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## Remote Patient Monitoring: Decrease Rehospitalization for Spinal Cord Injury Patients

Abegail Cabunoc-Garcia  
*University of St. Augustine for Health Sciences*

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**Remote Patient Monitoring: Decrease Rehospitalization for Spinal Cord Injury Patients**

Abegail Cabunoc-Garcia, MSN, RN, NE-BC

School of Nursing, University of St. Augustine for Health Sciences

This Manuscript Partially Fulfills the Requirements for the

Doctor of Nursing Practice Program and is Approved by:

Sarah M. I. Cartwright, DNP, MSN-PH, BAM, RN-BC, CAPA, FASPAN

Angelica Adriano, DNP, NP-C, NE-BC

Approved: December 2, 2022

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**University of St. Augustine for Health Sciences  
DNP Scholarly Project  
Signature Form**

<b>Student Last Name:</b> Cabunoc-Garcia	<b>First Name:</b> Abegail	<b>Middle Initial:</b> R
<b>E-mail:</b> a.cabunocgarcia@usa.edu		
<b>Title of DNP Project:</b>  Remote Patient Monitoring: Decrease Rehospitalization for Spinal Cord Injury Patients		
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<b>DNP Project Preceptor:</b> Angelica Adriano, DNP, NP-C, NE-BC	<small>DocuSigned by:</small> Angelica E. Adriano	12/2/2022
<b>DNP Project Preceptor:</b>		

### Abstract

**Practice Problem:** The lengthy distance required to access specialty care, the overall higher cost of SCI/D care, complications associated with SCI, and the potential negative impact of shortened hospital stays are all compelling reasons to use telehealth technologies to deliver specialty services for medical issues.

**PICOT:** The PICOT question that guided this project was in adult spinal cord injury patients with chronic disease receiving primary care at a spinal cord injury center (P), how does the implementation of a remote patient monitoring home telehealth for SCI patients recently discharged from acute-care setting (I) compared to the usual practice of one post-discharge follow up phone call at 7 days (C), improve early recognition of patient deterioration to prevent acute care rehospitalization (O) within 30 days of discharge (T).

**Evidence:** Spinal Cord injury patients are at risk for developing complications after injury. Past studies have demonstrated the effectiveness of telehealth to prevent rehospitalization, which suggests the potential of telehealth on post-discharge follow-up care.

**Intervention:** Implement remote patient monitoring home telehealth for SCI patients meeting the criteria for high-risk rehospitalization.

**Outcome:** The pilot project results have a positive correlation with the reduction of 30-day hospital readmission rates for SCI patients participating in the RPM. During the pilot period, no readmissions occurred for the RPM participants, whereas those who declined participation were readmitted at a rate of 22%. Clinical significant findings of improved outcomes and reduced 30-day readmissions are supported through this pilot project.

**Conclusion:** The project utilized the Johns Hopkins evidence-based model's three-step PET framework and Roger's diffusion of innovation change theory to support reduced rehospitalization for SCI patients through RPM.

### **Remote Patient Monitoring: Decrease Rehospitalization for Spinal Cord Injury Patients**

Spinal cord injuries (SCI) are one of the most complex and disabling diseases, with severe consequences for all aspects of a person's life. Paralysis is only one of the several major medical complications associated with SCI (Sweis & Biller, 2017). Long-term, secondary medical problems are prevalent and play a critical role in the continuum of care for individuals with SCI (McKinley et al., 1999). Expanding access to care is critical to improving outcomes for this population. The ability to monitor some elements of a patient's health from the comfort of their own home has grown in popularity as a telehealth option. Providers can address acute and chronic illnesses via remote patient monitoring. This project aims to determine the effect of telehealth remote patient monitoring on SCI patient to avoid rehospitalization.

#### **Significance of the Practice Problem**

According to the National Spinal Cord Injury Statistical Center's (2021) "Facts and Figures at a Glance," over 296,000 Americans now live with a spinal cord injury and roughly 17,900 new cases are reported each year. Spinal cord injury and/or disorders (SCI/D) patients are among the most difficult and expensive to manage in any healthcare system (Woo et al., 2011). The ongoing management and treatment of acute and chronic health problems frequently include many human organ systems, including the genitourinary, gastrointestinal, cutaneous, pulmonary, cardiovascular, autonomic nervous, and neuromuscular systems, as well as psychological concerns.

Despite these multifaceted demands, persons with SCI experience severe barriers to treatment (Stillman et al., 2014). Limited mobility as a consequence of the disability, in addition to long distances to SCI/D specialized providers, creates geographic barriers to access and can have an adverse impact on expenses and quality of care. Without the access to care complications become the cause of morbidity and death and contribute to higher rates of rehospitalization (McKinley et al., 1999). Since 2015, over 30% of individuals with SCI have

been readmitted to the hospital one or more times during any given year following injury (Administration for Community Living, 2021).

Individuals with SCI face transportation challenges, and they represent a demographic that might benefit from telehealth services. Telehealth is defined as the providing and facilitation of health and health-related services via telecommunications and digital communication technologies, including medical treatment, provider and patient education, health information services, and self-care (Catalyst, 2018). Telehealth is an broad word that refers to clinical interactions between patients and healthcare professionals who are geographically separated (Gajarawala & Pelkowski, 2021). Telehealth can be utilized for a variety of purposes, including preventative, diagnostic, instructional, and therapeutic intervention. Remote patient monitoring is a subset of telehealth that entails the collection and transmission of vital signs or physiologic data from a patient who is not in the office (Sensmeier, 2021). Clinical staff monitors this data and uses it to provide continuing patient care, communication, and education.

Hospital readmissions have placed a huge financial strain on the United States' healthcare system. According to the Agency for Healthcare Research and Quality (AHRQ), the average cost of readmission was \$14,400 in 2016. The Center for Medicare and Medicare Services (2018) reported that hospital readmissions cost Medicare approximately \$26 billion annually. Readmissions have a negative impact on patients, frequently resulting in deterioration of health conditions.

The transition back to daily life following a SCI or recent hospitalization can be difficult. The lengthy distance required to access specialty care, the overall higher cost of SCI/D care, complications associated with SCI, and the potential negative impact of shortened hospital stays are all compelling reasons to use telehealth technologies to deliver specialty services for medical, rehabilitation, vocational, and mental health issues. Additionally, with continued care to preserve optimal health and function, there is a possibility of enhancing access and decreasing

the likelihood of developing expensive secondary problems in individuals with SCI requiring rehospitalization.

### **PICOT Question**

For continuity of care, this project will confirm, in adult spinal cord injury patients with chronic disease receiving primary care at a spinal cord injury center (P), how does the implementation of a remote patient monitoring home telehealth for SCI patients recently discharged from acute-care setting (I) compared to the usual practice of one post-discharge follow up phone call at 7 days (C), improve early recognition of patient deterioration to prevent acute care rehospitalization (O) within 30 days of discharge (T). The population of this project will include Veterans with a spinal cord injury or disorders (SCI/D) that receive primary care at SCI/D center. The intervention is telehealth remote monitoring, a means of delivering healthcare that makes use of the latest advances in information technology to collect patient data outside of traditional healthcare settings (Howland et al., 2021). Telehealth monitoring program will collect a variety of health data, including vital signs, weight, blood pressure, blood sugar, blood oxygen levels, and heart rate through a portal that patient self-reports through a telephone system. The data is subsequently transferred to facility-based health professionals. Telehealth remote monitoring enables a provider to continue monitoring a patient's healthcare data once they are discharged to their home, with the expected outcome of lowering acute care rehospitalization rates identified through chart review. The duration of this project will be eight weeks.

### **Evidence-Based Practice Framework & Change Theory**

The Johns Hopkins nursing evidence-based model is used in this project. The methodology incorporates the best research into practice by taking a problem-solving approach to clinical decision-making. It is tailored to the needs of practicing nurses and is based on a three-step process known as PET: practice question, evidence, and translation (Dang et al., 2022). The first step of the PET framework the practice question is identified in a PICOT form. In the second step, the most persuasive evidence is found to address the PICOT question. Lastly,

the evidence is converted into practice. The model's objective is to ensure that the most recent research findings and best practices are integrated into patient care quickly and appropriately in order to improve patient outcomes, satisfaction, and quality of life, as well as to foster a culture of critical thinking and continuous learning (White et al., 2019). According to (Dang et al., 2022), the Johns Hopkins nursing model is a process that allows for consideration of both internal and external influences on practice, such as those involved in telehealth remote patient monitoring, patient, nurse, and provider, encouraging them to think critically while applying evidence.

