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CardioMEMS Staff Education to Improve Use of Pulmonary Artery Sensor Data in an Emergency Department

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Abstract

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MS, Chamberlain University, 2016

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Project Submitted in Partial Fulfillment

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Abstract

Assessing volume status in patients with congestive heart failure (CHF) remains a difficult task. Newer technology, such as CardioMEMS, allows providers to download pulmonary artery pressure measurements from an implanted sensor. In a large rural emergency department (ED), lack of staff education on CardioMEMS made the device useless when a patient presented to the ED. The purpose of this project was to develop a staff education in-service to address the gap in practice. The theory used to guide development of an effective curricular program and instruction method was Knowles' theory of andragogy. Application of the analysis, design, development, implementation, and evaluation model ensured a robust and repeatable process of translation of research into practice. The practice-focused question involved whether a staff education in-service would improve staff members' ability to recognize the significance of CardioMEMS, appropriately use the device, and apply the data downloaded from the device to diagnose and guide treatment for patients with CHF. The design included a 5-point Likert scale pretest and posttest to evaluate staff knowledge and confidence to use the device in practice. On the pretest, three of 25 participants agreed that they were familiar with CardioMEMS. While all 25 participants agreed or strongly agreed that they encountered patients with CHF symptoms daily, all 25 reported strongly disagreeing or disagreeing that they were confident in CardioMEMS use. After the education, all participants agreed or strongly agreed that they were familiar with CardioMEMS, and 21 participants agreed or strongly agreed that they were confident in using the CardioMEMS device. This project will impact social change through improved CardioMEMS application in the ED.

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Section 1: Nature of the Project

Introduction

Congestive heart failure (CHF) is one of the leading causes of death within the United States and is the most common cause of readmissions for Medicare patients. According to the American College of Cardiology (ACC), it is estimated that 6.5 million adults have been diagnosed with CHF (Benjamin et al., 2018). While a large focus needs to be on risk factor reduction such as coronary artery disease, hypertension, and diabetes prevention, focus also is needed on management of the disease once it develops and reduction in hospital readmissions for affected patients.

Newer technology such as the CardioMEMS Heart Failure Management System allows providers to see daily patient pulmonary artery (PA) measurements via an online download from an implanted PA sensor within the patient's PA that transmits readings into a Merlin Carelink site. With such technological advancements, providers must become knowledgeable about its purpose and benefits. Not only should cardiology providers, who do the implants and monitoring, be efficient with this technology; providers such as those in the emergency department (ED), as well as inpatient physicians/nurses, also need to be able to use this technology to aid in appropriate diagnoses and treatment. With education of staff on the benefits of CardioMEMS technology, the hospital will see a decrease in readmission rates of CHF patients. Fewer hospital admissions and improved quality of life will promote positive social change for patients living with CHF. In addition, as word spreads about the benefit of such technology, more individuals are likely to be offered this technology.

Problem Statement

Nursing Practice Problem

It is estimated that the cost for treating CHF will rise to $53 billion by 2030, at which point the cost will have doubled since 2012 (Chamberlain et al., 2018). Hospital readmissions greatly affect individual facilities by consuming resources and becoming a financial burden on the entire health care system (Benjamin et al., 2018). In addition to traditional at-home monitoring techniques to help manage CHF effectively and reduce readmission rates, newer technological advances have allowed for the implantation of sensors directly within the pulmonary artery that transmit PA pressures to enable assessment and effective treatment of volume status issues of patients while they are at home. These monitoring techniques will allow for a reduction in hospitalizations and an overall decrease in costs associated with CHF management (Ziaeian & Fonarow, 2017).

The setting for this Doctor of Nursing Practice (DNP) project was a major rural hospital in the eastern region of the United States that offers state-of-the-art care to a population that would otherwise have to travel great distances for the same care. The mission of the hospital is to provide world-class quality health care. As part of the organization's strategic plan, continually improving staff knowledge through education is a top priority.

The downfall to such technology is the lack of education of health care professionals on the benefits and operation of such devices. If providers are aware of what these devices are, they typically have no idea of how to download the data, whom to call for assistance, or what to do with the information. The focus of this staff education

in-service was to educate ED staff on the CardioMEMS technology, where to locate the data, how to interpret the data, how to download the data when necessary, and the importance of using this technology in the care of patients with CHF.

Local Relevance of the Need

With so many individuals suffering from the debilitating effects of CHF, the need to address the lack of knowledge of CardioMEMS technology is critical to improving the overall treatment for patients presenting to the ED with complaints of symptoms that could be heart failure in origin. However, many symptoms suggestive of heart failure, such as shortness of breath, could also be indicative of other conditions such as chronic obstructive pulmonary disease (COPD) or pneumonia (Celutkiene et al., 2017). Often, patients with heart failure will also suffer from COPD and, as a result, they pose a challenge to providers in diagnosing and treating them appropriately (Deek et al., 2015). CardioMEMS technology provides necessary information regarding pulmonary arterial pressure to aid in determining if the patient is suffering from a CHF exacerbation, a COPD exacerbation, or both. However, in order to be effective, providers must be able to recognize these individuals with such technology and to obtain the information within the device through appropriate interrogation.

After speaking with several nurses and providers in the ED, it quickly became evident that they had no knowledge of the CardioMEMS technology. If a patient who possessed a CardioMEMS device were to present for care, the staff in the ED did not know exactly what the device was, how to interrogate the device, or how to use the information obtained from the device. This lack of knowledge fueled the motivation

behind this doctoral project. Through developing and implementing this staff education in-service, the ED staff, including nurses and providers, will become better equipped to provide the highest quality of care possible to patients who present with CardioMEMS technology available for use.

Significance of Nursing Practice

This doctoral project poses great significance to the practice of nursing as it equips bedside nurses, as well as advanced practice nurses and other providers, with evidence-based education on the purpose, use, interrogation, and translation of information provided by CardioMEMS heart failure technology. It is the responsibility of nurses throughout all specialties and levels of practice to provide the safest, highest level of care based on current evidence. Lack of knowledge of the widely utilized CardioMEMS technology greatly hinders the care a patient receives, not only upon presentation to the ED, but also throughout the course of their hospitalization.

This DNP project consisted of the development, implementation, and evaluation of a staff education in-service on CardioMEMS HF technology. Following the in-service, nurses and providers were expected to identify the importance of CardioMEMS technology, understand how to interrogate the device once the patient presented to the ED, and use that information to plan appropriate treatment of the patient. This knowledge would empower not only the ED staff, but hopefully the entire organization to educate staff across departments on the importance of using CardioMEMS technology.

