes	The authors provided statistics and evidence to support the use of a cardiac rehab program in patients with heart disease. The authors also provided extensive information in regards to specific aspects of this program such as diet, exercise, and emotional health.	This is not a research article, however the authors utilized data gathered from other sources in order to support the implementation of cardiac rehab programs in patients with heart disease. The authors also discussed barriers to cardiac rehab use, and new approaches to these programs.

Wu, C., Li, Y., & Chen, J. (2018). Hybrid versus traditional cardiac rehabilitation models: A systematic review and meta-analysis. *Kardiologia Polska*, *76*(12), 1717–1724. https://doi.org/10.5603/kp.a2018.0175	The purpose of this study was to determine if hybrid cardiac rehab programs were as effective as traditional cardiac rehab programs	Meta-Analysis	Participants in this study included those who have had a myocardial infarction, heart failure, or cardiac surgery. 1,195 participants were studied by analyzing original research found in Medline, Scopus, Cochrane Central, and Web of Science databases.	The intervention of this study was the analysis of original research data found within the aforementioned databases.	The authors found that there were similar improvements noted in functional capacity in both the hybrid and traditional cardiac rehab programs. There was no difference noted in the two programs in terms of duration of exercise, blood pressure, and quality of life.	This study used a wide range of data and had a very large study group. This data is found to be reliable, however selection of research by the authors could create bias within the study.

Appendix C

Gap Analysis Table

Current State	Desired State	Identified Gap	Gap due to Knowledge, Skill, and/or Practice	Methods Used to Identify Professional Practice Gap
Patients encounter barriers to participation in CR. Barriers to CR participation contribute to nonparticipation, which increases the risk of negative patient health outcomes.	Barriers to participating in CR at the urban community hospital are identified and addressed in order to promote CR participation in all patients who qualify for the rehabilitation service. Increasing patient participating in CR subsequently reducing the rates of negative health outcomes.	The use of telehealth in reducing barriers to CR participation, and subsequently reducing negative health outcomes associated with nonparticipation.	Practice: The implementation of a telehealth system has begun, but does not allow for a fully remote tele-CR program. Knowledge: It is currently unknown what the most commonly occurring barriers are within the hospital's patient population who qualifies for CR.	Staff interview, evaluation of research, and performing retrospective data analysis of patients at the urban community hospital to assess for barriers to CR participation, and negative health outcomes.
Patients are frequently being referred to CR facilities that are closer to their residence, which reduces the urban community hospital's ability for close follow up and continuity of care.	Reduced referral rates to outside CR facilities. Patients remain able to participate in CR within the urban community hospital system, thus promoting continuity of care and financial benefit.	The use of telehealth to allow for the urban community hospital staff to provide patient care within the hospitals CR program.	Practice: The implementation of a fully remote telehealth system has the potential to allow for the urban community hospital's staff to closely follow each of the patients within the CR program regardless of their location.	Staff interview and performing a retrospective data analysis of patients who qualify for CR to further assess for referral rates to outside CR facilities and the ability to determine the patient's rate of participation or completion of the CR program.