Change is extremely challenging but important to achieve a better end. Therefore, it is critical to comprehend the change theory to implement new changes that improve patient care successfully. Rogers' diffusion of innovation theory will be used in this project. The idea enables evaluation of how specific clinical behaviors are adopted and focuses attention on perceived innovation qualities that increasingly drive acceptance. Rogers believed that an innovation's characteristics were effective factors in its adoption. He specified that the five characteristics of an innovation, relative advantage, compatibility, simplicity, observability, and trialability, were determinants of the innovation's adoption and diffusion in a target population (Rogers, 2002).

Rogers's diffusion of innovation model states that knowledge is generated when an individual is exposed to an existing innovation and has an awareness of its mechanics and functions. This involves patient/nurse/provider education on how to use the telehealth remote monitoring program. To get to the level of persuasion, the individual must create an opinion about remote monitoring based on its perceived characteristics (relative advantage, complexity, and so on). Following that, the individual must be engaged in an activity that requires him or her to select between using or rejecting the program. Finally, for adoption to occur, the individual must determine that the telehealth remote monitoring is the best path ahead (Doyle et al., 2014)

### **Evidence Search Strategy**

To identify current evidence that could be used to answer the PICO question "How does remote patient monitoring home telehealth affect patient readmission to acute hospital setting?"



a comprehensive search for relevant, evidence-based literature was conducted using electronic databases, CINAHL Complete, PubMed, and Google Scholar from 2012 to 2022. The keywords "telehealth" OR "telemedicine" OR "remote patient monitoring" AND "rehospitalization" OR "readmission prevention" OR "readmission" was used in the search. The search results will be reviewed using the following criteria: (a) full-text articles; (b) empirical research studies; (c) articles relating to the usage of remote patient monitoring applications rather than their development; and (d) articles relating to clinical care. The inclusion criteria also include patients discharged to nursing homes or long-term care facilities participating in a remote patient monitoring program, as well as those established remote patient monitoring after discharged from an acute care setting. Protocols for research, articles, editorials, conference papers, non-English publications, applications that provide education or information but did not collect data, and papers on remote patient monitoring app development were excluded from the review. The data from 20 studies matched the inclusion criteria were then retrieved and aggregated.

### **Evidence Search Results**

Once applying the detailed inclusion and exclusion criteria, a total of 1318 records were identified. After removing 1098 duplicates, the articles were subjected to an additional screening process based on their titles, which resulted in the exclusion of 116 records, leaving 104 for eligibility assessment. Next screening the abstracts of these articles, only those that contained empirical evidence were considered eligible for the current project. This process resulted in the exclusion of an additional 13 articles, leaving 91 for qualitative analysis. The remaining unduplicated 91 articles were reviewed as full text to determine the usefulness and relevance to the PICOT question. Seventy-six articles were excluded based on the following: (1) education based intervention of telehealth, (2) telehealth monitoring as an implantable device, and (3) lack or no reference to readmissions. The remaining studies achieved the inclusion criteria based on (1) involvement in telehealth program, (2) treatment to adult patient, (3) effect of a telehealth intervention, and (4) reference to readmission.

The result of search for research evidence yielded 15 scholarly in a PRISMA Flowchart (see Figure 1). The PRISMA flowchart illustrates the screening process (Page et al., 2021). It begins by recording the number of articles discovered and then transparently reports on the selection process at various phases of the systematic review. At various stages, the number of articles is recorded.

Reviewed articles reported enhanced patient outcomes after incorporation of telehealth to care outside of the acute care setting and reduction of hospital readmissions (Blum & Gottlieb, 2014; Liang et al., 2021; Noel et al., 2020; Phillips et al., 2001). Evidence-based approaches were structured based on the results on readmission, and telehealth in the care among adult patients.

Most articles referred to the use of telehealth intervention and referenced readmission. The EBP change project was supported by the articles selected that focused on the use of a telehealth intervention. Using the Johns Hopkins level of evidence, three studies were Level 1, Quality A (Blum & Gottlieb, 2014; Noel et al., 2020; Takahashi et al., 2012), three studies were Level I, Quality B (Arcilla et al., 2019; Liang et al., 2021; Phillips et al., 2001), two studies were Level II, Quality B (Orozco-Beltran et al., 2017), two studies were Level III, Quality B (Bashi et al., 2017; Smith, 2013), one study was Level III, Quality C (Aronow & Shamliyan, 2018), and one study was Level V, Quality B (Hanlon, 2019) (see Appendix A and B).

### **Themes with Practice Recommendations**

A synthesis of the literature was appropriate to achieve a better understanding into the components of the PICOT question. This synthesis consisted of fifteen articles as follows: 3 qualitative (Barclay et al., 2020; Houlihan et al., 2017; Soopramanien et al., 2020) and 12 quantitative (Arcilla et al., 2019; Aronow & Shamliyan, 2018; Bashi et al., 2017; Blum & Gottlieb, 2014; Hanlon, 2019; Ho et al., 2021; Liang et al., 2021; Noel et al., 2020; Orozco-Beltran et al., 2017; Phillips et al., 2001; Smith, 2013; Takahashi et al., 2012). These publications generated significant interest in telehealth as a novel mode of healthcare delivery and its potential to

reduce hospital readmissions. A table summarizes the key research evidence (see Appendix A). The primary themes discovered throughout the analysis of these fifteen publications were (1) population, (2) telehealth application, and (3) influence on hospital readmission.

### **Population**

The population recognized for this project were patients with spinal cord injury or chronic disease who obtained follow-up care after discharge. Five of the articles (Barclay et al., 2020; Ho et al., 2021; Houlihan et al., 2017; Phillips et al., 2001; Soopramanien et al., 2020) acknowledged that patients with SCI have a higher likelihood of readmission and highly urged that organizations prioritize developing readmission prevention measures, such as early post-discharge follow-up. Ten articles (Arcilla et al., 2019; Aronow & Shamliyan, 2018; Bashi et al., 2017; Blum & Gottlieb, 2014; Hanlon, 2019; Liang et al., 2021; Noel et al., 2020; Orozco-Beltran et al., 2017; Smith, 2013; Takahashi et al., 2012) showed telehealth helped non-SCI patients with congestive heart failure, chronic obstructive pulmonary disease, and diabetes.

### **Applicability of Telehealth**

The applicability of telehealth was determined by the innovation in healthcare to assist with chronic disease management, rising healthcare costs, limited resources in communities, and the need for specialized services in all fifteen articles ( Arcilla et al., 2019; Aronow & Shamliyan, 2018; Barclay et al., 2020; Bashi et al., 2017; Blum & Gottlieb, 2014; Hanlon, 2019; Ho et al., 2021; Houlihan et al., 2017; Liang et al., 2021; Noel et al., 2020; Orozco-Beltran et al., 2017; Phillips et al., 2001; Smith, 2013; Soopramanien et al., 2020; Takahashi et al., 2012). Patients who received telehealth interventions exhibited improvements in quality of life (Blum & Gottlieb, 2014; Ho et al., 2021; Houlihan et al., 2017; Phillips et al., 2001), decreased mortality (Blum & Gottlieb, 2014; Liang et al., 2021; Takahashi et al., 2012), and reduce emergency visits (Hanlon, 2019; Liang et al., 2021; Noel et al., 2020; Orozco-Beltran et al., 2017). Remote patient monitoring intervention, a type of telehealth application, is crucial to save time and can

dramatically improve the outcome of patients with chronic disease (Bashi et al., 2017; Hanlon, 2019; Noel et al., 2020), and in SCI patients (Phillips et al., 2001).

### **Readmission**

On the subject of reducing readmission, six studies (Arcilla et al., 2019; Aronow & Shamliyan, 2018; Hanlon, 2019; Orozco-Beltran et al., 2017; Phillips et al., 2001; Smith, 2013) investigated telehealth influence on preventing or decreasing readmission for adult patients. Three studies reported positive outcomes for readmissions among SCI patients with telehealth support after discharge (Barclay et al., 2020; Ho et al., 2021; Houlihan et al., 2017; Soopramanien et al., 2020).

