DEVELOPMENT AND EVALUATION OF A NURSE PRACTITIONER-DIRECTED STANDARDIZED ELECTRONIC MEDICATION RECONCILIATION PROCESS IN AN AMBULATORY INFECTIOUS DISEASE PRACTICE

An Evidence-Based Scholarly Project

Submitted to the College of Health Professions and Natural Sciences

in Partial Fulfillment of the

Requirements for the Degree

Doctor of Nursing Practice

Elizabeth Walls

Wilmington University

April 2024

Wilmington University
College of Health Professions and Natural Sciences
Doctor of Nursing Practice Program

We hereby approve the Doctor of Nursing Practice project of

Elizabeth Walls

Candidate for the degree of Doctor of Nursing Practice

Signature on File

_____ _____

Date *DNP Project Advisor Name & Credentials*
DNP Project Advisor

Signature on File

_____ _____

Date *DNP Project Team Member Name & Credentials*
DNP Project Team Member

ACCEPTED

Signature on File

_____ _____

Aaron Sebach, PhD, DNP, MBA, AGACNP-BC, FNP-BC, NP-C, CP-C, CEN, CPEN, CLNC, CGNC, CNE, CNEcl, SFHM, FRSPH
Dean, College of Health Professions and Natural Sciences

Date

Title: Development and Evaluation of a Nurse Practitioner-Directed Standardized Electronic Medication Reconciliation Process in an Ambulatory Infectious Disease Practice

Author: Elizabeth Walls

DNP Project Advisor: Dr. Lisa Drews

DNP Project Team Member: Dr. Angela Miller

Medication reconciliation is critical to medication safety and has remained an unmet US National Patient Safety Goal for over two decades (TJC, 2021). Ineffective medication reconciliation contributes to medication errors that can result in patient harm and increased healthcare costs. High-quality medication reconciliation is one of many responsibilities facing healthcare providers at the time of an ambulatory care office visit. Healthcare providers are frustrated with process inefficiencies in medication reconciliation workflows, especially within the electronic health record (McCahon et al., 2022). A consistent, technology-supported approach to MR is the most likely way to engage healthcare providers (Gionfriddo et al., 2021). This project focused on implementing a single, standardized approach to completing medication reconciliation in the electronic health record. A best practice electronic health record workflow was outlined, and over the course of eight weeks healthcare providers in an ambulatory infectious disease practice received tip sheets and 1:1 education. Provider completion rates of rates of MR were compared before and after. This project found that there was a statistically significant difference in completion rates after implementing the standard workflow.

Keywords: medication reconciliation, electronic health record, ambulatory care, healthcare provider

ACKNOWLEDGMENTS

I would like to express my utmost gratitude to the entire doctoral staff at Wilmington University for their guidance throughout the entire program. Specifically, I want to acknowledge Dr. Lisa Drews for her direction in navigating the project process, providing the constructive feedback necessary to succeed, and being a moral support through times of uncertainty. Additionally, I want to thank Dr. Stacey Malinowksi, Dr. Aaron Sebach, and Dr. Joanne Fletcher for encouraging and believing in me.

The completion of this project would not have been possible without the mentorship and patronage of Dr. Angela Miller and Dr. Helen Koenig. Their support allowed me to develop and implement a meaningful project that bolstered both health system and department goals, all while navigating a new professional role and complex organizational structure. I would be remiss if I did not thank the whole of the executive team of the Clinical Practices of the University of Pennsylvania and the leadership team and clinicians in the Division of Infectious Disease within the Department of Medicine.

Finally, and most importantly, I would like to thank my husband, Steve, my daughter, Kaname, and my extraordinary village of family and friends for their love, sacrifices, patience, and unwavering support. Without them, none of this would have been possible, or worthwhile.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

APP- Advanced Practice Provider

BPMH- Best Possible Medication History

DNP – Doctor of Nursing Practice

EBP- Evidence-Based Practice

EHR- Electronic Health Record

FOCUS- F= Find a problem, O= Organize a team, C= Clarify the problem, U= Understand a problem, S= Select an intervention