Appendix D

Needs Assessment Table

Expanded Literature review	A thorough literature review was performed and was noted to support the use of telehealth in CR programs. Results found increased patient participation rates, satisfaction rates, completion rates, as well as a reduction in negative patient outcomes in those who participated.
Population	Patients who have received a referral for CR at the urban community hospital.
Stakeholder Identification	Marijah Harney-Tolo, the project mentor, the project advisor within the urban community hospital, the project advisor within St. Scholastica, St. Scholastica IRB, Hospital IRB, the urban community hospital's research department staff, cardiac unit supervisors and nursing staff, and a hired statistician.
Organizational Assessment SWOT	**Strength:** and specificity of data, data privacy, and quantity of data. **Weakness:** duration of time for project completion, low number of surveys disbursed, and low number of surveys returned. **Opportunities:** provide supporting data to urban community hospital to encourage a future tele-CR program, offer data for cardiology department use, potential to advocate for continued Medicare and Medicaid coverage of telehealth, a potential to advocate for high speed internet access, and potential to advocate for communicating EHR systems. **Threats:** unintentional disclosure of patient information, unintentional omission of patient information for who qualify for CR, and risk that the urban community hospital staff may not have interest in the results of the study.
Assess Available Resources	Available resources include: Meditech Expanse, Citrix, Mobile Pass, Microsoft Word, Microsoft Excel, Microsoft Office, Gmail, The United States Post Office, Intellectus Statistical Software, Laptop, Printer, Zoom, cardiac unit supervisors, and cardiac unit nursing staff.
Desired Outcomes	Identify barriers to CR participation or completion at the urban community hospital, identify rates of negative outcomes, rates of mortality, participation rates, referral rates to other CR facilities and the ability to monitor patients at those facilities, and determine patient interest in a tele-CR program. These would be utilized to support the overarching outcome of supporting the potential creation of a tele-CR program.
Team Selection	Team selection included: Stakeholders: the project mentor, the project advisor within the urban community hospital, the project advisor within St. Scholastica, in addition to the author. Additional team members include: Information technologists, a statistician, cardiac unit supervisors, cardiac unit nursing staff, the St. Scholastica IRB, and the Urban community hospital IRB.
Cost/Benefit Analysis	Cost of the project is estimated at $1,157.82 with a potential return on investment of $31,925.70 per addition of 100 new CR patients per year with future a tele-CR program. This does not account for costs associated with startup and maintenance of a tele-CR program. Benefits would also include increasing access to CR to patients with decreased access to healthcare or those who face other barriers to participation. Additionally, providing supporting information to encourage a tele-CR program could potentially encourage the reduction in hospital readmissions if a tele-CR program were to be implemented, thus offering potential cost savings.

Note. All stakeholder and institutional names were removed and re-named for de-identification purposes.

Appendix E

SWOT Analysis Table

Strengths	Weaknesses
Quality of collected data	Duration of time for project completion
Specificity of collected data	Inability to evaluate CR completion at outside facilities
Patient data protection	Original data set including a substantial amount of nonrelevant data
Quantity of retrospective data	Low number of disbursed patient surveys
	Low number of patient surveys returned
Opportunities	**Threats**
Provide supporting data to the urban community hospital encourage a potential future tele-CR development	Unintentional disclosure of patient information due to nonadherence to directions on the patient perception survey
Provide data to the cardiology department at the urban community hospital for further professional use	Hospital-wide computer software access, and ultimately patient information, by professional hackers
Potential use of project outcomes to advocate for continued tele-CR coverage by Medicare and Medicaid services past the end of the year 2022	Risk that patients who had a referral for CR during the study dates, were not included in the data set that was provided to the author
Potential use of project outcomes to advocate in the continued effort for high-speed internet access in communities with decreased access to healthcare	Risk that staff at the urban community hospital may not have interest in the results of the study

Appendix F

Patient Perception Survey

1. Circle any health conditions or events in which you have been diagnosed
A. Heart attack
B. Heart Failure
C. Atrial fibrillation
D. Cardiomyopathy
E. Pulmonary Hypertension
F. COPD
G. Chronic Kidney Disease of any stage
2. Circle any of the following that apply
A. I live within 5 miles of the urban community hospital
B. I live within 6 to 15 Miles of the urban community hospital

C. I live within 16 to 30 Miles of the urban community hospital
D. I live within 31 to 60 Miles of the urban community hospital
E. I live greater than 60 Miles of the urban community hospital
3. Circle all that apply
A. I currently have a driver's license and a mode of transportation
B. I am comfortable driving any distance
C. I do not have a driver's license or a mode of transportation
D. I am not comfortable driving long distances
E. I live with a family member or friend
4. Following this hospitalization, I qualify for Cardiac Rehabilitation
A. Yes
B. No