### **Practice Recommendations**

The practice recommendations are centered on a thorough analysis of the literature that was conducted as part of the evidence search strategy. The most significant finding was that telehealth improved patient outcomes, enhanced access, and facilitated communication with healthcare providers. The success of telehealth was based on findings involving self-reports by interviews and surveys (Ho et al., 2021; Soopramanien et al., 2020). Telehealth also successfully redefined how services were provided and enhanced the timeliness of appropriate care (Hanlon, 2019; Orozco-Beltran et al., 2017). Five studies revealed a decrease in hospital admissions with the use of telehealth (Arcilla et al., 2019; Aronow & Shamliyan, 2018; Bashi et al., 2017; Blum & Gottlieb, 2014; Takahashi et al., 2012); one study as a component in the transition of care (Noel et al., 2020). A logical intervention for the PICOT question was developed based on a summary statement derived from all data in this synthesis and all other studies cited.

## **Setting, Stakeholders, and Systems Change**

### **Setting**

With 90 acute inpatient beds, 12 long-term care beds, a SCI outpatient clinic, and urgent care in the Western United States, the facility is one of the largest SCI centers in the country.

The SCI/D Health Care Group provides care to around 908 veterans and active-duty military personnel with SCI/D on a yearly basis, with roughly 355 inpatient hospitalizations and over 7845 outpatient visits. While individuals serviced on average are around 65 years old, their ages range from 23 to 95. About 93% of customers are male, and 7.2% are female (national 92.1% male, 7.9% female). The center treats all neurologic stages of spinal cord damage and multiple sclerosis with spinal involvement. With the organization's primary objective of assisting Veterans with spinal cord injury/disorders in achieving optimal health and maximum independence in a dignified and compassionate environment, telehealth enables the organization to expand patient access to care outside of the hospital setting. The Spinal Cord Injury/Disorder Health Care Group aspires to be a leader in spinal cord injury/disorder care, research, and teaching.

### **Stakeholders**

The SCI Chief of Patient Care Services, Outpatient Nurse Manager, and Nurse Informaticist are the major stakeholders for the EBP change. Other stakeholders included the medical staff on the inpatient SCI unit, which coordinates pre-discharge telehealth remote patient monitoring. The PACT team, which includes medical professionals, clerical support, and all levels of nursing, are stakeholder in the outpatient SCI unit. The most critical stakeholders are newly released SCI patients who were provided telehealth services and required post-discharge follow-up because they were experiencing restricted mobility as a result of their SCI, having trouble adhering to treatments, or lacking caregiver assistance.

### **SWOT Analysis**

A SWOT analysis of the SCI center was performed to identify its strengths, weaknesses, opportunities, and threats (see Appendix C). Several strengths were found, including leadership endorsement and the interdisciplinary team's excitement for telehealth utilization. Several problems were highlighted, including the utilization of telehealth as a new technology and source of information, conflicting priorities, and employee reluctance to change. Opportunities included integrating telehealth into current services, identifying appropriate telehealth

equipment, and facilitating multidisciplinary training and cooperation. Patients' desire for face-to-face consultations, their lack of access to a phone, regulatory restrictions associated with telehealth, and the influence on payment were mentioned as risks.

### **Systems Change**

The pilot change occurs at the micro level to examines how telehealth remote patient monitoring may be adapted to offer a holistic view of a patient's health across time, provide insight into a patient's adherence to treatment, and enable early intervention before an expensive care event occurs. As the center deploys telehealth, data on treatment regimen compliance, readmissions, and better patient outcomes will be presented weekly at medical staff meetings. Additionally, the effectiveness of the project modification will be shared with and presented to other clinical specialties, such as those dealing with spinal cord injury.

### **Implementation With Timeline and Budget**

Telehealth's key objective is to improve patient outcomes on an aggregate level. Whether through increased accessibility, continuous follow-up treatment, or simply a comfortable and focused interaction, remote patient monitoring (RPM) can enhance patient outcomes in various ways, including decreasing rehospitalization. The following goals have been formulated to assist with implementation, evaluation, or a mix of both:

- Goal 1: To determine the significance of the telehealth program, comparing rehospitalization rate 30 days post discharge for the 2 groups, RPM home telehealth program and the usual practice a follow up phone call.
- Goal 2: To ensure a good sample size for the project, the developed criteria for enrollment to RPM home telehealth programs should obtain patient consent and physician approval for at least 60% of those eligible.
- Goal 3: One project champion will be responsible for conducting patient, physician, and staff training to enhance involvement weekly or as needed basis prior to patient discharge from acute care setting.

- Goal 4: Data will be collected 30 days post patient discharge to monitor patient records and update clinical care plans through the duration of the implementation phase as necessary using information accessible through the state-designated health information exchange and electronic health record.
- Goal 5: The Telehealth Case Manager will review clinical data, identify of appropriate follow-up care, and directly consult with patients and clinicians daily to ensure 100% of the required data is captured.

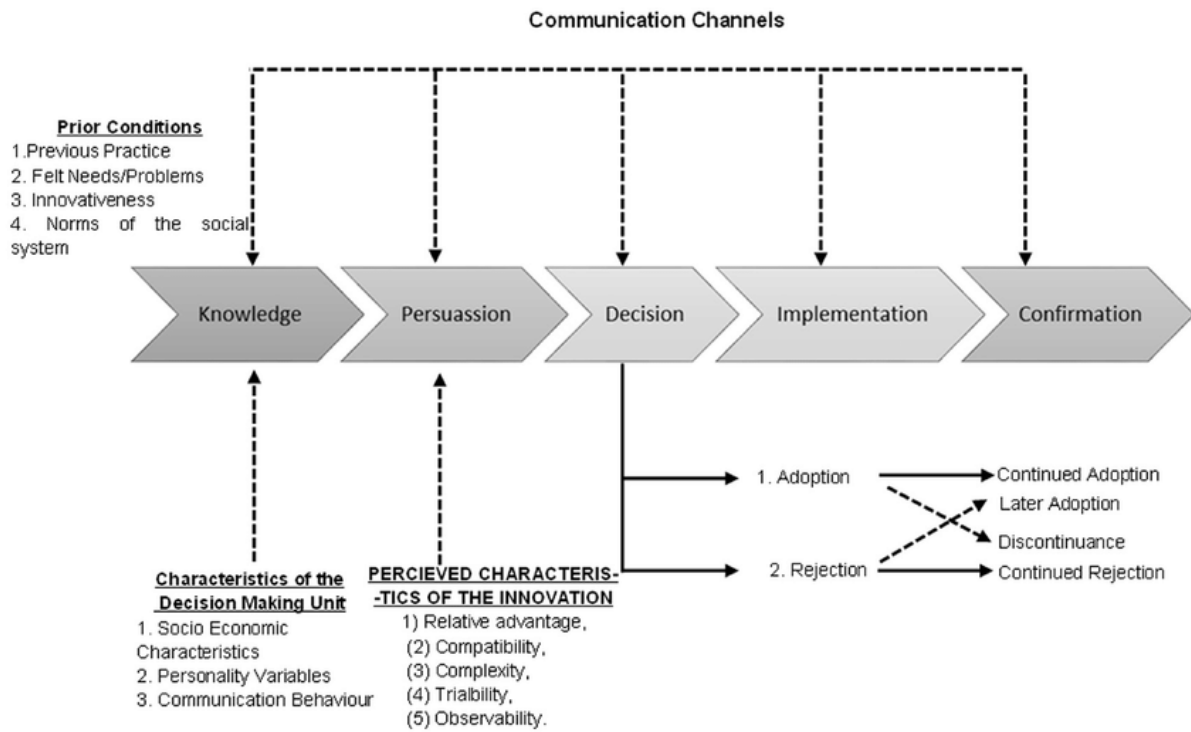
The Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) model is a great problem-solving approach to clinical decision-making (Dang et al., 2022). It is intended to specifically meet the needs of the practicing nurse using a three-step process that includes practice question, evidence, and translation (PET). The purpose of the model is to guarantee that the newest research discoveries and best practices are quickly and correctly integrated into patient care. Translation is the last step of the PET process steps that include the implementation stage.