HCP- Healthcare Provider

ID- Infectious Disease

IDSA- Infectious Disease Society of America

IHI- Institute for Healthcare Improvement

MR- Medication Reconciliation

MRP- Medication Related Problems

NP- Nurse Practitioner

NPSG- National Patient Safety Goals

PDSA- Plan-Do-Study-Act

PICOT – Population, Intervention, Comparison, Outcome, and Time

TJC- The Joint Commission

UPHS- University of Pennsylvania Health System

US- United States

YEE- Years of EPIC Experience

YPE- Years of Provider Experience

CHAPTER ONE

INTRODUCTION

Problem Description

The healthcare needs of patients in the United States (US) have become increasingly complex. People are living longer and have multiple medical comorbidities. These compound needs often correlate to an extensive list of medications. Discrepancies or errors on medication lists can lead to medication-related problems (MRP) for patients (AHRQ, 2019; TJC, 2021). This translates to the potential for significant physical, psychological, and financial cost to patients. Approximately, 7 million patients in the US are impacted by medication errors annually at a cost of around $40 billion (Rodziewicz et al., 2023). Because of this, medication safety is a priority for The Joint Commission (TJC). TJC is the enterprise responsible for setting quality standards in the US and continuously evaluating a healthcare organization's performance. The TJC annually outlines National Patient Safety Goals (NPSG) that they utilize as guidelines for these assessments. Medication safety, including high-quality medication reconciliation (MR) has been an NPSG since the early 2000s and aligns with federal medical reimbursement services (TJC, 2021).

MR is recognized by several world-renowned patient safety organizations including TJC, the World Health Organization (WHO), and the Institute for Healthcare Improvement (IHI), as a process critical to achieving medication safety. The process of high-quality MR involves subjectively obtaining the best possible medication history (BPMH) from a patient, comparing the existing list of what the health record shows is ordered, reviewing the list for accuracy and appropriateness, resolving any medication discrepancies, and providing the patient with an updated list of medications. Healthcare providers (HCP), such as Physicians and Advanced

practice Providers (APPs) are responsible for the completion of medication reconciliation (MR) during every patient encounter. The providers are often assisted by registered nurses, pharmacists, or other clinical staff (AHRQ, 2019; TJC, 2021). The MR process is particularly important during transitions of care (i.e., from hospital to home) and when patients changeover between various providers in the ambulatory care setting (Kane-Gill, 2022; Pereira et al., 2022). While MR appears straightforward in theory it is challenging to implement in practice (AHRQ, 2019). Due to this, the NPSGs surrounding MR remains unmet (TJC, 2021).

HCPs face a multitude of challenges with MR in many healthcare settings, including ambulatory care. First and foremost, inconsistency with processes. This includes workflows, knowledge, communication, time, resources, patient involvement, provider engagement, and more (Dobish et al., 2021; Gionfriddo et al., 2021; McCahon et al., 2022; Yuan et al., 2022). Additionally, there is a lack of understanding amongst HCPs about the value and impact of accurate MR and a lack of clarity around their responsibilities within the process. Amongst HCPs, these barriers contribute to frustration, dissatisfaction, and a reduced likelihood they will complete MR at a patient visit (McCahon et al., 2022; Pereira et al., 2022). Patients' perception and understanding of the MR process are variable and drives patient engagement, positively or negatively (McCahon et al., 2022).

The University of Pennsylvania Health System (UPHS) is a large, academic health system located in Philadelphia, Pennsylvania that has been providing innovative care for patients in the region for over 200 years. The system represents healthcare excellence on both the national and international stages. Penn is widely known as a pioneer in immunotherapy, using a patient's own cells to create vaccines against cancer, and for the development of the mRNA technology used in the COVID-19 vaccine. Its hospitals and specialized programs have acquired

numerous accolades including several Centers of Excellence, the Magnet Award for nursing, Leapfrog Hospital Safety Grade A, and TJCs Gold Seal of Approval- indicating top performance in key quality metrics. Quality and safe patient care is a top priority for UPHS (Penn Medicine, 2023). They strive to be a high reliability organization and as part of that journey have put into place a substantial quality and safety reporting and evaluation system. Annually, UPHS teams develop risk reduction initiatives focused on improving quality and safety. Over the past few years, completion of MR has been a risk reduction focus. UPHS consistently meets similar obstacles to other healthcare organizations, as outlined above.