5. I have qualified for Cardiac Rehabilitation in the past
A. Yes
B. No
6. Describe any barriers to participation in Cardiac Rehabilitation
7. My comfort level for telehealth is:
A. very uncomfortable
B. Uncomfortable
C. Neutral

D. Comfortable
E. Very comfortable
8. If Cardiac Rehabilitation was offered via telehealth at the urban community hospital I would want, or have wanted, to participate in this mode of delivery
A. Yes
B. No

Note. This table is the needs assessment survey in which patients will complete and mail to the DNP student. This survey consists of a multiple-choice answer system as well as a short answer portion to allow for open ended answers. The hospital name was originally listed within this survey, but was removed and replaced with “urban community hospital” for de-identification purposes.

Appendix G

GANTT Chart of Project Timeline

	Dec -20	Jan -21	Feb -21	Mar -21	Apr -21	May -21	Jun-21	Jul -21	Aug -21	Sep -21	Oct -21	Nov -21	Dec -21	Jan -22	Feb -22	Mar -22	Apr -22	May -22
Obtain approval from CSS IRB and Hospital IRB																		
Request Data Information																		
Analyze data set and perform chart review																		
Perform chart review																		
Deidentify data set																		
Obtain approval to share data set with hired statistician for review																		
Statistician review of data set																		
Communicate about distribution of patient surveys with cardiac unit staff																		
Distribution of patient perception surveys																		
Evaluation of patient perception surveys																		
Create written evaluation of project and results																		
Present results to preceptor and hospital staff																		

Appendix H

Work Breakdown Structure

Design Phase	Plan Phase	Intervention Phase	Results Phase	Evaluation Phase
The scope of the project was developed	Additional team members were identified: information technologists, the urban community hospital's research department staff, unit supervisors of the hospital's cardiac unit, cardiac unit nursing staff, a statistician, and St. Scholastica's and the hospital's IRB's.	Data was requested and evaluated	Results of the retrospective data analysis were calculated by the author and the statistician	Thorough review of data was performed
The project gap analysis was performed	Roles of team members were identified	Patient chart reviews were performed and documented in an Excel spreadsheet	Results included: barriers to CR participation, patient health outcomes surrounding CR participation, rate of referral to an outside CR facility, and results of the patient perception survey	A formal write up of results was performed
Objectives for the project were developed	The project plan was created as below:	Patient information was de-identified	Findings were summarized within the paper	Discussion regarding results, outcomes, and findings was created
Key stakeholders, excluding the author, were identified: the project mentor, the project advisor within the urban community hospital, & the project advisor within St. Scholastica	Obtain approval from St. Scholastica and the hospital's IRB	De-identified information was provided to the statistician		Discussion of results is anticipated to be provided to stakeholders during this time

An action plan for the project was created	Create a plan to request data from the urban community hospital's research department staff and information technologists	Patient perception surveys were distributed and the returned surveys were collected for further evaluation		
An action plan was submitted to St. Scholastica advisors for approval	Create a plan to assess patient data via a retrospective data analysis	Communication was maintained with stakeholders regarding timeline, implementation, and barriers		
Approval was obtained from St. Scholastica advisors for action plan of the project	Create a plan for chart review and data organization			
	Create a plan for de-identification of patient information			
	Communicate with hired statistician regarding plan for statistical analysis of data			
	Patient perception surveys were created for distribution			
	The timeline for survey distribution was discussed and created with the cardiac unit supervisors and a plan for distribution was made.			
	Necessary tools needed for the project were identified as follows: Laptop, Microsoft Word, Microsoft Excel, Microsoft Office Mail, Citrix, Mobile Pass, Gmail, and Zoom			
	A budget of $1,200 was created			
	The project timeline was created : December 2020 through May 2022, as noted in Appendix F			

Note. All stakeholder and institutional names were removed and re-named for de-identification purposes.