### **Rogers' Diffusion of Innovations Theory**

Rogers' diffusion of innovations theory is the most pertinent for examining the adoption of telehealth for remote patient monitoring. The theory was developed in communication to explain how an idea or product gains momentum and spreads throughout a population or social system over time. As a result of this diffusion, individuals within a social system adopt a new concept, behavior, or product. The five stages of the change adoption process are knowledge, persuasion, decision, implementation, and confirmation see Figure 2. Each stage is critical to the success of the implementation.

**Figure 2**

*Steps in Rogers' Diffusion of Innovations Theory*



*Note.* A Model of Five Stages in the Innovation-Decision Process (Source: Diffusion of Innovations, Third Edition by Everett M. Rogers, 1983, Pg-165)

**Knowledge**

Knowledge is the first step in the diffusion of innovation. This is the first time a prospective adopter (patient/provider/staff) is exposed to the remote patient monitoring. This step involves an individual becoming aware of the existence of telehealth program and seeking information about it. The individual makes an attempt to understand what remote patient monitoring is and how and why it works. The training of patients will focus on setting expectations, answering any questions, and emphasizing the goals of the program including how RPM can help them reach their health goals and avoid rehospitalization. The training of Telehealth Case Manager and provider will focus on device utilization and have proper training



materials developed so the clinician is educated about the program itself and how to teach the patient.

### ***Persuasion***

Persuasion occurs when a prospective adopter becomes receptive to the idea of the program. They are looking for information that will help them make an informed decision. After an individual learns about RPM, he or she shapes his or her attitude toward it. Certain patients will need to be convinced of the benefits of RPM care delivery that include the following:

1. Maintain patient health, allowing patients to avoid leaving their homes and traveling to the office to obtain services supplied through remote patient home monitoring.
2. Collaboration between patient and provider increased.
3. Enabling the patient to take a more active role in their own treatment.
4. Reducing hospitalizations, readmissions, and durations of stay in hospitals.
5. Reducing overall patient expenditures, including travel expenses to access care.

### ***Decision***

Providing staff opportunities to test and use telehealth equipment creates comfort and builds skills is an important component to successful telehealth encounters. This can be accomplished by educational training meetings, online on-demand videos based on staff needs, and providing ongoing retraining opportunities to maintain continued use and competencies with the technology. At some point, the prospective adopter must make a choice. They will weigh the benefits and drawbacks of adoption and decide whether to accept or reject the innovation. If RPM is partially trialed, it is typically adopted more quickly, as most individuals want to try the program first in their own situation before deciding to adopt it (Rogers, 2002).

### ***Implementation***

Once the facility has decided to adopt RPM, the program will nearly always be used. However, RPM introduces some unknowns, and diffusion of the program use entails some level of uncertainty. Uncertainty about the innovation's outcomes can still bring concerns at this

stage (Rogers, 2002). Providing ongoing education and technical support to patients and staff will ensure their continued engagement and use of the technology, as well as to establish a single point of contact.

### ***Confirmation***

It's important to monitor progress towards objectives to help identify areas where protocols and processes need to be adjusted that could be done by incorporating data collection into an existing workflow to support evaluation of the project. In the confirmation stage, the user evaluates their choice and decides whether or not to continue using RPM. Rogers asserts that an individual's decision can be reversed if he or she is "exposed to contradictory messages about the innovation" (Rogers, 2002).

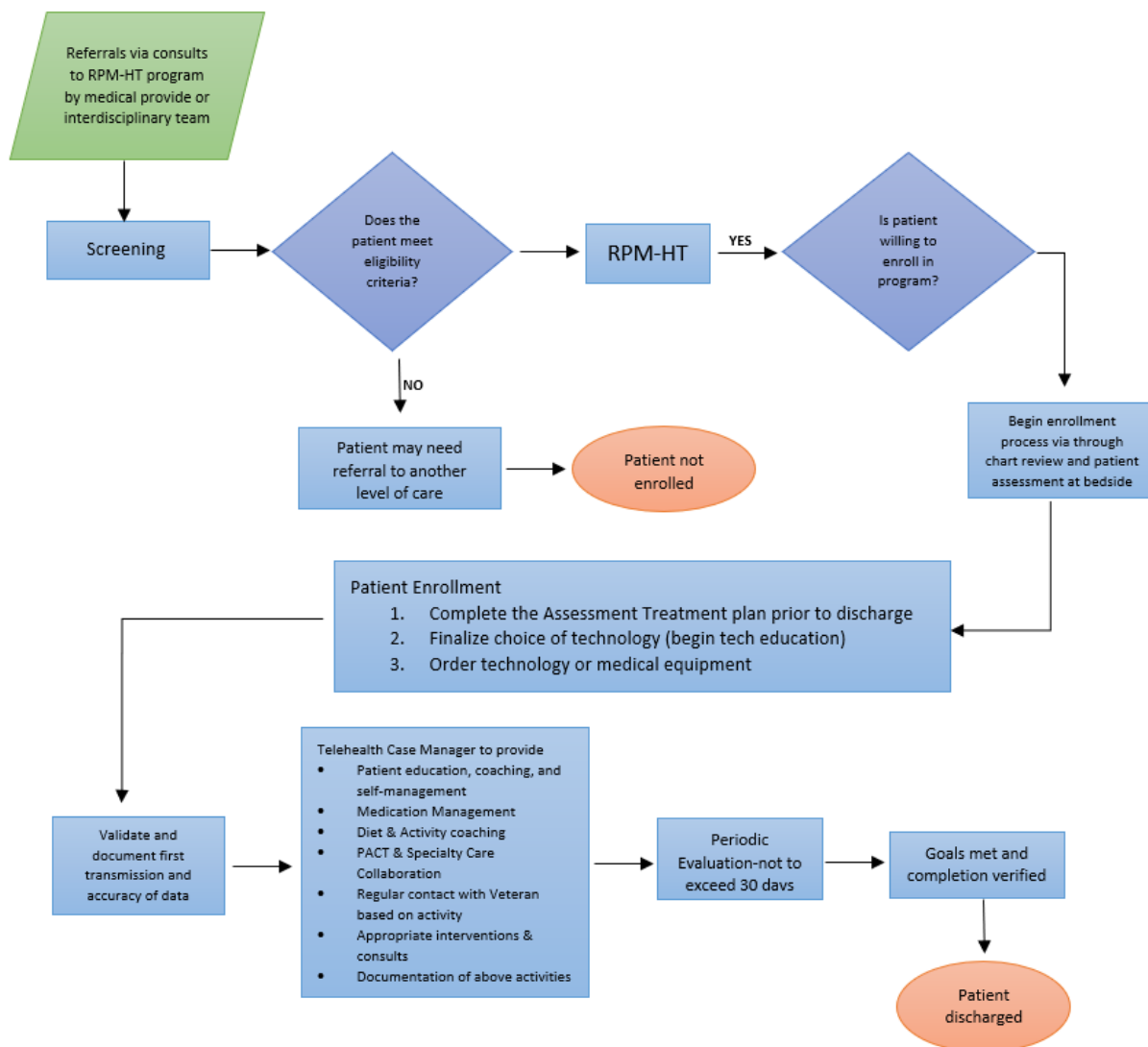
### **Project Rollout**

Remote Monitoring enabled a physician or nurse to monitor medical conditions remotely through the use of home monitoring technology and equipment. A thorough assessment was done to determine whether the patient or their caregiver already has their own device. Their own device is recommended whenever possible as the Veteran is already familiar with the features and is operating with a reliable internet service provider. The Telehealth Case Manager finalizes the choice of technology and orders the chosen technology to be sent directly to the Veteran. Prior to the start of service delivery, the Telehealth Case Manager ensures verbal consent obtained is documented in the EHR as a verbal agreement, and properly functioning equipment is ready to use by performing test calls and documents in the health record confirming technology equipment functionality. After discharge, patients monitored their vital signs and collect other health data. Patients were given the option to record their vital signs once or twice daily, or more frequently, as directed by their provider. The readings were transmitted in real time to the Telehealth Case Manager, who then monitored trends. When a reading was noted to be out of range, the provider was notified via risk alerts, which enabled the provider to respond proactively.

The RPM program process of care are defined in Figure 3.