Rationale

There are no universal best-practice guidelines for performing MR. UPHS ambulatory practices utilize TJC NPSG as the basis for their policies surrounding medication reconciliation. TJC standards require medication review and documentation at the start of every episode of care (TJC, 2021). Despite concerted efforts by clinical experts and the quality and safety teams there remains significant variability between both HCPs and departments at UPHS on if and how MR is completed. A consistent theme that emerged from the author's observation of workflows, discussion with various frontline HCP, and input from clinical experts was HCPs frustration with the electronic health record (EHR) process for completing MR. That frustration stemmed from perceived inefficiencies with the EHR software, contributing to a lack of provider engagement. The literature supports that a consistent, well-defined approach to the MR process, supported by technology, can improve the likelihood that HCPs will have a positive experience and perform the best MR possible (Anderson et al., 2019; Gionfriddo et al., 2021; Rangachari, 2019). UPHS uses an EPIC systems EHR called Penn Chart. There are currently three different processes within PennChart that HCPs can use to perform MR. Based on PennChart expert advice, there is

only one process that is recommended as best practice and consistently results in the EHR capturing completion of MR.

MR is particularly crucial in high-risk patients with complex diagnoses and extensive medication lists that frequently transition between specialists or care settings (Abrahamsen 2020; Johansson et al., 2023; TJC, 2021). This describes the type of patients managed by Infectious Disease (ID) providers. UPHS has a robust and busy ambulatory ID practice. As part of a departmental incentive metric and risk reduction initiative, the HCPs in this practice were tasked to reach an MR completion rate of at least 70% within the EHR. Many HCPs in the practice continuously failed to meet their MR completion goals for three years in a row. The HCPs in ID, like their colleagues in other departments, frequently express frustration with variable EHR processes and lack of clarity around their responsibilities and accountability around MR. The medical director for ID opted to engage with an experienced nurse practitioner (NP) with subject matter expertise to evaluate and make recommendations to effect change.

This NP chose to use this as a project to meet the qualifications for completion of a Doctor of Nursing Practice (DNP) program. A DNP program, guided by the American Association of Colleges of Nursing (2006), requires students to be competent in eight essential areas:

I. Scientific Underpinnings for Practice
II. Organizational and Systems Leadership for Quality Improvement and Systems Thinking
III. Clinical Scholarship and Analytical Methods for Evidence-Based Practice
IV. Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

V. Health Care Policy for Advocacy in Health Care

VI. Interprofessional Collaboration for Improving Patient and Population Health Outcomes

VII. Clinical Prevention and Population Health for Improving the Nation's Health

VIII. Advanced Nursing Practice (p. 1)

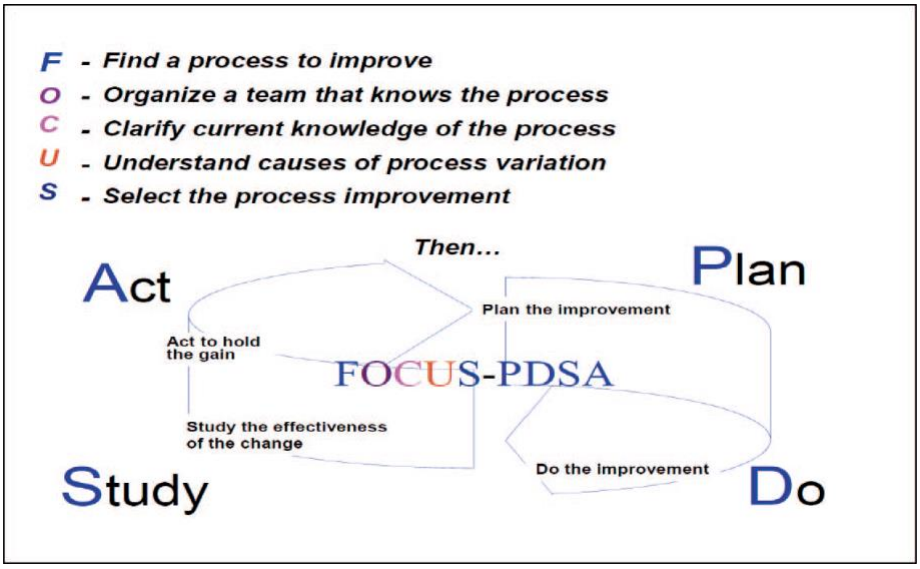
The purpose of this DNP project is to standardize, and ideally improve, the EHR MR process for HCPs (including Physicians and APPs) caring for a population of high-risk patients within an ambulatory ID practice. The project took place at the Perelman Center for Advanced Medicine, part of the UPHS. This project aims to exemplify competency in all eight essentials.