Appendix I

Stakeholders Table

Stakeholder Name	Stakeholder Role
Marijah Harney-Tolo	Author
The Project Mentor	Project Advisor- Hospital
The Project Advisor Within the Urban Community Hospital	Project Advisor- Hospital
The Project Advisor Within St. Scholastica	Project Advisor- St. Scholastica
Additional Team Members	Team Member Role
Hired Statistician	Statistical Analysis
Information Technologist	Create student account for data analysis, assist with technological difficulties
The Urban Community Hospital's Research Department Staff	Obtain requested patient data, assist in the collection of the patient perception surveys
Cardiac Unit Supervisors	Assist with planning the distribution of the patient perception surveys
Cardiac Unit Nursing Staff	Distribute the patient perception surveys
St. Scholastica IRB	Oversee the project to ensure patient safety
Urban Community Hospital IRB	Oversee the project to ensure patient safety

Note. All stakeholder and institutional names were removed and re-named for de-identification purposes.

Appendix J

Data Collection Tools and Instruments

Tool	Use of Tool
Standard Laptop	Used for obtaining patient data and documentation of results
Microsoft Word	Used for creation of professional paper to discuss the project creation and results
Microsoft Excel	Used for documentation of patient information surrounding the goals and outcomes of the project
Microsoft Office Mail	Used for communication between stakeholders and team members
Meditech Expanse	Used for chart review and patient data collection
Citrix Software	Used for access of Meditech Expanse and the protected folder within the urban community hospital's research department on the authors personal computer to ensure protection of patient data
Mobile Pass Software	Used for access of Meditech Expanse and the protected folder within the urban community hospital's research department on the authors personal computer to ensure protection of patient data
Gmail	Used for communication between stakeholders and team members
Zoom	Used for communication between the author, the statistician, and the project advisor within St. Scholastica
The Urban Community Hospital's Research Departments' Protected Folder	Used for storage of the Microsoft Excel spreadsheet which contained private patient information
Standard Printer	Used for the creation of the patient perception surveys
Intellectus Statistical Software	Used for evaluation of the patient data for the creation of accurate results
Patient Perception Survey	Created by the author and used to determine patient perspective and support surrounding tele-CR
Retrospective Data Analysis	Used to assess barriers to CR participation, patient health outcomes, and rates of CR referral to outside facilities

Note. All stakeholder and institutional names were removed and re-named for de-identification purposes.