Purpose Statement

Gap in Nursing Practice

The gap within nursing practice identified for this DNP project was the lack of knowledge among the ED nurses and providers regarding CardioMEMS technology. With CHF readmission rates continuing to soar and expected costs to reach $53 billion by 2030 (Chamberlain et al., 2018), it is vital to identify solutions to reduce this large financial burden on the health care system. This DNP staff education project was designed to focus on educating staff on the benefits of CardioMEMS technology in aiding CHF management and prevention of unnecessary readmissions.

Practice-Focused Question

The practice-focused question identified was as follows: Will a staff education in-service improve staff members' ability to recognize the significance of CardioMEMS, appropriately interrogate the device, and use the data downloaded from the device to guide treatment for patients suffering from CHF? This evidence-based staff education project evaluates the effects of staff education on CardioMEMS technology use within the ED when a patient presents with symptoms that paint an unclear diagnostic picture for CHF. The overall purpose of this project was to provide nurses and providers with knowledge on the use of CardioMEMS in patients suffering from CHF and how this technology can be used to aid in the recognition of CHF exacerbation symptoms versus other diseases such as COPD. Through this education, unnecessary readmissions for CHF can be avoided, improving overall patient care and quality of life while decreasing the financial burden on the hospital due to high readmission rates. This project was an

example of developing and implementing a staff education project aligned with the requirements of scholarly projects for DNP students. The project design was based on evidence to improve patient care and reduce unnecessary hospital readmission for those suffering from CHF. While addressing the gap in nursing practice, this project also proposed a solution to an ongoing organizational goal to reduce readmission rates for CHF.

Nature of the Doctoral Project

This DNP project was supported by evidence collected through an in-depth literature review. Boolean searches focused on these key words and combinations of words: *development and delivery of staff education*, the *CardioMEMS CHF management system*, *CHF*, and *traditional CHF management*. Peer-reviewed articles were included for the period from 2009 to 2019, and the online databases searched included CINAHL, Medline, PubMed, Google Scholar, ProQuest, Cochrane, and Ovid MEDLINE as well as websites including the National Database of Nursing Quality Indicators, the ACC, and the American Heart Association.

Health care providers strive to provide the highest quality, safest care to their patients. They do this by constantly staying up to date on evidence-based practice (EBP) guidelines. EBP provides nurses and providers with the best evidence available to guide care and improve overall patient outcomes. Nurses use EBP to find solutions to health care problems using an evaluative and qualitative approach (Academy of Medical-Surgical Nurses, 2018). This DNP education project was presented to providers and

nurses at the identified site to improve knowledge of CardioMEMS technology and ways to include data from this technology in their plan of care for CHF patients.

As the project was developed, not only did interdisciplinary collaboration with hospital administration and education departments occur, but also teamwork with ER management and cardiology providers occurred, specifically the providers within the heart failure clinic who managed these patients. Through interprofessional collaboration, the project gained the benefit of offering the best educational module to the staff based on the specific clinical needs identified.

The analysis, design, development, implementation, and evaluation (ADDIE) instructional design model was chosen as the framework for this DNP project, along with Knowles' theory of andragogy. Evaluation took place before the education using a 5-point Likert scale questionnaire (see Appendix A) and again at the end of the education using the same 5-point Likert scale questionnaire (see Appendix A). In addition, a survey (see Appendix B) regarding the educational technique and instructor ability was administered after the education.

With the improved knowledge base of providers and nurses within the ED on CardioMEMS technology, not only can better quality of care be provided, but also a reduction in unnecessary admissions for CHF patients should be observed. A decrease in the overall financial burden on the hospital associated with penalties for readmission rates will be an added organizational outcome, while not the primary focus for the project.

Significance

Identification of Stakeholders

The stakeholders for this DNP education project included emergency room physicians, nurse practitioners, physician assistants, and registered nurses, as well hospital administrators and cardiology physicians and nurse practitioners in the heart failure clinic. Through this education, nurses and providers learned to identify patients with CardioMEMS technology in place, interrogate the device to obtain the data, and then efficiently interpret the data to differentiate between acute CHF exacerbation and other diagnoses for the patient. The providers also were able to see trends for PA pressures for the patient and then discuss that patient's particular data with the on-call cardiologist if necessary.

Potential Contributions

Once equipped with education on and orientation to the CardioMEMS technology, providers and nurses were expected to be more confident in the technology. Thus, they could identify individuals with a CHF exacerbation using the technology and interrogate these devices successfully. Through this knowledge, providers can reduce unnecessary readmissions for CHF exacerbations in patients who may be having an acute COPD exacerbation or pneumonia rather than a CHF exacerbation.

Potential Transferability

As the use of CardioMEMS technology grows, the development of a comprehensive education in-service may provide a framework for similar projects within other EDs within the area and even be transferable to other departments of this

organization. Nephrologists, for instance, struggle daily to find the ideal "dry weight" for the hemodialysis (HD) patient. The use of CardioMEMS technology can provide nephrologists with volume data and allow them to successfully remove the needed amount of fluid off an individual during HD without the adverse effects associated with removing too much or too little fluid during a session.

Implications for Positive Social Change

Such educational projects have great potential for positive social change and may be offered in both the inpatient and outpatient settings to encourage the development of CardioMEMS CHF management departments within other facilities in the area to provide the community with better quality of life for individuals suffering from CHF and their families. The potential involvement of other specialties, such as nephrology, provides great potential for those HD patients who struggle with volume management to have less adverse effects and improved quality of life as well.

Summary

The literature supported the increased readmission rates among CHF patients and the financial burden that these readmissions place on health care organizations. Until recently, traditional methods for management included daily weights and symptom recognition as part of identifying patients with decompensating CHF. Recent advances in CHF management have included the CardioMEMS management system, which comprises implantation of sensors directly within the PA to transmit PA pressures to assess volume status of patients while they remain at home. Such advances have proven to have great hospital readmission reduction rates (Ziaeian & Fonarow, 2017) and

improved patient reported quality of life. This DNP education project was designed to provide ED nurses and providers with the knowledge and education necessary to identify, interrogate, and use the CardioMEMS technology when a patient first presents to their department with symptoms suggestive of an acute CHF exacerbation.