**Figure 3**

*Remote Patient Monitoring Home Telehealth Program Process of Care*



1. The medical provider, interdisciplinary team, or clinical staff refers patients to the RPM program via consultations.
2. The Telehealth Case Manager screens the Veteran for eligibility.
  - If the Veteran does not meet the criteria, they may need a referral to another level of care or other services.

- If the Veteran is eligible and willing to enroll in the program, the Telehealth Case Manager reviews the Veteran's chart.
3. The Telehealth Case Manager completes the assessment treatment plan at the bedside before discharge. The Telehealth Case Manager finalizes the choice of technology, and orders the chosen technology as needed. Technology equipment used will be a smartphone or iPad. Medical equipment used will include scales for weights, pulse oximeters, blood pressure machines, and/or blood glucometers.
  4. The Telehealth Case Manager validates and documents the first transmission and accuracy of data.
  5. Care and case management through telehealth technology will include the following:
    - Patient education,
    - Medication management
    - Specialty care collaboration
    - Regular contact with the Veteran, based on activity
    - Appropriate interventions and consults
  6. The Telehealth Case Manager must document all the above activities.
    - The Telehealth Case Manager conducts a periodic evaluation of the Veteran not to exceed 30 days, or if the Veteran's condition changes.
    - As part of that evaluation, the Telehealth Case Manager verifies completion that goals are met at which time they are discharged.

The project site, Spinal Cord Injury Center, considered Remote Patient Monitoring medically necessary for SCI patients if:

1. The patient agrees to remote patient monitoring services and has the ability to use the monitoring tools and equipment to improve management of the chronic disease.
2. The patient has the internet connections necessary to host the equipment in the home.

3. The patient is at high risk for avoidable hospital utilization due to poorly controlled:
  - Respiratory complications, such as chronic obstructive pulmonary disease;
  - Cardiovascular complications, such as congestive heart failure and autonomic dysreflexia;
  - Diabetes Mellitus type 1 or type 2;
  - Urinary and bowel complications; and
  - Pressure ulcers or wounds.
4. The provision of remote patient monitoring may reduce the risk of preventable hospital utilization and promote improvement in control of the chronic condition.

Training patient and staff were equally important. When training the telehealth case manager, the emphasis was on RPM process of care and disease management protocols set by the facility available through the Talent Management System (TMS) training courses. Disease Management Protocols (DMPs) defined as a set of questions, answers, responses, education, and information drawn from standard clinical practice and intended to mimic parts of face-to-face assessments. The DMPs specify which biometric data must be collected based on the needs of each particular patient. Other trainings included device utilization, devices troubleshooting, and how to educate the patient.

Because the RPM program required a high level of patient engagement, patients were engaged early on in the process to be adequately prepared. When patients were trained, the emphasis was on setting expectations, answering any questions, and emphasizing the program's goals, including how RPM would assist them in meeting their health goals and avoiding rehospitalization. In addition, patients were educated by the Telehealth Case Manager about the limitations of remote monitoring, what constitutes an emergency reading, and how to respond. All patient education will be recorded in the patient's medical record.

Ongoing monitoring and assessment are critical components of enrolled Veterans' daily case management. DMPs were given to Veterans registered in RPM for daily responses, which

are then transmitted back to the case manager for review and, if necessary, intervention. Monitoring and assessments include analyzing all of the Veteran's daily responses to disease management protocol (DMP) questions, vital signs, biometric data, and other health-related data and determining whether timely intervention by the Telehealth Case Manager is required (using clinical judgment within one's scope of practice). Each biometric data piece tracked had its own set of alert parameters. The RPM alert parameters are tailored to the Veteran's present health status and will be configured so that the Telehealth Case Manager is notified if the Veteran's health status changes.

For any data that fall outside of the expected parameters, the Telehealth Case Manager adhered to guidelines or standard operating procedures for alerting appropriate team members of changes in the Veteran's health status and assisting with prompt interventions and care plan updates. If interventions were indicated, the Veteran was contacted via phone. At this time, the data was validated with the Veteran. Then, additional evaluation and analysis were completed with the results reported to the appropriate health care specialists. Education was given on a number of topics, including, but not limited to, medication management and adjustment in collaboration with the physician. Other services referrals may also be part of the intervention. These details were then recorded in the Veteran's EHR. As part of their routine case management and process of care, Telehealth Case Managers conducted continuous chart reviews to assess Veterans' current needs, overall status, and any changes that have occurred.

Veterans may not always participate as intended. This necessitates contact and follow-up with the Veteran to discuss the benefits of involvement and the goals of care. Contact will be made if a Veteran has not used reported data for more than three days in a row, or sooner if clinically indicated. It will be critical to interact with the Veteran in a timely manner in order to fully engage them in the RPM program.

Rehospitalization within 30 days of discharge was used to compare patients enrolled in the RPM program and patient who are not enrolled in the program to determine if there was a significance indicating the program's success and to identify areas for improvement.

### **Project Timeline**

The Gantt chart in Appendix D depicts the tasks of data collection, proposal presentation, case manager, provider, and patient training, progress meeting, project implementation, evaluation, and dissemination in a 16-week timeframe.

### **Budget Plan**

A budget will detail the estimated total cost of the project and will aid the project team in cost control (Naji et al., 2021). The project's budget included estimated direct and indirect costs for the salary and benefits of one existing telehealth case manager, as well as training, marketing, and telehealth equipment and supplies. The budget was kept to a minimum because the existing infrastructure supporting telehealth remained unaffected, including computers, phones, and office space. This project did not necessitate additional personnel. However, it will be necessary to factor in ongoing project costs, such as budgeting for IT support and additional computers and RPM devices (Figure 4).

**Figure 4**

*Budget*

<b>Expenses</b>		<b>Revenue</b>	
<b>Direct</b>			Billing
Salary and benefits	\$115,000.00		Grants
Supplies	\$10,000.00		Institutional budget support
Services			
Statistician			
Training	\$1000.00		
Marketing	\$200.00		
<b>Indirect</b>			
Overhead			
<b>Total Expenses</b>	\$126,000.00	<b>Total Revenue</b>	
<b>Net Balance</b>			\$126,000.00

**Results**

The evaluation of the process and outcomes was centered on data collected to determine the effectiveness of RPM home telehealth in reducing rehospitalization occurrences among patients with spinal cord injury. Adult SCI patients discharged from a SCI inpatient setting with comorbidities and complications such as COPD, CHF, HTN, DM type 1 or type 2, respiratory complications, cardiovascular complications, urinary and bowel complications, pressure ulcers or wound, and sepsis were eligible for RPM home telehealth and were followed by a Telehealth Case Manager for 30 days. The SCI centers' inpatient case managers tracked admissions and discharges based on admitting diagnoses associated with listed comorbidities and complications to notify physicians and the Telehealth Case Manager when a patient was being discharge met eligibility to enroll in telehealth RPM. Age, gender, level of injury, and admitting diagnosis were among the demographic variables obtained. Intervention data comprised date of telehealth consult, date of discharge, date of RPM home telehealth start, daily completion of RPM home telehealth data completion, and occurrence of rehospitalization within 30 days of discharge.



The Telehealth Case Manager was assigned to gather patient data from the EHR after 30 days post-discharge for patients in the RPM program to obtain hospitalization occurrences for each group. Intellectus Statistics (2020), an evaluation tool, captured ordinal and nominal data for process and outcome measures. An excel file protected by password login was used to store collected data. The integrity of the data collection process was ensured by chart review of patients in the RPM home telehealth program using a self-made audit tool. The audit tool included assigned patient number, discharge date, 30-day evaluation date, admitting diagnosis, if the patient was enrolled in RPM, if the patient has telehealth capabilities, RPM education provided, completed daily RPM entries, and whether rehospitalization occurred with 30 days of discharge date (Appendix E). All pertinent staff were accustomed and trained with the workflow, program criteria, and continuing data surveillance to avoid missing records. Personal identifiers were removed from the data collection to avoid HIPAA protocol violations. Descriptive statistics was used to compare the demographic and clinical characteristics of the 2 groups.