Appendix K

DNP Project Charter/Action Plan- Communication Matrix

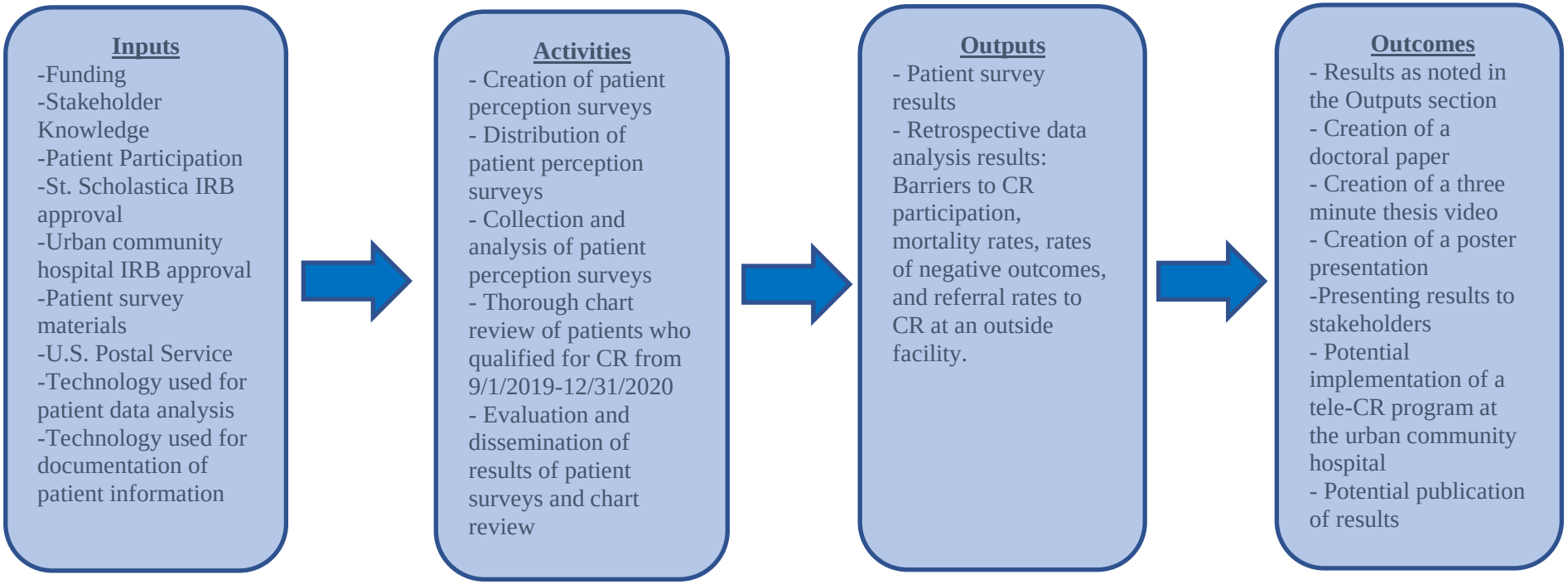
ID #	Purpose/Objectives	Method of Communication	Frequency	Recipients	Person Responsible	Notes
1	Project Creation	In person/Email/Text	1-3 times per semester	The Project Mentor	Author	The author communicated frequently with the project mentor toward the beginning of the project in order to create the original project. The author provided the project mentor with updates throughout the duration of the project, including discussion of project changes.
2	Project creation, adjustment, and updates	Email/Zoom	2-5 times per semester	The Project Advisor Within St. Scholastica	Author	The author communicated frequently with the project advisor within St. Scholastica regarding the creation, development, implementation, stakeholder communication, project adjustment, project questions, and project updates.
2	Project Adjustment	Email/Telephone Call	5 to 15 times per semester	The Project Advisor Within the Urban Community Hospital	Author	The author came in contact with the project advisor within the urban community hospital after St. Scholastica's IRB project approval. The project advisor within the urban community hospital suggested an addition of a retrospective data analysis to support the original project. Due to the complexity of the retrospective data analysis, the project changed to encompass only the retrospective data analysis and patient surveys. The author frequently emailed the project advisor within the urban community hospital regarding the addition of a statistician to the project, IRB amendments, data acquisition, questions pertaining to the project, and project updates.

3	Statistical analysis	Email/Zoom	3 to 5 times per semester	Hired Statistician	Author	The author was in frequent communication with the statistician regarding timeline updates due to the unanticipated additional time required for the evaluation of the retrospective data analysis. Once the patient data was deidentified and approved by the project advisor within the urban community hospital, the author provided the data set to the statistician for further analysis and to provide the author with results.
4	Project Approval	Email	1-2 times per semester	St. Scholastica IRB	Author	The author communicated with St. Scholastica's IRB to obtain initial project approval, and project approval after amendment's were submitted for addition of the retrospective data analysis, addition of a statistician, and change in project to encompass the retrospective data analysis.
5	Project Approval	Email	1-3 times per semester	Urban community hospital's IRB	Author	The author communicated with the urban hospital's IRB frequently at the beginning of the project to obtain approval and for the addition of the statistician to the project. The urban hospital IRB discussed further changes to the project with the author during the final semester of the project as well.

Note. All stakeholder and institutional names were removed and re-named for de-identification purposes.