In this section, the DNP project was introduced, including the problem statement, purpose, and nature of the project. Emphasis on the diagnosis of CHF and its impact on patients and their families as well as on health care and providers was included. Further discussion was presented on the significance of the chosen project to the practice of nursing and how it will directly impact positive social change and be transferred to similar areas of practice within the same organization and even surrounding facilities in the community.

In the following section, the application of Malcom Knowles' theory of andragogy and the ADDIE model will be discussed as they served as the theoretical and evidence translation frameworks for the project. In addition, the relevance to nursing practice will be discussed, including the local background and context as well as my role as a DNP student in the completion of the project.

Section 2: Background and Context

Introduction

The clinical practice problem for this project was the lack of knowledge that ED staff, including nurses and providers, possessed regarding the new technology, CardioMEMS, being used within the cardiology department in the organization. The practice-focused question was the following: Will a staff education in-service improve staff members' ability to recognize the significance of CardioMEMS, appropriately interrogate the device, and use the data downloaded from the device to guide treatment for patients suffering from CHF? This DNP project was supported through evidence collected using an in-depth literature review. Boolean searches focused on the following key words: *development and delivery of staff education*, *CardioMEMS management system*, *CHF*, and *traditional CHF management*. Relevant peer-reviewed articles were selected through a search of the publications included in the online databases CINAHL, Medline, and PubMed, as well as websites including the National Database of Nursing Quality Indicators, the ACC, and the American Heart Association. This evidence-based staff education project evaluated the effects of an education in-service on the uses and benefits of CardioMEMS technology in CHF identification and management within the ED. The overall purpose of this project was to provide nurses and providers with knowledge on the use of CardioMEMS in patients suffering from CHF and how to employ this technology to aid in the recognition of CHF exacerbation symptoms versus other diseases such as COPD.

As this section progresses, discussion of the theories and models used as a framework to guide this doctoral project as well as the relevance of the project to nursing practice, including local background and context, and my role as a DNP student in the success of this project will be addressed.

Concepts, Models, and Theories

Adult learning is often difficult and much different from the way that children learn. Often, adult learners, especially those who may not have participated in educational offerings for an extended period of time, may actually lack the capability to be self-directed and independent in their learning and require more dependence on the educator for complete understanding of the content (Spies et al., 2015). If this situation is not recognized early, both the adult learners and educator may be disappointed in the outcome. Perhaps the biggest difference in mature learners versus child learners is the simple fact that mature learners may have already developed a way of learning and doing that can become a barrier to their success. These adults learn more often on a need-to-know basis, in that they seek to know why they need to learn a particular task or skill. Identifying and developing strategies to overcome these barriers plays a key role in being successful in any educational effort with adult learners. Content should be provided in different formats to accommodate the different learning needs for that particular group. The goal of Knowles' theory of andragogy was to develop an effective curricular design and instruction method for the delivery of knowledge to adults (Kenner & Weinerman, 2011). Initially, Knowles identified four principles to characterize the adult learner. A fifth and sixth were later added. These principles included the following:

1. *Self-concept*: The individual needs to be involved in the planning and evaluation of their instructions and take responsibility for their own actions (Chan, 2010).
2. *Experience*: The individual has a certain depth of experience, which serves as a foundation of their self-identity (Chan, 2010).
3. *Readiness to learn*: The individual needs to be ready to learn and actively engaged in the learning process (Chan, 2010).
4. *Orientation to learning*: The individual must be task motivated (Chan, 2010).
5. *Motivation to learn*: The individual must have an internal motivation to learn (Chan, 2010).
6. *Need to know*: The individual has a need to know the value of learning the content (Chan, 2010).

The ADDIE model provides a 5-step process to ensure that a robust and repeatable process is developed that will aid in effective education and training (Uzunboylu & Kosucu, 2017). The five steps are as follows:

1. *Analysis*: Identify if the education is appropriate and define the requirements for the education (Uzunboylu & Kosucu, 2017).
2. *Design*: Identify the objectives, create the program, and choose the methods and media (Uzunboylu & Kosucu, 2017).
3. *Development*: Conduct a pilot course using the materials in accordance with the outlined objectives (Uzunboylu & Kosucu, 2017).

4. *Implementation*: Implement "Version 1" of the education, evaluate it, and then refine it (Uzunboylu & Kosucu, 2017).
5. *Evaluation*: Conduct evaluations to ensure that the goals are being met (Uzunboylu & Kosucu, 2017).

Knowles' theory of andragogy and the ADDIE instructional design model formed the theoretical and evidence translation frameworks for the education project. Evaluations in the form of a pretest and posttest took place at the beginning and end of the educational in-service.

Relevance to Nursing Practice

The chosen local nursing practice problem for this doctoral project was the lack of knowledge possessed by ED staff nurses and providers regarding the new technology being utilized within cardiology known as CardioMEMS. Identifying an acute exacerbation of CHF is often difficult in individuals who possess additional comorbidities with symptoms that often overlap. The cardiology department at the site of the project has been utilizing new CHF management technology known as CardioMEMS to aid in the recognition of elevated PA pressures before symptoms develop. This technology allows for aggressive diuretic regimens to begin prior to worsening of symptoms and eventual hospitalization. However, this technology is useless if providers who encounter these individuals in the emergency setting are unfamiliar with how to use it.

CardioMEMS interrogation can be performed by anyone who is trained in the technique for interrogation with the Merlin interrogation device that is provided by

Abbott in the cardiology clinic, which, following this project, will be available 24/7 within the ED. Triage nurses or bedside nurses caring for the patient upon presentation to the ED were educated on the appropriate source to alert for interrogation depending on time of day. The device could then be interrogated, and the results made readily available for the provider prior to assessment of the patient. While the interrogation device was connected to a printer to deliver an immediate printout of the information, nurses and providers needed to log into the Merlin.net clinical application website to view download trends, including the current download just performed in the ED, and effectively piece together the clinical picture for the past week. For example, an elevated mean PA pressure today may actually be a much-improved reading when compared to one recorded 7 days ago, indicating that symptoms should have improved and not worsened, leading the provider to consider alternative causes for a patient's symptoms. Obtaining access for multiple providers/nurses to the Merlin.net site was not feasible, so to simplify the process, specific individuals were identified as "essential" and given access to the Merlin.net site. During routine clinic hours Monday–Friday, cardiology staff and Abbott representatives were present to obtain the readings and already had access to the Merlin.net site. From 4 p.m. (after clinic hours) until 7 p.m., cardiac catheterization laboratory staff were available to interrogate, but as of now, they do not have access to the Merlin.net site. The goal will be to target 1 to 2 members from this department to give access to the Merlin.net site as well. From 7 p.m.–7 a.m. every day, cardiology nurse practitioners are available to interrogate and access the Merlin.net site. On weekends, cardiology nurse practitioners are available for most of the day hours as well.