Theoretical Framework

The FOCUS-PDSA (F= Find a problem, O= Organize a team, C= Clarify the problem, U= Understand a problem, S= Select an intervention; P= Plan, D= Do, S= Study, A= Act) Quality Improvement Methodology Model in Healthcare, was utilized as a guide to design this project. Through action-oriented learning, this framework serves as a systematic approach for identifying, evaluating, and quickly addressing barriers to providing high-quality patient care, as outlined in Figure 1 (Abuzied et al, 2023). FOCUS-PDSA is an evolution of the IHI's Model for Improvement (IHI, 2023). This healthcare-focused model sets the stage for the implementation of evidence-based interventions in real-world clinical settings while accommodating continuous evaluation and improvement through a team-based approach. FOCUS-PDSA methodology is a widely applicable and realistic approach to quality improvement that saves time, money, and energy. It engages the whole healthcare team to improve patient safety (Abuzied et al., 2023). FOCUS-PDSA is a system approach to problem solving. It allows for failure and ongoing evaluation of the problem and interventions.

Figure 1

FOCUS-PDSA Processes



Note. Visual representation of the FOCUS-PDSA framework. From "Using FOCUS-PDSA Quality Improvement Methodology Model in Healthcare: Process and Outcomes", Abuzied et al., 2023, *Global Journal on Quality and Safety in Healthcare, 6*(2), p. 71. Reprint permission not required for non-commercial use. Copyright 2023 by Innovations Journals.

The DNP student used this framework to identify that there was a problem: multiple EHR MR processes and HCP lack of clarity around the process and recommended best practice. Then, they consulted with a multidisciplinary team including the physician champion in ID, UPHS Quality and Safety team members, MR subject matter experts, Penn Chart experts and clinical experts to clarify and understand the problem. Using the evidence, the DNP student selected an intervention targeting the MR EHR process. The DNP student continued to work through each step in the process, outlined in subsequent sections, in collaboration with the multidisciplinary team.

Specific Aims

This DNP project aimed to address the following PICOT (patient, intervention, comparison, outcome, time) question:

P- APPs and Physicians in Ambulatory ID practice

I- Single Standardized EHR MR process

C- Current three variable EHR MR processes

O- Provider completion rate of MR in the EHR

T- Eight weeks

For APPs and Physicians in an ambulatory ID practice, how does implementing one standardized EHR MR process, compared with the current variable practice, impact their completion rate of MR, over a period of eight weeks?

This evidenced based practice (EBP) project was designed to evaluate the significance of a consistent approach to MR. It sought to determine if following a best-practice, single, standardized EHR process would improve HCPs completion of MR. This process change is practical and can be incorporated into other ambulatory practices that utilize PennChart. The process and outcomes were continuously evaluated for realistic implementation and sustainability with an overall goal of improvement in completion of MR which has the potential to reduce medication errors and improve patient safety.

Definition of Terms

The following conceptual and operational definitions of terms were used throughout the project:

- *Advanced practice provider (APP)* is used here as an umbrella term for non-physician providers (i.e., nurse practitioners, clinical nurse specialist, nurse midwives, nurse anesthetists, physician assistants).
- *Ambulatory care* is defined as healthcare services provided in an outpatient setting, such as a physician's office, surgery center, or urgent care clinic, which does not require hospital admission (IPFCC, n.d.).
- *Best possible medication history* is the first step in the MR process. It includes interviewing patients about their medication use and identifying at least one alternative source (i.e., caregiver, external pharmacy, clinical database) for comparison (Famiyeh et al., 2021).
- *Electronic health record* is a digital version of a patient's chart where medical care is documented (HealthIT.gov, 2019).
- *Healthcare Providers* is an umbrella term utilized in this document to describe Physicians and APPs.
- *Infectious Disease* is the practice of medicine led by HCPs, public health experts and researchers who study, diagnose, treat, and prevent diseases that are caused by bacteria, viruses, fungi and parasites (IDSA, 2023).
- *Medication discrepancy* is defined as a variation between what medications patients are prescribed and what they are taking, which can negatively impact patient safety (Anderson et al., 2019).

- *Medication error* is defined by AHRQ (2019) as "an error (of commission or omission) at any step along the pathway that begins when a clinician prescribes a medication and ends when the patient actually receives the medication" (para.1).
- *Medication reconciliation* is defined as a process by which an HCP compares a list of medications that the patient has been prescribed and what they are taking, to identify and resolve medication discrepancies (TJC, 2021).
- *Medication-related problem* refers to any problem that a patient has regarding their medication use related to obtaining medications, taking medications, getting appropriate care by a healthcare provider, or experiencing adverse events (Nicosia et al., 2020).
- *Medication safety* is defined as freedom from harm due to errors made during the process of prescribing and using medications (TJC, 2021).