This project was given full implementation approval by both the University of St. Augustine for Health Sciences Doctor of Nursing Practice Evidence-Based Practice Review Council (EPRC) and the SCI center where it was implemented. Between July 2022 and October 2022, 27 patients were discharged for the acute inpatient stay at the SCI center and met the criteria to be enrolled in the RPM home telehealth program. The enrolled group (n = 12) had no readmission within 30 days of discharge while the usual group (n = 15) not enrolled in RPM had 6 (22%) readmissions within 30 days of discharge.

A Fisher's exact test was conducted between patients enrolled in RPM and those receiving the usual care after discharge. This is an appropriate statistical test when the purpose of the project was to examine the relationship between two groups. Contrary to the cell size requirements for the Chi-square test of independence, the Fisher's exact test does not make any assumptions about. For this reason the Fisher's exact test is a common alternative to the

Chi-square test of independence, when there are small values in some of the cells of the contingency table (Mehta & Patel, 1983).

The results of the Fisher exact test were significant based on an alpha value of .05,  $p = .020$ , suggesting that Rehospitalization and RPM are related to one another. The following level combinations had observed values that were greater than their expected values: RPM (Yes): Rehospitalization (No) and RPM (No): Rehospitalization (Yes). The following level combinations had observed values that were less than their expected values: RPM (No): Rehospitalization (No) and RPM (Yes): Rehospitalization (Yes). Table 1 presents the results of the Fisher's exact test.

**Table 1**

*Fisher's Exact Test Observed and Expected Frequencies*

RPM	Rehospitalization		$p$
	No	Yes	
Yes	12 [9.33]	0 [2.67]	.020
No	9 [11.67]	6 [3.33]	

*Note:* Values formatted as Observed [Expected].

Summary statistics were calculated for each demographic and clinical characteristics. The most frequently observed category of Gender was Male ( $n = 25, 92.59\%$ ). The most frequently observed category of Level of Injury was Cervical ( $n = 15, 55.56\%$ ). Frequencies and percentages for Gender and Level of Injury are presented in Table 2.

**Table 2**

*Frequency Table for Gender and Level of Injury*

Variable	<i>n</i>	%	Cumulative %
Gender			
Male	25	92.59	92.59
Female	2	7.41	100.00
Level_of_Injury			
Multiple Sclerosis	4	14.81	14.81
Cervical	15	55.56	70.37
Thoracic	7	25.93	96.30
Lumbar	1	3.70	100.00

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

The observations for Age had an average of 67.07 (*SD* = 14.04, *SE<sub>M</sub>* = 2.70, Min = 32.00, Max = 98.00, Skewness = -0.61, Kurtosis = 1.32, *Mdn* = 68.00, Mode = 75.00). The summary statistics for Age are presented in Table 3.

**Table 3**

*Summary Statistics Table for Age*

Variable	<i>M</i>	<i>SD</i>	<i>n</i>	<i>SE<sub>M</sub></i>	Min	Max	Skewness	Kurtosis	<i>Mdn</i>	Mode
Age	67.07	14.04	27	2.70	32.00	98.00	-0.61	1.32	68.00	75.00

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

**Impact**

The intervention results suggest a positive correlation for reducing 30-day hospital readmission rates for SCI patients participating in the RPM. No rehospitalizations occurred among patients enrolled in RPM. All the patients hospitalized within 30 days of discharge were not enrolled in RPM. The project's clinical significance was identified through the achievement of the goal of RPM intervention to improve clinical outcomes and access to treatment while minimizing complications, hospitalizations, and emergency department visits for SCI Veterans in post-acute care settings who are at high risk for chronic illness. RPM provides an additional connection between the patient and the care team, reducing the fragmentation that can often develop, particularly in chronic care management. The care team is aware of the patient's

condition and whether or not therapies are effective in real-time. This allows the provider to make decisions based on data-driven clinical care between office visits without requiring the patient to travel to the office.

There are no foreseen issues in the sustainability of the pilot project of RPM in the SCI center. The telehealth case manager strongly supports the implementation and is interested in promoting RPM among peers and providers. Processes are in place to enable effective, efficient, and a sustainable RPM program. In addition, a process has been established to ensure that information on performance improvement and clinical outcomes is shared with and disseminated to facility quality management and leadership.

This evidence-based project had a number of limitations that were found that could have had an impact on the results. Only two months were allotted for the project. Data should be gathered over a longer length of time in order to have a more precise understanding of the impact of RPM on the occurrence of rehospitalizations. The small sample size was the project's second drawback. To generalize the findings, a bigger and more varied sample size would be required. Finally, findings could have been impacted by a recently expanded home care program. The home care program recently implemented the use of an Annie app, text-messaging service that helps providers support Veterans as they engage in self-care to monitor enter specific Veteran-generated data, such as vital signs. However, the information and data in Annie are not usually monitored or alerted by or to professional staff as it is for RPM. The findings and limitations identified in this project will be useful in developing future studies.

One opportunity for future project improvement is surveying RPM participants to assess their satisfaction with the quality and care. This can aid in the identification of issues, and modifications can be made based on the experience obtained during the implementation. The outcomes can be measured by patient satisfaction and can financially benefit the organization. As a result, more data is needed to determine the impact on patient satisfaction levels and organizational cost savings based on reduced rehospitalizations.

### **Dissemination**

The results of this project were presented during a monthly SCI townhall meeting on Microsoft TEAMS using PowerPoint. The meeting invite was open and emailed to all SCI department staff. To promote attendance, announcements of the presentation were made at the daily huddles of all SCI disciplines and areas, including physician, case manager, social work, inpatient units, and outpatient clinic. Sharing the outcomes further empower the staff who use telehealth in their practice to share experience during the daily huddles and promote others to change their processes to guarantee the project's sustainability.

A second presentation to the Facility's Research Committee meeting during the November 2022 monthly meeting confers project results with representatives from each section of the facility. Participants have a genuine interest in raising nurses' understanding of the importance of evidence-based practice and promoting quality patient care in their practice. The presentation to this group benefits the departments that care for patients with multiple comorbidities when the representatives share the knowledge with their colleagues.

The full-text scholarly manuscript is published to SOAR@USA, an institutional repository, to increase public awareness of the EBP change related to RPM home telehealth to enhance quality patient care and improve outcomes. The EPRC of the institution will provide feedback on the manuscript to ensure high-quality work. In addition, a peer review within the organization will be requested for a collaborative presence. Finally, a link to the paper will be posted through social media accounts to boost the visibility of the project, inviting other researchers to explore it and comment.

### **Conclusion**

Spinal cord injury and/or disorders (SCI/D) patients are among the most difficult and expensive to manage in any healthcare system (Woo et al., 2011). The continuity of care that RPM home telehealth provides can should decrease the likelihood of developing expensive secondary problems in individuals with SCI patients requiring rehospitalization. The project

utilizes the Johns Hopkins evidence-based model's three-step PET framework and Roger's diffusion of innovation change theory to reduce rehospitalization for SCI patients through RPM. The effectiveness, sustainability, and potential for widespread implementation of RPM telehealth will be determined using multiple key findings from the EBP change project regarding rehospitalization rates, data from the evaluation tool, and the patient care team's willingness to integrate telehealth as a critical component of health care delivery. The change project will provide a chance to minimize rehospitalization rates among SCI patients and established a methodology for determining if RPM can lower SCI rehospitalization rates.