Specifically, within the ED, charge nurses would benefit from gaining access to the Merlin.net site in the event that all other sources have failed. Staying up to date on the evolving technology and utilization of that technology allows nurses and providers to provide evidence-based care for optimal patient outcomes. Following this DNP project, the development of a protocol for interrogation of CardioMEMS within the ED will be considered.

The current practice for CHF patients presenting to the ED at the facility for the project is that they undergo routine diagnostic tests, including complete blood count (CBC), comprehensive metabolic panel (CMP), brain natriuretic peptide (BNP), and chest x-ray. These results, in addition to clinical findings, aid in the diagnosis of a CHF exacerbation, and then a typical treatment plan involves admission and IV diuretic use. Often, after an evaluation by cardiology, CardioMEMS data interrogation, and a review of recent trends have been performed, it becomes evident that the patient is not having an acute CHF exacerbation, but another etiology is responsible for the worsened shortness of breath and needs to be investigated and treated. In the meantime, the aggressive diuretic regimen prescribed by the ED and admitting physicians often leads to worsened renal function and potentially increased lengths of stay.

Since it gained Food and Drug Administration (FDA) approval in 2014, cardiology practices across the nation have begun using the CardioMEMS device in their class III/IV CHF patients who have been hospitalized in the past year for a CHF exacerbation. This new technology required in-depth training by the Abbott representatives for the cardiology department's staff involved in the implantation and

management of the device. However, the ED staff, nephrology staff, and staff on the units who also were involved in the care of these patients were overlooked during the implementation of the new technology. Education of ED staff can be critical in reducing CHF readmission rates and improving overall patient outcomes and quality of life.

Local Background and Context

Hospital readmission rates for heart failure are a growing problem in health care. It is estimated that the cost for treating CHF will rise to over $50 billion by 2030 (Chamberlain et al., 2018). Hospital readmissions greatly affect individual facilities by consuming resources and becoming a financial burden on the entire health care system (Benjamin et al., 2018). In addition, individuals and family members suffer decreased quality of life from frequent hospital readmissions. Despite continued efforts to reduce readmission rates, the number of readmissions at this site continues to grow. The local population suffering from CHF continues to have poor outcomes even with the use of such advanced CHF monitoring systems as CardioMEMS. The reason could lie in the fact that everyone outside of the cardiology practice is oblivious to the new technology, its benefits, and how to interrogate and use the data it provides for direct treatment.

This doctoral project took place in a very busy local rural ED in the eastern region of the United States. The hospital offers 340 acute-care beds with 40 ED beds. Unfortunately, as at many other facilities, hospital staff have struggled with readmission rates for CHF. Not only have the readmissions within 30 days decreased reimbursement rates for the facility, but the overall cost of care is skyrocketing, and patients are

experiencing a decreased quality of life as a result of frequent readmissions and increased debility.

It was brought to facility leaders' attention on multiple occasions in the past that appropriate use of the CardioMEMS technology could be beneficial to the ED providers when a patient presented to the ED with CHF-type symptoms. However, time after time, this recommendation had been brushed off as not as important as other aspects of care, and efforts were focused instead on improved discharge education and follow-up appointment compliance to decrease overall readmission rates in this patient population. While these discharge-related instructions are all very important to quality patient care, use of readily available data from the CardioMEMS could reduce unnecessary readmissions and should be given a chance. With persistence and the assistance of CardioMEMS representatives, education for staff on this new technology and how to interpret and use its results was provided to improve incorporation of the technology for the well-being of both the facility and the patients. With the education of staff and the involvement of ED management and the education department within the facility, a standardized protocol for CardioMEMS interrogation within the ED could be developed.

Prior to my initiation of the in-service, review of all material took place within the facility's education department, cardiology/HF department, and ED management department. Opportunity was provided for their input on the material to be presented to the staff. Every effort was made to incorporate any additional requirements requested by the facility. In order to achieve continuing education credits for the staff, the Kentucky Board of Nursing facility approved education offerings evaluation was provided to

participants. The goal was to develop an education module that could be used by the facility education department to continue staff education within other departments as well as provide the facility with a basis to develop a standardized protocol for interrogation of patients who present to the ED with CardioMEMS technology.

One of the most important aspects for the success of this DNP project was for the ED staff, including physicians, to have the willingness to learn and the ability to retain the information provided to them on the CardioMEMS technology and how to interrogate the device. Prior to beginning this project, a needs assessment was performed that included the hospital administration, reflecting the need for education on the CardioMEMS technology not only within the ED, but also throughout the hospital, including the cardiac units. To be more efficient, the focus was on the area that is typically the first stop for patients, the ED.

The context of this project went beyond local aspects and could be applicable on a state and federal level. The Hospital Readmissions Reduction Program (HRRP) is a Medicare program that is value based and reduces payments to hospitals with excess readmission rates for six specific conditions/procedures. These include acute myocardial infarction, COPD, pneumonia, coronary artery bypass graft surgery, elective primary total hip arthroplasty and/or total knee arthroplasty, and CHF (Centers for Medicare and Medicaid Services, 2019). In the past, 20% of readmissions were Medicare patients. Through the HRRP, not only do individual facilities benefit from the cost reduction associated with reduced readmissions, but also Medicare will achieve a substantial cost

savings. If the use of CardioMEMS can help reduce unnecessary readmission rates, then the entire health care system stands to benefit as a result.

Role of the DNP Student

My interest in the use of technology to aid in the improvement of patient care has steadily increased since completing my master's degree and starting my career as an advanced practice registered nurse (APRN) in cardiology. As an APRN, I have to be able to incorporate nursing science with the evolving technology that is used to save lives and improve quality of lives in individuals with chronic diseases such as CHF.

CardioMEMS technology is a part of my daily routine when caring for my cardiac patients with heart failure. As part of the facility protocol, all education modules must be presented to the education department and administration prior to approval. Part of my role as a DNP student was to facilitate interprofessional collaboration during this discussion and allow for feedback from the facility representatives. I decided to include ED management as well as the cardiologist within the HF clinic in an effort to be thorough and facilitate a desire for change in protocol within the ED and potentially facilitate the development of a protocol for interrogation of these patients upon presentation to the ED. Not only did I present them with the actual module I used for the in-service, but I also focused on the statistics obtained during the literature review as part of a "buy-in" process for the stakeholders. The long-term financial implications combined with improved patient outcomes and satisfaction in using the CardioMEMS technology was an important aspect that could not be overlooked when presenting results to the administrative staff.