Appendix L

Logic Model



Appendix M

Patient Survey Results

Patient	Diagnosed Health Condition	Living Distance from the Urban Community Hospital	Barriers to CR Participation	Does the Patient Have Internet Access?	Following This hospitalization, Does the Patient Qualify For CR?	Has the Patient Qualified for CR in the Past?	Barriers the Patient Has/Had in Regards to Participation in CR?	Level of Comfort Regarding Telehealth?	If CR was Offered Via Telehealth, Would the Patient Want to Participate in this Mode of Delivery?
1	Heart Attack	greater than 60 miles	I am not comfortable driving long distances	No	Yes	No	"It was never previously needed"	Neutral: "I think I would like it if could learn to do it and had the means"	Yes
2	Pulmonary Hypertension	within 6 to 15 miles	I do not have a driver's license or a mode of transportation	Yes	Yes	No	Blank	Comfortable	Yes
3	Heart Attack, COPD	within 5 miles	I live with a family member or friend	Yes	No	Yes	"Dependent on others for transportation to rehab"	Neutral	Yes
4	Heart Attack, Heart Failure	Greater than 60 miles	I currently have a driver's license and a mode of transportation, I am comfortable	Yes	Yes	No	"None"	Neural	Yes

			driving any distance						

Appendix N

IRB Approval St. Scholastica

The College of St. Scholastica

Institutional Review Board

DATE:	October 25, 2021
TO:	Marijah Harney-Tolo and [*Dr. Sherry Johnson*]
FROM:	The College of St. Scholastica, Institutional Review Board
RE:	Facilitating Change to Increase Patient Healthcare Access: Promoting Stakeholder Confidence in the Safety and Effectiveness of Remote Exercise Monitoring for Tele-Cardiac Rehabilitation: A Quality Improvement Project
SUBMISSION TYPE:	Continuing Review/Progress Report
ACTION:	APPROVED
REVIEW TYPE:	Expedited Review

Thank you for your submission of materials for your project. The College of St. Scholastica Institutional Review Board has reviewed your application and determined that the proposed activity does not meet the definition of research under the Code of Federal Regulations 45 Part 46.102 provided by the Department of Health and Human Services. As such, your project does not require ongoing review or approval from The College of St. Scholastica Institutional Review Board. We will retain a copy of this correspondence within our records.

Any modification to your project procedures that could change the determination of "not research" must be submitted to the IRB before implementation.

When your project is complete, submit a protocol closure form by following these steps: (1) log in to your project in IRBNet, then create a new package (not project), (2) download the protocol closure form from the Forms and Templates menu, (3) complete, sign and submit the protocol closure form.

If you have any questions, please contact Nicole Nowak through the project email function in IRBNet or [redacted]. Please include your study title and reference number in all correspondence with the IRB office.

Best regards,

[redacted]

Appendix O

IRB Amendment One Approval St. Scholastica

The College of St. Scholastica

Institutional Review Board

DATE:	March 7, 2021
TO:	Marijah Harney-Tolo and [*Dr. Sherry Johnson*]
FROM:	The College of St. Scholastica, Institutional Review Board
RE:	Facilitating Change to Increase Patient Healthcare Access: Promoting Stakeholder Confidence in the Safety and Effectiveness of Remote Exercise Monitoring for Tele-Cardiac Rehabilitation: A Quality Improvement Project
SUBMISSION TYPE:	Amendment/Modification
ACTION:	NOT RESEARCH
REVIEW TYPE:	Expedited Review

Thank you for your submission of materials for your project. The College of St. Scholastica Institutional Review Board has reviewed your application and determined that the proposed activity does not meet the definition of research under the Code of Federal Regulations 45 Part 46.102 provided by the Department of Health and Human Services. As such, your project does not require ongoing review or approval from The College of St. Scholastica Institutional Review Board. We will retain a copy of this correspondence within our records.

Any modification to your project procedures that could change the determination of "not research" must be submitted to the IRB before implementation.

If you have any questions, please contact Nicole Nowak through the project email function in IRBNet or [redacted]. Please include your study title and reference number in all correspondence with the IRB office.