Chapter Summary

Chapter One introduced the process of MR, its relationship to safe, high-quality patient care, and some of the challenges HCPs and organizations face when putting MR into practice. Variability in UPHS EHR processes related to MR completion was identified as the problem of focus. Evidence suggests that implementation of a standardized, consistent EHR process can improve the HCP experience and positively affect the completion of MR. Specific aims of the project were outlined. Next, the FOCUS-PDSA Quality Improvement Methodology Model in Healthcare was described as a framework to guide this evidence-based DNP project. Finally, definitions of key terms related to this project were outlined.

This paper describes an EBP scholarly project designed to improve the MR process in an ambulatory ID practice caring for high-risk patients with a history of suboptimal MR completion compliance. This project was the culminating assignment in partial fulfillment of the

requirements for the Doctor of Nursing Practice (DNP) program at Wilmington University in New Castle, Delaware. Next, chapter two will provide a review of the Ohio State University (OSU) evidence-based practice (EBP) model and a detailed analysis and synthesis of the available knowledge regarding the MR process in the ambulatory care setting.

CHAPTER TWO

LITERATURE REVIEW

Search Strategy

An exhaustive electronic database search was completed to examine MR more deeply. Appendix A provides a visual depiction of the search strategy. Specifically, Medical Literature Analysis and Retrieval System Online (MEDLINE), Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete, Google Scholar, Ovid Nursing Full-Text Plus, and ProQuest Dissertation and Theses (PDQT) Open were used. All articles were peer-reviewed and full text in the English language. Key search terms were chosen based on their direct relationship to the stated PICOT question, including medication reconciliation, medication review, medication safety, and process improvement. Secondary search terms included ambulatory, patient safety, healthcare provider, and electronic health record. Limiters were utilized to exclude the terms hospital and acute care. Inclusion criteria included studies from January 2019 to March 2023 that addressed the EBP question, focusing on high-quality, patient-oriented clinical evidence utilizing the Johns Hopkins Nursing EBP model. References from the identified studies provided 16 additional relevant articles for review.

After review, a total of 26 articles were selected to be used to support project development and implementation. Report literature and government publications were also utilized from organizations, including AHRQ, IHI, IPFCC, and TJC. Search terms used on these sites include medication reconciliation, medication safety, process, ambulatory care, tools, and guidelines. Articles from these sites were reviewed for relevancy related to the PICOT question, and only current information from January 2019 to March 2023 was used.