Even within education, bias exists, and an educator must be aware of this potential bias and take steps to avoid it. For this module, one of the biggest biases that could exist involves ED experience. Providers and nurses with a long ED history may have a hard time accepting that old diagnostic criteria for CHF may be obsolete and that technology can offer a more accurate depiction of volume status in patients who possess the device. It is also easy for someone who has a lot of experience in a particular area, such as with CardioMEMS technology, to experience cognitive biases when presenting education to individuals with the same educational level or in some instances higher levels of education. One way to mitigate this bias is to provide education on the assumption that all participating individuals have no knowledge on the topic. This will ensure that all participants, regardless of prior assumed knowledge on the topic, will receive the same educational experience.

Summary

In this section, the application of Malcom Knowles' theory of andragogy and the ADDIE model was discussed as they served as the theoretical and evidence-translation frameworks for this DNP project. Further emphasis was placed on the relevance of the particular project to nursing practice, which included providing local background and context on the topic and defining my role as a DNP student in the completion of the project.

In the next section, focus will shift to the collection and analysis of evidence. I will identify objectives that were used to guide the project through completion and depict the identified outcome objectives for evaluation. Further discussion of the Likert scale

questionnaire (see Appendix A) chosen for the pretest and posttest, and analysis and synthesis of results will also occur.

Section 3: Collection and Analysis of Evidence

Introduction

The identified local nursing practice problem for this doctoral project was the lack of knowledge possessed by ED staff including nurses and providers regarding CardioMEMS technology. Since the implementation of the CardioMEMS technology within the cardiology clinic, providers have been battling the issue of unnecessary readmission rates for individuals who have had the device implanted and in whom interrogation upon admission revealed normal PA pressures and absence of an acute CHF exacerbation.

The institution has focused efforts on CHF discharge education for patients rather than education for staff on the CardioMEMS technology and how to use it effectively to determine a true heart failure exacerbation versus a COPD exacerbation or other diagnosis. Through communication with nursing staff members within the facility, it became evident that the technology was not known by the providers or nurses within the ED or even on the cardiac units within the facility. Therefore, the overall purpose of this project was to provide staff within the ED with an educational in-service for CardioMEMS technology that included background on the device, the internet-based monitoring system, the interrogation technique for the device, and how to interpret and apply the pressure measurements obtained from the interrogation.

Practice-Focused Question

With inconsistencies regarding CHF admissions, the institution focused on preventing readmissions through improved discharge patient education. Staff did not

share the same initial belief that the benefit of CardioMEMS technology could go beyond the outpatient cardiology clinic. The fact that staff outside the cardiology clinic lacked knowledge of the CardioMEMS technology led to the development of this practice-focused question: Will staff education in-service improve staff members' ability to recognize the significance of CardioMEMS, appropriately interrogate the device, and use the data downloaded from the device to guide treatment for patients suffering from CHF?

The development of objectives guides any program development. For this doctoral project, the project objectives included the following:

1. Collect educational data from CardioMEMS technology website, Abbott representatives, and the multiple trials/studies regarding the CardioMEMS technology identified through an in-depth literature review.
2. Identify the targeted ED staff audience (i.e., nurses, APRNs, physician assistants, and physicians). These professionals volunteered to participate in the in-service and evaluation of the CardioMEMS technology. Should the administration, education department, ED management, and cardiology department find that the benefit is significant, mandating of this education for all staff will likely occur.
3. Develop an evidence-based, staff-oriented education in-service detailing the CardioMEMS technology, interrogation technique, website, and how to interpret and apply the information obtained.
4. Arrange appropriate dates and times for the education to be delivered in order to give ample opportunity for all shifts to participate.

5. Complete the education in-service development, including pretest and posttest surveys as well as the course evaluation.
6. Process all collected data.

The outcome objectives for this project include the following:

- participation from ED staff (i.e., nurses, APRNs, physician assistants, and physicians) in the education in-service
- posteducation surveys depict new knowledge for CHF management using the CardioMEMS technology for diagnosis and treatment of patients who possess the device

Sources of Evidence

To begin, a thorough evidence-based literature review of nursing- and health-care-related online databases that included scholarly, peer-reviewed articles from 2009 to 2019 was performed to identify any sources of evidence that could be applied to address the practice-focused question. The online databases included CINAHL, Medline, PubMed, Google Scholar, ProQuest, Cochrane, and Ovid MEDLINE, as well as websites including the National Database of Nursing Quality Indicators, the ACC, and the American Heart Association. Boolean searches focused on development and delivery of staff education, and key words included *CardioMEMS*, *congestive heart failure*, *heart failure management system*, *heart failure and traditional heart failure management*, *staff education modules*, *ADDIE model*, and Malcolm *Knowles' theory of andragogy.* Each article was reviewed in depth using the Grading of Recommendations Assessment,

Development, and Evaluation (GRADE) model for identifying strengths and weaknesses of the research as well as level of evidence (Rafiq & Boccia, 2018).

Providers and nurses caring for patients diagnosed with heart failure need to have the most up-to-date knowledge of evidence-based tools such as the CardioMEMS technology to provide patients with the best care possible when they present to the ED with symptoms that suggest a possible CHF exacerbation. The CardioMEMS technology has been effective in reducing mortality and hospitalizations in patients with the device compared to individuals without the device. The CHAMPION trial consisted of a total of 550 patients suffering from New York Heart Association (NYHA) functional class III heart failure who had at least one hospital admission for heart failure in the past 12 months. During the total trial's 15-month follow-up, a 33% reduction in hospital admissions was seen for patients with the device compared to the control group (Ayyadurai et al., 2019).

While some may argue that ED providers or nurses should not interrogate such devices, but rather contact the representative on call to come in for interrogation, this could lead to extended wait times for the patient and delay in either discharge or admission. Most representatives for the CardioMEMS technology who serve this particular site are not local and drive at least 1.5 to 2 hours in the area to arrive at the facility. Neuenschwander (2016) concluded that ED providers and staff interrogate CardioMEMS faster and with similar 30-day outcomes when compared to standard process interrogation.