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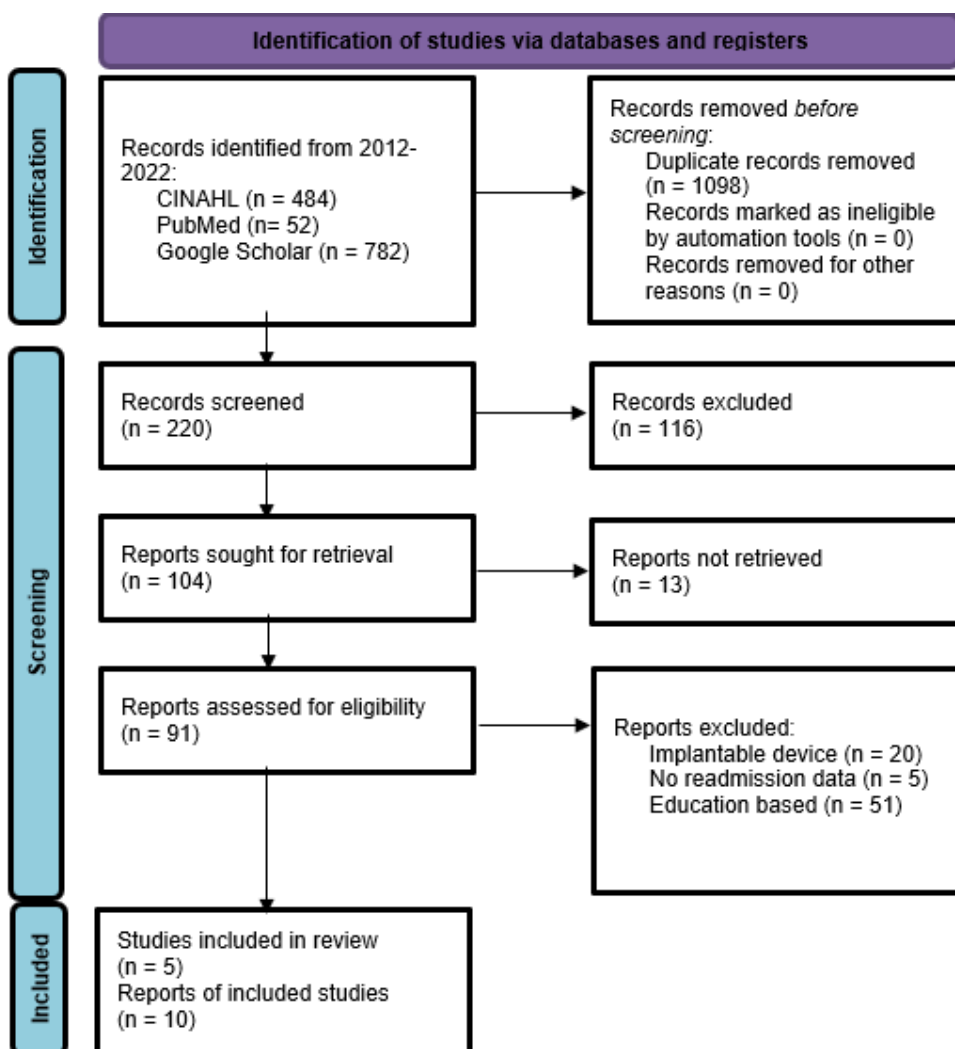
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**Figure 1**

*PRISMA Flowcart*



Note. Prisma flow chart diagram from “The PRISMA 2020 statement: An updated guideline for reporting systematic reviews,” by Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., & Moher, D., 2021. *Systematic Reviews*, 10(1), 89. (<https://doi.org/10.1186/s13643-021-01626-4>). Copyright 2020 by The American College of Physicians.

**Appendix A**

**Summary of Primary Research Evidence**

Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
Noel et al., 2020	Randomized controlled trial (RCT)  Level I Quality A	Adult patients with 2 or more chronic disease processes  Mean age 65  n=102	Telehealth (remote patient monitoring and video visits)- vital signs daily and weekly virtual visits 30 days following hospital discharge  Versus standard transition of care- reviewing patient instructions and discharge summary, encouraged to follow up with PCP within 7-14 days and with scheduled specialist appointment as indicated.  Health Information	None	Hospital readmission  Emergency department utilization  Access to care  Medication management  Adherence  Patient engagement	Telehealth interventions using primarily communications and surveillance technologies, show most promise in counseling and enhancing patient compliance  Telehealth can improve care transitions after hospital discharge improving patient engagement and adherence to medications.

Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
			Exchange, EMR data, phone survey, REDCap, SAS 9.3, SPSS version 25			
Blum & Gottlieb, 2014a.	Randomized controlled trial (RCT)  Level I Quality A	Adult patients with HF admission  Mean age 71.85  n=206	Monitor with SF-36 and MLHF. Transmitted weight, blood pressure, and heart rate in Philips Electronics E- care System  Usual care versus monitored group  SPSS version 18	None	Hospitalization and Medicare Payments  Thirty-day readmission  Mortality  Health-related Quality of Life  Adherence	Telemonitoring decrease 30- day readmission rate for 1 year.
Takahashi et al., 2012.	Randomized controlled trial (RCT)  Level I Quality A	Adult patients  Mean age 80.3  n=205	Telemonitoring device used in patient home. Video conferencing capability and vital signs  Versus usual care routine	None	Hospitalization  ED visits  Total hospital days  Mortality	Telemonitoring in individual diseases has had mixed results in various trials.  Telemonitoring is a potential method of home

Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
			outpatient visit, nurse phone call 1day post discharge.  Patient health questionnaire; SF-12; Barthel ADL index; Billing resources; SAS version 9.1			care management to reduce hospitalizations and ED visits.
Liang et al., 2021.	Randomized controlled trial (RCT)  Level I Quality B	Patient > 65, high risk for readmission with a LACE index > or equal to 7  Mean age 80.2  n=200	Continuous telemonitoring twice daily of vital signs (BP, HR, blood sugar) through wireless transmission devices and home visits the day of discharge, 3 month, and 6 months after discharge.  Compared to discharge planning home care 3 month	None	Mortality  Readmission  Number of ED visits  Medication adherence  ADLs  Health Status  QOL	For patients, who received usual home care, disease warning signs was not detected as promptly as with tele-homecare, resulting in the gradual worsening of disease conditions, which may have contributed to the high number of ED visits and high mortality.

Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
			and 6 months after discharge  C-MABS, ADL scale, C-EQ5D-5L, EQ-VAS SPSS version 20			Study revealed that the effectiveness of this nurse-led tele-homecare program strengthened the care of patients with multiple chronic illnesses.
Arcilla et al., 2019.	Randomized controlled trial (RCT)  Level I Quality B	Adult patients with HF COPD or DM  Mean age 72.5  n=102	Telehealth – 3 coaching visits, daily monitoring of vital signs and sign/symptoms of exacerbation  the number of hospitalizations 90 days prior to current hospitalization compared with the hospitalizations in the 90 days following discharge from the hospital.  Vasarstats.net	None	Number of hospitalization  Rehospitalization rate	Statistically significant decrease in the number of hospitalizations and 30-days rehospitalization



Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
Phillips et al., 2001.	Randomized controlled trial (RCT)  Level I Quality B	Spinal Cord Injury patients  Mean age 35  n=111	Video and phone group educational and review care sessions once a week for 5 weeks, then once every two weeks for one month  Versus standard care group- routine care requires patients to call the help line if and when they need assistance  QWB scale, FIM score, CES-D, Interviews	None	Hospitalization  Depressive Symptoms  Health related quality of life	In-home telephone or video-based interventions do improve health-related outcomes for newly injured SCI patients.  Telehealth interventions may be cost-saving if program costs are more than offset by a reduction in rehospitalization costs.
Orozco-Beltran et al., 2017.	Quasi-experimental study  Level II Quality A	Adult patients with DM, HTN, HF or COPD	ValCronic program-continuous telemonitoring based on disease	None	Systolic BP  Diastolic BP  Hemoglobin A <sub>1c</sub>	The proportion of patients who required hospital admission either as a result of an

Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
		Mean age 70.4 n=521	Compared with preintervention year  eHealth record  SPSS version 21		Primary care services due to exacerbation  Emergency hospital visit due to exacerbation  Emergency hospital admission  Hospital admission due to exacerbation	emergency or due to exacerbation was significantly reduced.  ValCronic telemonitoring program in patients at high risk for rehospitalization or emergency department visit appears to be useful to improve target disease control and to reduce the use of resources.
Hanlon, 2019.	Expert Opinion  Level V Quality B	Adult patients with COPD or CHF  n=74	The Smart Program home monitoring vital signs	None	ER visits  Hospitalization	A home surveillance system helps manage lower risk population and can have a positive impact on outcome.  Patients might be more likely to use a remote monitoring

Citation	Design, Level Quality Grade	Sample Sample size	Intervention Comparison	Theoretical Foundation	Outcome Definition	Usefulness Results Key Findings
						system that is convenient as using a phone.  Promotes adherence to physician-prescribed therapy.
Houlihan et al., 2017.	Randomized controlled trial (RCT)  Level I Quality B	SCI patients  Mean age 46  n=84	MCMC-Person-centered health self-management interventions  Compared with Usual Care  Phone Interview-PAM  Statistical Analysis System software version 9.1	Undefined	health self-management  global ratings of service/resource use  health related quality of life  quality of primary care	Telephone-based empowerment interventions result in positive impact on self-management to prevent secondary conditions
Barclay et al., 2020.	Qualitative Studing using semi-structured interview  Level III Quality C	SCI patients  N=12	Interviews compare models of service delivery	Undefined	Characteristics of model and approach	Telehealth has the potential to assist in self-management of SCI patient.