Best regards,

[redacted]

Appendix P

Patient Informed Consent

The College of St. Scholastica

Facilitating Change to Increase Patient Healthcare Access: Promoting Stakeholder Confidence in the Safety and Effectiveness of Remote Exercise Monitoring for Tele-Cardiac Rehabilitation: A Quality Improvement Project

Informed Consent
Patient Participants

You are invited to participate in a quality improvement project which will evaluate stakeholder acceptance and confidence in the potential for developing a tele-cardiac rehabilitation program at the urban community hospital in the future. This study is being conducted by Marijah Harney-Tolo, a graduate student in the department of graduate nursing at The College of St. Scholastica under the supervision of the project advisor within St. Scholastica and the project mentor. You were selected as a possible participant because you have been recently hospitalized for a cardiac-related illness and have been offered cardiac rehabilitation. We ask that you read through this form and ask any questions prior to agreeing to participate in this project.

Study Purpose

The aim of this specific project is to create and improve stakeholder support of a tele-cardiac rehabilitation program with hopes that one may be created in the future at the urban community hospital. The patient participant's role will be to offer patient insight, which will be anonymously provided to stakeholders. The creation of a tele-cardiac rehabilitation program will increase access to healthcare for patients.

Study Procedure for Patient Participants

If you choose to participate, you will be asked to complete a needs assessment survey. This survey will be handed out to you with your discharge paperwork. The survey will take no more than fifteen minutes to complete. Data collected from the needs assessment surveys will be used anonymously in an informational session in order to show if patients are willing, or want, to participate in cardiac rehabilitation remotely via telemedicine. After the survey is completed, you will be asked to put the survey in the provided pre-addressed and pre-stamped envelope with no return address requirement in order to maintain confidentiality. These surveys will be returned by mail and will need to be picked up from a mail carrier or dropped off in a local mailbox. It is asked that the survey be returned by April 15, 2021.

Risks of Study Participation

Risks and discomforts for this project include the time it takes to complete the needs assessment survey as well as return it via standard mail. There is also a potential for lack of privacy if return address information is filled out by the participant or patient information is written on the survey by the participant.

Means to reduce risk and discomfort include offering participation in the survey on a volunteer basis. Additionally, in order to maintain privacy, there will be no areas which prompt the participant to identify

themselves. If a survey is returned with any participant identifiers, the identifiers will be destroyed promptly in order to maintain privacy and confidentiality.

Benefits of Study Participation

The benefits of this project are to promote comfort and education to healthcare professionals in order to support the development of a remote tele-cardiac rehab program at the urban community hospital in the future. This program has the potential to allow for increased access to this healthcare service.

Contact and Questions

The principal investigator of this quality improvement project is Marijah Harney-Tolo. You may ask questions at any time and are encouraged to contact her by email at [redacted]

If you have questions regarding the project and would like to speak to someone other than the principal investigator, you are encouraged to contact the following individuals:

- Faculty Advisor: Sherry Johnson DNP, APRN, CNP, CNS, Phone: [redacted]
- Chair of Department: Laurel Ash DNP, CNP, RN, Phone: [redacted]
- Dean of the School of Nursing: Sheryl Sandahl DNP, APRN, CPNP-PC, FNP-BC, MPH, MSN, Phone: [redacted]
- Nicole Nowak-Saenz, Ph.D., Chair of the Institutional Review Board at [redacted]

You may also contact any of the above-named individuals in writing or in person at The College of St. Scholastica, 1200 Kenwood Ave, Duluth, MN 55811.

You may keep this copy of the consent form for your records

In order to maintain privacy, no signature for consent will be collected. Submission of the needs assessment survey will signify that the participant has read and agreed to participate in this quality improvement project.

Note. All stakeholder and institutional names were removed and re-named for de-identification purposes.

Appendix Q

Locations for CR Referral, CR Referral Rates, and Determining Participation