The project followed Walden University's Staff Education Module. Staff education was chosen for this project because the need for education of staff within the ED setting was identified through a prior needs assessment. Before the education, a quantitative 5-point Likert scale questionnaire (see Appendix A) was administered to assess the current knowledge base, and following the education, the same questionnaire was repeated to assess for an increase in knowledge associated with the education. A course evaluation tool (see Appendix B) was administered at the end of the education to evaluate the instructor and course material.

Analysis and Synthesis

Specific dates and times were determined for the education in-service that allowed for optimal attendance of all ED staff regardless of shift worked. This in-service was provided on an online platform, and emails were generated to ED employees, as well as posts on the facility's social media platform. Individuals who expressed willingness to participate were given their choice of one of the multiple scheduled online sessions. Once they joined the session, they received a consent form for anonymous questionnaires via the online platform and were asked to sign, giving consent to participate. Upon signing, they were then asked to complete the 5-point Likert scale (see Appendix A) prequestionnaire, again using the online platform. Once this was completed, the module began. Following completion of the module, the same 5-point Likert scale questionnaire (see Appendix A) was given as the postquestionnaire to validate the content of the staff education module. While the validity of Likert-scale questionnaires is doubted by some, according to Willits et al. (2016), they have maintained their validity throughout the years

and have been major contributors to health care advancements. The Likert-scale questionnaire (see Appendix A) utilized for this project contained the following choices:

- *strongly disagree*
- *disagree*
- *neither agree nor disagree*
- *agree*
- *strongly agree*

The above choices were used for six specific topics related to the staff in the ED and the CardioMEMS technology. The topics included the following:

1. I encounter a patient with heart failure symptoms daily in my practice
2. I am familiar with CardioMEMS technology
3. I am confident in locating the CardioMEMS interrogator within the facility
4. I am confident with interrogating CardioMEMS technology
5. I am familiar with locating contact information for a CardioMEMS rep within my area
6. I am confident in utilizing PA systolic and diastolic pressures to identify heart failure exacerbation.

Participants were also asked to fill out a short evaluation (see Appendix B) on the course material and the instructor's teaching ability. The participants were given random identification numbers initially, which coincided with their pretests and posttests in order to allow linking the scores of the pretest and the posttest while maintaining anonymity. The participants were asked to list their identification numbers on their pretest/posttest as

they completed them. The consent form as well as the course evaluation tool (see Appendix B) were not numbered to ensure totally anonymous data collection. The data collected from the pretest and posttest questionnaires were then analyzed and synthesized using a descriptive analysis approach following the Walden DNP Staff Education Manual requirements.

Institutional Review

Prior to data collection, an application to the Walden University Institutional Review Board (IRB) was required. This requirement was to ensure that the well-being and the rights of the participants involved were protected. The IRB approval number for this project was 08-25-20-0981231.

Summary

The devastating effects of CHF on patients, their families, and the health care system continue to skyrocket. In addition to focusing on self-care and discharge patient education, the development of monitoring technologies such as the implantable PA monitoring system CardioMEMS has given providers PA pressures at the press of a button, without performing additional invasive procedures. While the technology is being used routinely within cardiology practice, individuals typically present to the ED when they experience symptoms suggestive of a CHF exacerbation. Unfortunately, anyone who has cared for CHF patients realizes that often these symptoms overlap with symptoms of additional comorbidities that the patient may possess, such as COPD or viral/bacterial illnesses such as bronchitis or even pneumonia. It was apparent that providers and staff of this particular ED lacked knowledge regarding the CardioMEMS technology and could

benefit from staff education focused on CardioMEMS. In the next section, findings, implications, recommendations, and strengths and limitations of this project are reviewed.

Section 4: Findings and Recommendations

Introduction

It was recognized by a needs assessment that the ED staff at a major southeastern hospital were not familiar with CardioMEMS technology or its potential benefit for their patients who had the technology. The purpose of this project was to develop a staff education module for ED staff at this facility to use as a reference guide to increase knowledge of the CardioMEMS technology and encourage the analysis of its data to aid in the recognition of treatment of CHF exacerbations within the ED. The practice-focused question surrounding this DNP project was as follows: Will staff education in-service improve staff members' ability to recognize the significance of CardioMEMS, appropriately interrogate the device, and use the data downloaded from the device to guide treatment for patients suffering from CHF? Findings from this DNP project supported the creation of mandatory education modules on the new CardioMEMS technology, which will improve overall knowledge of the technology and ways to integrate its findings into practice not only in the ED, but also within the other hospital departments.

Findings and Implications

According to Shauld et al. (2017), utilization of PA pressures reduces the readmission rates for individuals presenting with symptoms that may be indicative of heart failure. This specific education module was presented to ED staff to optimize knowledge and increase use of CardioMEMS data with those individuals presenting to the ER complaining of symptoms suspicious for a CHF exacerbation.

This staff education module learning objectives (see Appendix C) included strategies for staff on the following:

- understanding what CardioMEMS technology is
- identifying individuals presenting with CardioMEMS technology
- identifying the need to interrogate the CardioMEMS technology
- locating the CardioMEMS interrogator within the facility
- identifying the appropriate representative or staff available to interrogate the device
- identifying where the information from the interrogation can be found (printed version on chart; trends located at Merlin.com)
- understanding how to interpret the data from the interrogation (utilizing PA systolic and diastolic pressures) to identify a heart failure exacerbation.

After the review by one ED manager, two cardiologists, and a member of the facility's education department for approval of the content, the staff education module was delivered to the staff who volunteered to participate. A total of 25 ED staff members participated in this education module. The results are depicted in Table 1 and Table 2 and demonstrate an increase in knowledge and confidence in using the CardioMEMS technology. Only three participants agreed that they were familiar with CardioMEMS on the pretest. While all 25 of the participants agreed or strongly agreed that they encountered patients with CHF symptoms daily, all 25 reported strongly disagreeing or disagreeing that they were confident in interrogating the CardioMEMS. After the education, all participants agreed or strongly agreed that they were familiar with

CardioMEMS, and 21 participants agreed or strongly agreed that they were confident in interrogating the CardioMEMS.

Table 3 depicts the results of the course evaluation tool administered at the end of the presentation. The course evaluation indicated strong support of the content and the delivery of the CardioMEMS education, with nearly all participants indicating that the education was excellent. Areas for improvement were in ensuring that all participants can apply the skills taught, particularly interpreting the data from interrogation to diagnosis and treatment of a CHF exacerbation. Inclusion of a hands-on component and case studies in the education may improve confidence related to that outcome.