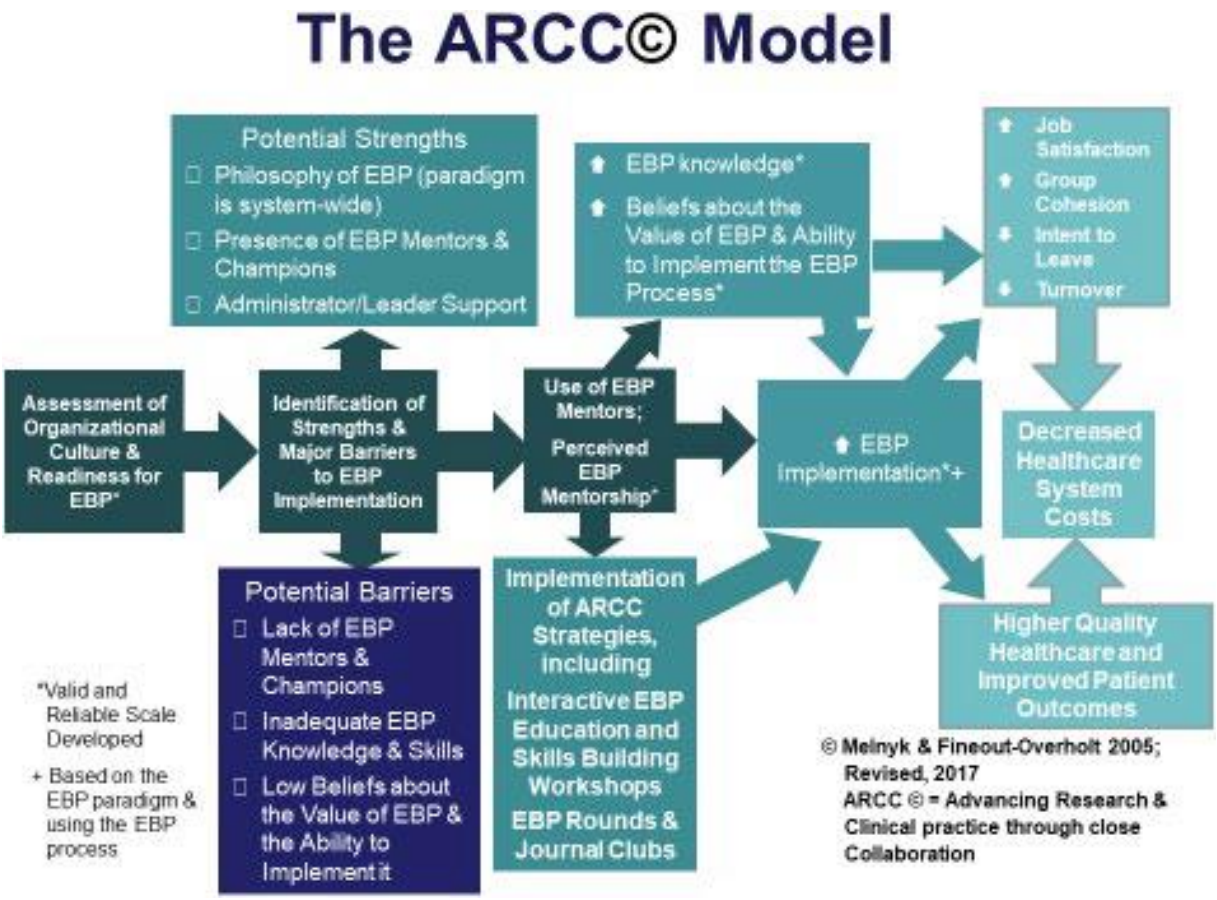
EBP Model

Melnyk et al. (2021) define EBP as "a problem-solving approach to clinical decision-making that integrates the best evidence from research with a clinician's expertise, in addition to a patient's personal preferences and values" (p.272). Melnyk and team originally developed a mentorship framework to guide advanced practice nurses in implementing EBP in 1999. That framework has evolved into the Ohio State University EBP model, also known as the Advancing Research and Clinical Practice through Close Collaboration (ARCC) model (Melnyk, 2021). This DNP project utilized the ARCC model to guide clinical practice change in conjunction with the FOCUS-PDSA framework.

The ARCC model, shown in Figure 2, starts with an organizational evaluation of culture, readiness to change, facilitators and barriers, and identifying measures to overcome the obstacles. The next step is placing EBP mentors within the system to work alongside other clinical staff to optimize EBP knowledge, beliefs, and skills. In the literature, this step improved the clinical staff's acceptance and optimistic assumptions regarding EBP implementation and positively impacted patient outcomes (Melnyk et al., 2021). This DNP project focused on MR, the problem of inconsistent EHR MR processes, and substandard MR completion rates. The DNP student determined it was critical to increase the knowledge of HCPs on the importance of high-quality MR for patient safety. The Ohio State University model provides quick critical appraisal tools to help determine the appropriate studies to utilize.

Figure 2

The Advancing Research and Clinical Practice through Close Collaboration (ARCC©) Model



Note. This model was produced by Melnyk and Fineout-Overholt originally in 2005 and then revised in 2017. From "Evidence-Based Practice Culture and Mentorship Predict EBP Implementation, Nurse Job Satisfaction, and Intent to Stay: Support for the ARCC© Model," by Melnyk et al., 2021, *Worldviews on Evidence-Based Nursing*, 18, p. 273. Reprinted with permission. Copyright 2021 by Sigma Theta Tau International.

Available Knowledge

Benefits of MR

MRPs can result in both short and long-term physical and psychological harm to the patient and their loved ones. In more severe cases, that harm might result in hospitalization and

even death. MRPs are also associated with increased healthcare costs, burdening patients, and healthcare organizations (Rodziewicz et al., 2023). There is notable evidence to support that MR has the potential to improve medication safety and reduce patient harm. Several studies have demonstrated the ability of MR to reduce medication discrepancies or errors, thereby reducing the likelihood of experiencing MRPs (Alghanem et al., 2022; Anderson et al., 2019; Herledan et al., 2020; Vega et al., 2016). High-quality MR, following all the steps from obtaining a BPMH through providing the patient with a reconciled medication list, is linked to reduced hospital admissions and positive economic effects (Abrahamsen et al., 2020; Alghanem et al., 2022; Miller et al., 2020).

