

Part A: The Development of mI SMART, a Nurse-Led Technology Intervention for Multiple Chronic Conditions

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Abstract

Background: The treatment of Multiple Chronic Conditions (MCC) is complex for both patients and providers. Used as integrated tools, technology may decrease complexity, remove the barrier of distance to obtain care, and improve outcomes of care. A new platform that integrates multiple technologies for primary health care called mI SMART (Mobile Improvement of Self-Management Ability through Rural Technology) has been developed. The purpose of this paper is to present to development of mI SMART, a nurse-led technology intervention for treating for MCC in primary care. **Methods:** The creation of mI SMART was guided by the model for developing complex nursing interventions. The model suggests a process for building and informing interventions with the intention of effectiveness, sustainability, and scalability. Each step in the model builds from and informs the previous step. **Results:** The process resulted in the integrated technologies of mI SMART. The system combines a HIPAA compliant, web-based, structure of mHealth sensors and mobile devices to treat and monitor multiple chronic conditions within an existing free primary care clinic. The mI SMART system allows patients to track diagnoses, medications, lab results, receive reminders for self-management, perform self-monitoring, obtain feedback in real time, engage in education, and attend visits through video conferencing. The system displays a record database to patients and providers that will be integrated into existing Electronic Health Records. **Conclusion:** By using the model for developing complex nursing interventions, a multifaceted solution to clinical problems was identified. Through modeling and seeking expert review, we have established a sustainable and scalable integrated nurse-led intervention that may increase access and improve outcomes for patients living in rural and underserved areas. The first trial of mI SMART has been completed and evaluated for feasibility, acceptability, and effectiveness in persons in rural areas living with multiple chronic conditions.

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Keywords

Multiple Chronic Conditions, mHealth, Telehealth, Health Disparities, Nursing Informatics

1. Introduction

People living with chronic conditions suffer from poor health, disability, and pre-mature death [1]. It is estimated that 117 million (half) of US adults have a chronic condition, and 1 in 4 adults have Multiple Chronic Conditions (MCC) [2]. In addition, most health-care expenditures in the United States are due to chronic conditions [3]. Due to the complexity of treatments, conflicting advice for each condition, and co-existing lack of the social, health and behavioral determinants of health due to disparities, individuals with MCC often have difficulty in achieving treatment goals [4]-[7]. Therefore, simplifying treatment regimens, managing conflicting advice, and assessing determinants of health such as addressing the availability of resources, access to healthcare, and improved diet physical activity are imperative to improving outcomes and self-management ability.

Healthcare technology is developing rapidly and may offer an opportunity to enhance care. Use of technology can improve healthcare systems' ability to monitor patients without travel, coordinate the services of multiple healthcare providers, and manage patient symptoms in real time [5] [8]. In addition, technology interventions augment care and management of MCC by improving access to care and improving patient outcomes. The subsequent long-term effects of technology use lead to diminished health disparities and reduced healthcare costs [9]. However, much of the available healthcare technology intended to treat MCCs is developed by private industry and used in non-academic settings. In the current literature, widespread reporting of development process is not present. Therefore, questions remain about acceptability, feasibility and efficacy across populations.

Some examples of existing patient facing technology interventions include: Access to information from electronic medical records, requesting medication refills and appointments through automated systems, communicating with healthcare providers using secure messaging systems, managing specific chronic conditions using telehealth, using personal health records to track progress, and interacting with on-line support groups using social media [10]. The available literature on these individual technology interventions is promising and does provide limited evidence of improving outcomes, cost effectiveness and cultural relevance [11]. However, the lack of integration of data into existing systems and healthcare records, lack of reimbursement for technology services, and the necessity to access multiple technology interventions individually, increase complexity for both healthcare systems and patients and decrease widespread use for patients with MCC.

Nurses are uniquely trained to address the complexity of caring for the whole person as an individual in the context of their family, community, and environment. The Institute of Medicine (IOM) calls nurses to practice to the full extent of their education and to be partners in redesigning health care in the United States [12]. As patient advocates who store, maintain and communicate data and information [13], nurses are trained to use validated processes to develop complex interventions, to think about patients within systems, and to implement and improve interventions [14]. The purpose of this paper is to present the development of mI SMART (Mobile Improvement of Self-Management Ability through Rural Technology), a nurse-led technology intervention for treating for MCC in primary care.

2. Methods for Intervention Development

The model for developing complex nursing interventions [15] guided the overall process of intervention development. The model was developed and refined from the Medical Research Council (MRC) framework for developing complex interventions [16] and other guidelines that contribute additional guidance to inform the development of nursing interventions. The model suggests a process for building and informing interventions with the intention of effectiveness, sustainability, and scalability. Each step in the model builds from and informs the previous step. The steps include: problem identification, practice analysis, identification of the overall objective, identification of theory or key principles, building and planning, modelling and seeking expert review, and developing the study protocol.