Table 1

Pretest Questionnaire Results

Question	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
1. I encounter a patient with heart failure symptoms daily in my practice				7	18
2. I am familiar with CardioMEMS technology	12	10		3	
3. I am confident in locating the CardioMEMS interrogator within the facility	8	15	1	1	
4. I am confident with interrogating CardioMEMS technology	18	7			
5. I am familiar with locating contact information for a CardioMEMS rep within my area	15	5	1	3	1
6. I am confident in utilizing PA systolic and diastolic pressures to identify heart failure exacerbation	6	7	1	8	3

Table 2

Posttest Questionnaire Results

	Question	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
1.	I encounter a patient with heart failure symptoms daily in my practice				7	18
2.	I am familiar with CardioMEMS technology				22	3
3.	I am confident in locating the CardioMEMS interrogator within the facility			1	18	6
4.	I am confident with interrogating CardioMEMS technology		2	2	15	6
5.	I am familiar with locating contact information for a CardioMEMS rep within my area		1	1	15	8
6.	I am confident in utilizing PA systolic and diastolic pressures to identify heart failure exacerbation	2	4		15	4

Table 3

Course Evaluation Tool

Question	Very poor (1)	Poor (2)	Fair (3)	Good (4)	Excellent (5)
1. The course objectives & content addressed knowledge required for my job					25
2. The course materials & methods were organized, effective and easy to follow					25
3. The methods of teaching were effective, motivating & enhanced learning					25
4. The course content was appropriate for the target audience					25
5. The classroom, learning environment and equipment was favorable for learning					25
6. The course content was relevant to the course objectives					25
7. It was easy to sign up to participate in the course					25
8. The course facilities were adequate					25
9. The instructor communicated clearly					25
10. The instructor answered my questions well					25
11. I would recommend this course to others					25
12. I can apply the skills I learned to my everyday practice			2	2	21

Question	Very poor (1)	Poor (2)	Fair (3)	Good (4)	Excellent (5)
13. Describing CardioMEMS technology				1	24
14. Identifying individuals with CardioMEMS				1	24
15. Recognize the need to interrogate CardioMEMS technology					25
16. Locating the CardioMEMS interrogator					25
17. Identifying the appropriate representative or staff available to interrogate the device				2	23
18. Identifying where the information from the interrogation can be found			2		23
19. Understanding how to interpret data from the interrogation to identify a heart failure exacerbation			2	3	20
20. Please rate the effectiveness of the instructor considering the content expertise, teaching methods, and the overall organization of the presentation					25
21. Please rate the overall quality and satisfaction with this course					25

Based on the pretest staff education findings, ED staff, including nurses and physicians, did not have much knowledge regarding CardioMEMS technology. Following the staff education, it was evident that their knowledge improved regarding the technology. In addition, knowledge on interrogation, PA pressures, and interpreting these pressures was also improved.

Limitations/Potential Impact on Findings

The research reviewed to evaluate the effectiveness of CardioMEMS technology in identifying heart failure exacerbations and reducing hospital admissions did not reveal any significant limitations to utilizing the device when the patient presents to the ED with symptoms suspicious for CHF exacerbation. The effectiveness greatly depends on the practitioner's knowledge of the CardioMEMS technology and their ability to interpret the data it delivers once interrogated.

Implications for Social Changes

This DNP project has potential to greatly effect social change by providing ED providers and nursing staff with the knowledge base needed to identify successfully those patients who have CardioMEMS technology, interrogate their device, and use the data obtained to identify those who are suffering from acute exacerbations of CHF in the emergent care setting. These potential implications for positive social change include strategies to reduce readmission rates for CHF, which would decrease hospital and patient financial burdens, as well as improve patient quality of life by keeping them out of the hospital.

Recommendations

Studies revealed that CardioMEMS technology, which is fully FDA approved, is shown to significantly reduce ED visits when used on an outpatient basis and to improve overall quality of life in CHF patients labeled NYHA class III (Sauld et al., 2017). Within the current nursing practice, nurses, as well as providers within the ED, were not knowledgeable on CardioMEMS technology, which led to unnecessary readmission rates for individuals with questionable CHF exacerbation. Recommendations following this DNP project were to host mandatory staffing education on the CardioMEMS technology, how to interrogate the device, and how to utilize its data in determining volume status for patients with a CHF diagnosis who present to the ED with questionable etiology of their symptoms.

Plan to Extend the Project Beyond the DNP Project Focus

In addition to the DNP project focus within the ED, I plan to collaborate with the facility site team, in the near future, to further extend the DNP project with the ultimate goal to include the education throughout the facility for all inpatient as well as outpatient departments. This education will initially focus on educating nephrology staff and physicians on the potential use for volume management through CardioMEMS technology for its hemodialysis patients who have existing CardioMEMS technology. As CardioMEMS implantation continues to increase within the facility, education throughout the department will become very beneficial in time to facilitate patient diagnosis and treatment differentials.

Strengths and Limitations of Doctoral Project

This DNP project provided an opportunity for ED staff, as well as cardiology staff and leadership team members, to see firsthand the knowledge deficit that exists within the facility on technology that is being utilized daily within specialty departments. CardioMEMS data could be very beneficial when used within the ED upon an initial visit for the patient who possesses this technology. Additionally, nurses and health care staff must appreciate the value of using advanced technologies and informatics to expand nursing practice and ultimately transform the current healthcare realm. The key to this DNP project was to recognize the benefits of successfully and proficiently incorporating a technology-based tool, such as CardioMEMS, into practice within the ED to support timely and appropriate recognition and treatment of CHF exacerbations. As with any project, members from the leadership team, as well as the clinical staff who are frontline workers, must be willing to acknowledge that there is a gap in their current knowledge base so they make every effort to gain the needed knowledge to improve their practice.

Recommendations for Future Projects

As mentioned, CardioMEMS technology can be utilized in areas other than cardiology; specifically, a benefit exists for its use within nephrology. With education on CardioMEMS offered to members of the nephrology team, its use could have substantial benefits for its patients and make identifying volume status much easier for nephrologists. Future staff education projects, such as the one utilized for this DNP project could greatly reduce hospitalization rates for patients receiving hemodialysis.

Section 5: Dissemination Plan

Introduction

The results of the evaluation of this CardioMEMS educational in-service were presented to several members of the facility's leadership team, including members from the education department, the cardiology/CHF department, and the ED management department. In addition to reviewing the findings, the leadership team provided feedback in the form of suggestions and strategies to distribute this knowledge throughout the ED and ways to develop a policy for interrogation of these devices in the ED and eventually education throughout the facility. The results were also posted within the ED staff lounge along with the education packet and brochures on CardioMEMS and tips for interrogation.