Cancer patients, like patients with infectious diseases, often have multiple medical comorbidities and are on high-risk medications with increased potential for drug interactions. These factors put them at elevated risk for experiencing MRPs (Herledan et al., 2020; Vega et al., 2016). In a systematic review of fourteen studies evaluating the clinical and economic impact of MR in cancer patients, Herledan et al. (2020) found sufficient evidence to conclude that MR can reduce MRPs. The studies encompassed hospitalized and ambulatory patients treated with oral or parenteral anticancer drugs. There was not insufficient evidence to thoroughly evaluate the impact of MR on clinical patient outcomes. The economic effect of MR was not evaluated consistently and could not be compared between studies. In a randomized, prospective controlled study looking at cancer patients in the ambulatory setting, Vega et al. (2016) found that medication errors reaching the patient decreased by 26% in patients that received standard care plus pharmacist-led MR versus standard care alone.

Medication-related hospital admissions and readmissions are common and preventable. Up to twenty-cent of all hospital admissions are associated with an MRP, and that proportion

rises to 64% for hospital readmissions. High-quality MR can positively affect those percentages (Linkens et al., 2020). A systematic review by Abrahamsen et al. (2020) revealed an overall reduction in hospital admissions when MR was completed in patients with multiple medical comorbidities. Similarly, Miller et al. (2020) found a statistically significant decrease in hospital readmissions for patients with high-risk diagnoses that had MR completed by a pharmacist. It is unclear the true impact of MR alone (Anderson et al., 2019). MR processes and interventions are multidimensional (i.e., may include educational components or specific tools) and can be performed by various clinical staff. These various components may independently or collaboratively impact the positive effect MR has on reducing patient harm.

This author identified no current studies directly connecting MR to improved cost-effectiveness, but many correlations have been identified. Medication-related costs can be direct, such as the price of medications, or indirect, related to the management of MRPs, hospitalizations, or the cost of HCPs to perform MR. In a retrospective, observational study done on another high-risk population, dialysis patients, Alghanem et al. (2022) revealed that routinely performing high-quality MR improved reduced medication costs to patients by approximately $500 over six months. In nine of the seventeen studies reviewed by Abrahamsen et al. (2020), a positive economic effect for MR was reported. The healthcare community likely underestimates the positive downstream impact of MR on cost-effectiveness. For example, if MR reveals medication discrepancies that are corrected before an MRP occurs, an expensive hospitalization can be avoided, and a caregiver will not experience lost wages from having to take off work to care for their loved one.

A potential benefit of MR, often overlooked, is improved quality of life for patients. A randomized controlled trial by Johansson et al. (2023) examined the impact of physician-led MR

on diabetic patients on twelve or more medications. They found that physician-led MR compared to standard care, resulted in a reduction in the overall number of medications prescribed to patients and a significant improvement in healthcare-related quality of life, measured using a standardized tool.

Barriers to MR

Despite the evidence demonstrating that MR can reduce MRPs, favorably impact medication-related hospital admissions, and improve global cost-effectiveness related to medication use, many barriers exist to facilitating high-quality MR. These barriers occur at various levels: patient, provider, and system. The following paragraphs will discuss all three.

Patient experience is positively associated with enhanced patient safety standards, better patient adherence to medical advice, and improved clinical outcomes (AHRQ, 2022). Therefore, patient input and involvement in the MR process are critical to long-term success. Many patients and caregivers are uncertain of their participation in the processes surrounding MR or its value. In a qualitative study by McCahon (2022), twenty-one patients were interviewed to examine patient perceptions related to MR. Many participants did not understand the purpose of MR or viewed it as just another task for an HCP to complete. Participants expected the review to focus on their concerns or questions related to their medications. Additionally, they were skeptical of the clinical skills and ability of the pharmacist performing the review since they did not understand the pharmacist's role in their care. Pereira et al. (2022) discovered that patients and caregivers felt there was an opportunity to be better informed and more involved in the MR process. Both studies emphasized the patients' desire to have better communication regarding the management of medications between their HCPs (McCahon, 2022; Pereira, 2022).

Often MR does not occur or is done ineffectively during a patient encounter because HCPs are not engaged in the process. Incomplete MR happens for various reasons, including inconsistency- in knowledge, concept of value, workflows, time, training, EHR design, and more (Gionfriddo et al., 2021). HCP engagement may be the most critical factor in performing high-quality MR and adding value (Giondfriddo et al., 2021; Rangachari et al., 2019; Yuan et al., 2022). Bitan et al. (2019) recognized this when they examined cognitive strategies HCPs use to perform MR. Their work suggested that clinical workflows and EHR support systems must be built to work with, and not against, the cognitive strategies that HCPs utilize most effectively. Rangachari et al. (2019) and Yuan et al. (2022) explored provider-perceived barriers to high-quality MR. Many providers lacked knowledge of best practices for performing MR and expressed discomfort in reviewing medications they did not prescribe. Training and support surrounding MR were variable and inadequate.