2.1. Problem Identification & Practice Analysis

The first phase of mI SMART development, problem identification, was undertaken through a needs, practice

and policy analysis. The identified problem originally started with a concern for the poor outcomes of persons with diabetes in a rural clinic serving uninsured and underinsured individuals. A retrospective review of the combined pharmacy records, front desk scheduling system, and Electronic Health Record (EHR) found that diabetes patients who lived further than 30 miles from the clinic and had more than one chronic condition missed appointments compared to those who live closer and had only one chronic condition [17]. Based on these findings, the research team decided that an intervention was needed that addressed MCCs and overcame the disparity of access to care due to distance. A search of the empirical evidence related to eliminating the burden of distance revealed the use of mHealth tools as a potential intervention to improve care [10]. In addition, it was also noted that policies for federal payers were improving and Medicare pays for services that provide live, interactive videoconferencing [18]. Hence, the decision was made to begin to develop an intervention that incorporated mHealth tools with live videoconferencing.

2.2. Identification of the Overall Objective

The overall objective of the mI SMART project is to improve quality of life and outcomes of care for rural and underserved individuals living with multiple chronic conditions. This objective was determined using a series of activities. First, the thoughts and ideas of nurses, including in-patient, out-patient, advanced practice, and researchers were sought. In addition, conversations intentionally included physicians, pharmacists, social workers, health educators, computer scientists, engineers, and private industry leaders. This objective will be accomplished by improving access, self-management ability, and communication with use of technology within a healthcare system that is trusted by patients.

2.3. Identification of the Theory or Key Principles

A substantive review of potential foundational theories was conducted. Two models came forward as having relevance and utility in the development of mI SMART. The first model, the Quality Health Outcomes Model, was selected for its broad concepts that could be conceptualized and adapted based on the system, patient population, and evolving intervention [19]. The second model chosen, the Chronic Care Model, assists in understanding how to build an intervention that changes healthcare delivery at the healthcare system level [20].

The Quality Health Outcomes Model was developed by the American Academy of Nursing's Expert Panel on Quality Health Care in 1996 as an expansion of Donabedian's structure-process-outcome framework. The four major concepts are: system, interventions, patients, and outcomes. The model is a dynamic framework that recognizes the reciprocal relationship that occurs between patients, the system where care is provided, and interventions [21]. Outcomes are linked to the interactions of a patient with the healthcare system and with healthcare interventions that are focused on the individual, family, or community [19]. Interventions are affected by both system and patient characteristics in producing desired outcomes.

The Chronic Care Model consists of six interrelated system changes meant to make patient-centered, evidence based care easier to accomplish [22]. The major concepts in the model are: health system, community support, self-management support, decision support, clinical information systems, and delivery system design [23]. This model is operationalized through a prepared healthcare team delivering planned interactions, self-management support with effective use of community resources, integrated decision support, and supportive information technology (IT) which are designed to work together to strengthen the provider-patient relationship, improve communication and improve health outcomes [23]. Therefore, the development of mI SMART is based on the major concepts and underlying assumptions of the Quality Health Outcomes Model and the Chronic Care Model.

2.4. Building, Planning & Modeling

Based on the guiding frameworks, problem identification and overall goals of the intervention, the first version of the mI SMART platform was modeled and a basic plan for implementation was developed. The expertise of an information technology specialist was sought to complete the programming involved. While the initial intervention was planned to be implemented in a free clinic in a rural location, the thought of expanding the intervention was a consideration. The decision was made to make the platform web-based as opposed to a system specific application (app). Hence, the first iteration of mI SMART was web-based, HIPAA compliant, system that

includes the use of self-monitoring devices, video conferencing capabilities, real-time feedback, automatic patient specific reminders for self-monitoring and medication, links and video education for chronic illness, and secure messaging.

2.5. Seeking Expert Review

After a model of the mI SMART platform was developed, expert review was sought by holding focus groups for in various settings [11]. The participants invited to the focus groups were intended to represent both the first users of the system and future potential users. The mI SMART platform was demonstrated to each group and specific questions were used to elicit conversation and feedback. After participation in the focus groups, participants were asked to complete surveys. Focus groups were attended by 37 individuals and surveys were completed by 29 healthcare team members including 7 males and 22 females, age range 23 to 62. The participants included: Medical Assistants, Registered Nurses, front desk staff, Physicians, Nurse Practitioners, Physician's Assistants, Pharmacists, Social Workers, Administrators, and Board Members. The focus group participants identified perceived obstacles of patient use as: ability, willingness, and time. System obstacles were identified as: lack of integration, lack of reimbursement, and cost. Many positive attributes of mI SMART were identified and included: capability for virtual visits, readability, connectivity, user-friendliness, ability to capture biophysical measures, enhanced patient access, and incorporation of multiple technologies. Providers suggested increasing capability for biophysical and symptom monitoring for more common chronic conditions.