Audiences for Dissemination

The primary audience for dissemination of this DNP project is the clinical staff within the facility's ED. The team selected to review the education module consisted of a member from the education department, physicians from the cardiology/CHF department, and members of the ED management department. The evaluation of the CardioMEMS education will be used to improve ED practice guidelines when caring for patients with CardioMEMS technology in place, which ultimately will reduce unnecessary admissions to the hospital. The implementation of this education within the ED will assist not only clinical nurses, but also the physicians to provide safe, high-quality, and patient-centered care to patients suffering from CHF who present to the ED with symptoms that are unclear or paint a mixed picture. To be effective with dissemination, a final oral

PowerPoint presentation will be presented to the ED clinical staff, along with copies of the CardioMEMS interrogation brochure. The findings may provide insight into the use of CardioMEMS technology within the ED to facilitate change within nursing practice.

Analysis of Self

The road to obtain my DNP degree began several years ago, and it has been a very challenging yet fulfilling overall experience. The decision to pursue my DNP came from a desire to change nursing practice within my facility, utilizing the latest technology and evidence-based practices. A particular technology of interest for myself was CardioMEMS technology for CHF management. I had become very familiar with the technology within my current practice and felt it was underutilized in areas that needed it the most. As I completed my Master of Science in Nursing—Family Nurse Practitioner program in 2016, I continued to work within cardiology, just in a different role. My passion for CHF patient management and CardioMEMS technology continued. Through this DNP project, my hope is that other nurses and providers will see the benefit of such technology and strive to change their daily practice to incorporate the beneficial data that can be obtained from device interrogation when a patient presents to the ED.

The completion of this DNP project was not easy. One of the biggest challenges I faced consisted of the restrictions placed on student access within facilities and in-person educational offerings as a result of COVID. Through perseverance and the availability of online platforms such as Zoom, I was able to find a solution that allowed for the project to be continued. Upon completion of this project, I was able to fully understand the lack

of CardioMEMS knowledge within the ED and the importance of providing the department with education on the technology and its benefits.

Summary

The use of CardioMEMS technology, especially within the ED, has the potential to greatly reduce unnecessary admissions, when utilized appropriately. The staff education manual provided by Walden University was used as the initial guide to plan and implement this project. This DNP staff education module provided ED staff with the information needed to recognize and interrogate the device as well as interpret the data provided within the interrogation.

Findings from this DNP project support the creation of mandatory education modules on the new CardioMEMS technology, which will improve overall knowledge of the technology and ways to integrate its findings into practice not only in the ED, but also within the other hospital departments. The potential implications for positive social change include strategies to reduce readmission rates for CHF, thereby decreasing hospital and patient financial burdens, as well as improving patients' quality of life by keeping them out of the hospital.

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Appendix A: Five-Point Likert Scale Pretest and Posttest Questionnaire

1. I encounter a patient with heart failure symptoms daily in my practice
2. I am familiar with CardioMEMS technology
3. I am confident in locating the CardioMEMS interrogator within the facility
4. I am confident with interrogating CardioMEMS technology
5. I am familiar with locating contact information for a CardioMEMS rep within your area
6. I am confident in utilizing PA systolic and diastolic pressures to identify heart failure exacerbation

Appendix B: Course Evaluation Tool

Course Evaluation Form

Title:	**CardioMEMS**
Date:	

1. Please answer the following question:

- **Identify two ideas or concepts you value the most from this course.**

1._____

2._____

2. Please rate the effectiveness of this course offering by responding to the statements below (please circle):	***1= Very Poor*** ***5= Excellent***
The course objectives & content addressed knowledge required for my job.	**1 2 3 4 5**
The course materials & methods were organized, effective and easy to follow.	**1 2 3 4 5**
The methods of teaching were effective, motivating & enhanced learning.	**1 2 3 4 5**
The course content was appropriate for the target audience.	**1 2 3 4 5**
The classroom, learning environment and equipment was favorable for learning.	**1 2 3 4 5**
The course content was relevant to the course objectives.	**1 2 3 4 5**
It was easy to sign up to participate in the course	**1 2 3 4 5**
I received my material in time to review prior to the course	**1 2 3 4 5**
The course facilities were adequate	**1 2 3 4 5**
The instructor communicated clearly	**1 2 3 4 5**
The instructor answered my questions well	**1 2 3 4 5**
I would recommend this course to others	**1 2 3 4 5**
I can apply the skills I learned to my every day practice	**1 2 3 4 5**

3. **Please rate the course's effectiveness in meeting the following objectives (please circle):**

	1= Very Poor ***5= Excellent***
1. Describing CardioMEMS technology	**1 2 3 4 5**
2. Identifying individuals with CardioMEMS	**1 2 3 4 5**
3. Recognizing the need to interrogate CardioMEMS technology	**1 2 3 4 5**
4. Locating the CardioMEMS interrogator	**1 2 3 4 5**
5. Identifying the appropriate representative or staff available to interrogate the device	**1 2 3 4 5**
6. Identifying where the information from the interrogation can be found (printed version on chart; trends located at Merlin.com)	**1 2 3 4 5**
7. Understanding how to interpret data from the interrogation (utilizing PA systolic and diastolic pressures) to identify a heart failure exacerbation	**1 2 3 4 5**

4. **Please rate the effectiveness of the instructor considering the content expertise, use of various teaching methods, and the overall organization of the presentation (please circle):**

	1= Very Poor ***5= Excellent***
Betty Reynolds, RN, MSN, FNP-BC	**1 2 3 4 5**

5. **Please rate the overall quality and satisfaction with this course (please circle).**

(Poor Quality) 1 2 3 4 5 ***(Excellent Quality)***

If you were unable to rate this class with a score of 5, please tell us how we can improve the quality of this course offering. We are anxious to hear any suggestions and/or concerns that you may have.

_____

_____

Thank you for your participation and cooperation

Appendix C: Course Objectives

1. Understanding what CardioMEMS technology is
2. Identifying individuals presenting with CardioMEMS technology
3. Identifying the need to interrogate the CardioMEMS technology
4. Locating the CardioMEMS interrogator within the facility
5. Identifying the appropriate representative or staff available to interrogate the device
6. Identifying where the information from the interrogation can be found (printed version on chart; trends located at Merlin.com)
7. Understanding how to interpret the data from the interrogation (utilizing PA systolic and diastolic pressures) to identify a heart failure exacerbation