## Legend:

RCT = Randomized controlled trial; SCI= Spinal Cord Injury; HTN = Hypertension; HF = Heart Failure; COPD = Chronic Obstructive Pulmonary Disease; DM = Diabetes Mellitus; BP = Blood pressure; QOL = Quality of Life; QWB = Quality of Well-being; CES-D = Center for Epidemiologic Studies Depression; FIM = Functional Independence Measure; ADL = Activities of daily living; PCP = Primary care physician; ED = Emergency Department; EMR = Electronic medical record; LACE = Length of stay, Acuity of admission, Comorbidity, Emergency department visits; C-EQ5D-5L = Chinese version EuroQol (EQ); EQ-VAS = EQ visual analog scale; SF-12 = 12 item short form health survey; SF-36 = Medical Outcomes Survey Short Form; MLHF = Minnesota Living With Heart Failure Questionnaire; C-MABS = Chinese version Medication Adherence Behavior Scale; SAS = Statistical Analytics Software; SPSS = Statistical Package for the Social Sciences; REDCap = Research electronic data capture; PAM= Patient Activation Measure; MCMC= My Care My Call

**Appendix B**

**Summary of Systematic Reviews (SR)**

Citation	Quality Grade	Question	Search Strategy	Inclusion/Exclusion Criteria	Data Extraction and Analysis	Key Findings	Usefulness/Recommendation/Implications
Bashi et al., 2017	Level III Quality B	What are the effects of RPM interventions on health outcomes of patients with heart failure?	Combination of MeSH terms as well as key terms related to telemedicine, heart failure, and systematic reviews  Databases: PubMed, EMBASE, CINAHL, and the Cochrane Library from 2005 to 2015	Inclusion: only quantitative systematic reviews, population with a diagnosis of heart failure regardless of age, sex, or ethnicity and RPM interventions  Exclusion: Conference proceedings, review summaries, editorials, and unpublished studies, and reviews with mixed population	2133 studies 1914 screened 50 eligible 19 included in review	Most common measured outcome were mortality and heart failure rehospitalization.	Telemonitoring has beneficial effects on clinical outcomes of heart failure hospitalization

Citation	Quality Grade	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Usefulness/ Recommendation/ Implications
Smith, 2013	Level III Quality B	In adult patients with CHF, what is the effect of home telemonitoring compared to usual care on all-cause hospitalization within 30 days of discharge?	<p>Keywords: telemonitoring, telemedicine, telehealth, remote monitoring, congestive heart failure, chronic heart failure, cardiac failure, heart failission, readmission, hospitalization, and rehospitalization.</p> <p>Databases: CINAHL, PubMed, Google Scholar</p>	<p>Inclusion: published or unpublished human research using systematic review, randomized controlled trial (RCT), or observational design</p> <p>Exclusion: studies in which electronic transmission of physiologic variables was not specified clearly</p> <p>No language or date restrictions were applied.</p>	<p>141 studies 119 excluded 17 included in review</p>	<p>Varying results on impact of telemonitoring on readmissions</p> <p>Significant number of studies demonstrating a reduction in CHF-related admissions</p>	<p>Remote telemonitoring as a method of reducing avoidable readmissions for CHF and other targeted chronic disease populations will continue to grow rapidly as hospitals react to the reimbursement changes, regulatory requirements, and customer demand for high-quality, cost-effective, evidence-based health care</p>
Aronow et al., 2018	Level III Quality C	In patients with HF what is the effect of using noninvasive information technology compared with usual care on outcomes of all-causes?	<p>Keywords: quality of evidence, heart failure, information communication technology</p> <p>Databases: PubMed, EMBASE, the Cochrane Library, and</p>	<p>Inclusion: Noninvasive information technologies included telemonitoring; structured telephone support; and use of personal</p>	<p>Direct meta-analysis of aggregate data with random effects models</p> <p>58 RCTs</p>	<p>Statistically significant heterogeneity in intervention effects on all cause hospitalization.</p>	<p>To reduce HF-related hospitalizations (or readmission), for adults with congestive HF, clinicians should offer noninvasive telemonitoring or structured telephone support.</p>

Citation	Quality Grade	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Usefulness/ Recommendation/ Implications
			www.clinicaltrials.gov up to March 2018	<p>digital assistants, videophone and conferencing, or interactive voice.</p> <p>Outcomes included all-cause mortality, mortality due to HF, treatment utilization (hospitalization, office visits, emergency department visits), quality of life measured with validated scales, and all adverse effects</p> <p>Exclusion: RCTs with mixed populations and did not report the outcomes in patients with HF, RCTs that examined the effects from tele-rehabilitation on</p>			

Citation	Quality Grade	Question	Search Strategy	Inclusion/Exclusion Criteria	Data Extraction and Analysis	Key Findings	Usefulness/Recommendation/Implications
				intermediate outcomes, adults at long-term care settings or discharged to long-term care settings			
Ho et al., 2021		What models of service delivery, specific to the rehabilitation and lifelong care of persons with SCI exist internationally?	Keywords: spical cord injury, delivery of care, telehealth  Databases: CINAHL, PubMed, Google Scholar	Inclusion: telemonitoring; structured telephone support; and use of personal digital assistants  Exclusion: RCTs that examined the effects from tele-rehabilitation	Direct meta-analysis of aggregate data with random effects models  46 peer-reviewed studies	Telehealth serve all geographical locations and span the continuum of care, improving the health status and quality of life of persons with SCI.	No single SCI model of care has been adopted across different countries internationally.
Soopramanien et al., 2020	Level II Quality C	Time has now come to offer rehabilitation using the digital health platforms at the different states of an individual's journey, from the onset of paralysis to return into the	Combination of MeSH terms as well as key terms related to telemedicine, heart failure, and systematic reviews  Databases: PubMed, EMBASE, CINAHL, and the Cochrane Library from 2005 to 2015	Inclusion: Noninvasive information technologies included telemonitoring  Exclusion: unpublished studies, and reviews with mixed population	20 studies from SCI centers	The strategic use of digital health technologies has been shown to result in cost and time savings and increase positive outcomes.	Digital health technologies result in cost and time savings and increase positive outcomes.



Citation	Quality Grade	Question	Search Strategy	Inclusion/ Exclusion Criteria	Data Extraction and Analysis	Key Findings	Usefulness/ Recommendation/ Implications
		community and lifelong care. How could we deliver on these aspects of care?					

Legend:

CINAHL = Cumulative Index to Nursing and Allied Health Literature; CHF = Congestive heart failure; HF = Heart failure; RCT = randomized controlled trial; RPM = remote patient monitoring; MeSH = Medical Subject Headings

**Appendix C**

**SWOT Analysis for SCI Center**

<p><b>STRENGTH</b></p> <ul style="list-style-type: none"> <li>• Leadership endorsement</li> <li>• Interdisciplinary team participation</li> <li>• Priority usage of telehealth.</li> <li>• SCI service of the highest standard</li> <li>• Healthcare providers enthusiastic in favor of telehealth</li> </ul>	<p><b>WEAKNESS</b></p> <ul style="list-style-type: none"> <li>• Telehealth is brand-new information.</li> <li>• a lack of technological readiness</li> <li>• a cost-benefit analysis</li> <li>• Priorities that conflict</li> <li>• Employees' resistance to change</li> </ul>
<p><b>OPPORTUNITIES</b></p> <ul style="list-style-type: none"> <li>• Other services had implemented telehealth</li> <li>• Telehealth equipment</li> <li>• Telehealth training available</li> <li>• Health data exchange</li> <li>• Interdisciplinary collaboration</li> </ul>	<p><b>THREAT</b></p> <ul style="list-style-type: none"> <li>• Patient may prefer a face-to-face appointment</li> <li>• Patient lack of access to phone</li> <li>• Regulatory requirements with telehealth</li> <li>• Lack of staff motivation</li> <li>• Decreased reimbursement</li> </ul>