2.6. Developing the Study Protocol

Based on the feedback provided in the focus groups, changes were made to the mI SMART system prior to developing the study protocol. The system combines a HIPAA compliant, web-based, structure of mHealth sensors and mobile devices to treat and monitor multiple chronic conditions. The mI SMART system allows patients to track diagnoses, medications, lab results, receive reminders for self-management, perform self-monitoring, obtain feedback in real time, engage in education, and attend visits through video conferencing. The system displays a record database to patients and providers that will be integrated into existing Electronic Health Records. Once these changes were made, the study protocol was developed and funding for the project was sought and obtained. The first trial of the mI SMART platform has been completed. The model for developing complex nursing interventions will be used to guide the refinement of the mI SMART platform prior to a larger randomized trial.

3. Discussion

The use of the model for developing complex nursing interventions was essential to the successful development of a robust, adaptive and empirically ground technology platform (see **Figure 1** for the operationalization of the Model for Developing Complex Interventions in Nursing). The mI SMART platform is an improvement over the currently available systems. Combining multiple health sensors, education, reminders, video conferencing, lab results, and secure messaging removes the necessity to access multiple technology interventions individually. This combination of services decreases complexity of care for both healthcare systems and patients. The intervention has been implemented with 30 adult participants living in a rural area who have MCCs and are experiencing difficulties attending clinic visits. Feasibility and acceptability for both the patients and healthcare providers was evaluated and reported in Part B. In addition, efficacy of the intervention was evaluated with patient outcomes which will be reported in a separate paper. The first implementation of mI SMART was targeted to a specific population and clinic. Future use of the mI SMART platform should be adapted to other populations and practice settings. The content of the platform in its present iteration is reflective of current empirical evidence about the use of technology, a specific needs and practice analysis, and has been adapted based on feedback of a wide, but not exhaustive, variety of healthcare providers.

4. Conclusion

Our long-term objective is to create a new and substantive departure from the status quo by integrating multiple mHealth tools into one platform within an existing rural health clinic to go beyond traditional office visits and shifting to real-time exchanges between patients and providers across geographical boundaries. An efficacious

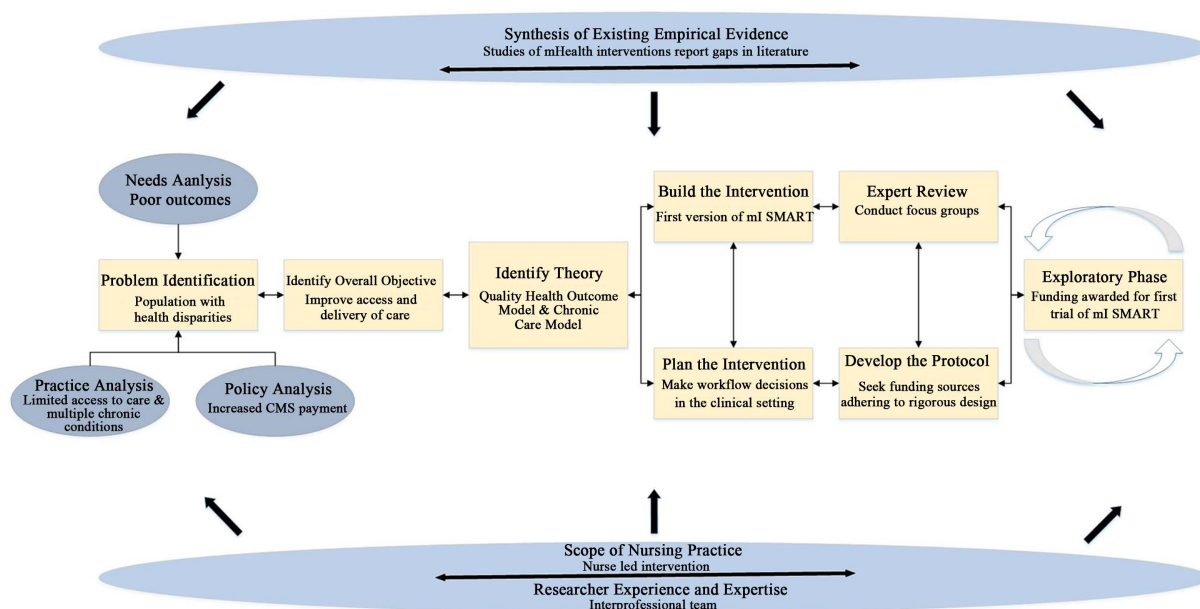


Figure 1. Operationalization of the model for developing complex interventions in nursing. This figure is based on the model found in [15].

shift in the traditional rural healthcare delivery paradigm to one that uses technology is expected to result. The model for developing complex nursing interventions is currently being used to update mI SMART based on patient and provider feedback and integration into the EHR is planned. The initial feasibility and acceptability of the mI SMART platform is published in Part B of this article. Other plans include fully disseminating the results of the first implementation of mI SMART, pursuing commercialization and seeking funding for the larger trial.

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