Other HCP concerns are directly related to system-level problems. Based on the ARCC model, barriers at the system level impede any progress with EBP implementation (Melnyk et al., 2021). HCPs perceived system-level obstacles include short staffing, lack of pharmacy resources, and unrealistic expectations about provider time allocation (i.e., expected to perform MR and many other tasks in a 20-minute visit). Providers report that clinical workflows in their offices do not support the MR process. Additionally, HCPs desire more functionality to be built-into EHRs to support MR. They want better interoperability between different EHR systems to support improved communications between healthcare settings and between various HCP within a practice (Rangachari et al., 2019: Yuan et al., 2022).

A final barrier identified by the author is the variability of evidence surrounding the implementation of MR in the ambulatory setting. Many of the studies reviewed were of low to

moderate quality, and there was a substantial variety in patients, types of HCPs, and types of MR processes and interventions. This disparateness makes in-depth data synthesis challenging. There is limited ability to compare different MR approaches directly, which contributes to a lack of clarity and inconsistent guidelines around best practices.

MR Process Improvement

There are clear benefits and challenges surrounding high-quality MR in the ambulatory setting. HCPs, quality and safety experts, and researchers constantly look for ways to improve the MR process and meet patient safety goals. In a scoping literature review exploring MR interventions in the ambulatory setting, McCarthy et al. (2016) identified three levels of implementation facilitators to support successful MR interventions: patient, staff, and clinic. Patient interventions focused on education, engagement, and comfort with the HCP and practice setting. Staff interventions were directed at educating about the MR process, giving one-on-one feedback about performance, and removing barriers to engagement. Finally, clinic-level interventions aimed to improve collaboration and interoperability with outside providers, remove obstacles preventing integration of MR into clinic workflows, and assure the cost-effectiveness of any changes. The following section will present the variety of interventions outlined in the current literature aimed at meeting these goals.

Patient Focused

Patients should play an active role in their healthcare, including medication management and reconciliation. MR process improvements aimed at patient engagement are less common than those directed toward HCPs but no less critical. In one open randomized controlled noninferiority trial, patients were randomized between completing MR via a patient portal or having MR completed by a Pharmacy Technician. Patients that participated in MR through a

patient portal saved time overall, and there was no statistically significant difference in medication discrepancies between the two groups. Additionally, patients were satisfied with the experience of using the patient portal tool (Ebbens et al., 2021). Similarly, Brady et al. (2022) found that the use of a Secure Messaging for Medication Reconciliation Tool (SMMRT) was viewed positively, saved time, and had the potential to reduce MRPs for those patients who chose to engage with it.

In a more fundamental approach, Garfield et al. (2020) examined the impact of patient-held medication lists on patient safety. They found that patient-held medication lists, in any form, can improve the accuracy of MR, increase the potential to identify MRPs, enhance communication between patients and HCPS, and empower patients to take an active role in their care. Of note, of the 103 tools examined for storing a patient-held medication list, none benefitted all users, indicating the need for an individualized approach.

Patients and caregivers are often the only link between HCPs and healthcare settings in rural areas. Several studies demonstrated the benefit of using a standardized, consistent approach to MR utilizing a framework or toolkit that drives patient engagement (Elbeddini et al., 2021; Jarrett et al., 2019; McCahon et al., 2021). Jarrett et al. (2019) evaluated the implantation of a standardized, consistent approach to MR in a rural primary care setting. Utilizing the Medications and Transitions and Clinical Handoffs (MATCH) toolkit available through the Agency for Healthcare Research and Quality, they identified gaps preventing patients from more fully engaging with MR and modified their processes and workflows. Both patients and staff reported an improved experience from pre to post-intervention surveys. Their evaluation finding also stressed the importance of having a common language about MR between patients and HCPs.

A study by van der Nat et al. (2022) demonstrated the value of including patients in the MR process. Providers and patients in an ambulatory rheumatology clinic were observed over two months. During this observational period, researchers found that in 1 in 3 visits, patient input was essential to completing adequate MR and being able to perform necessary drug-related actions. Despite provider beliefs, information in the EHR alone was not sufficient.

Provider Focused

Provider-focused interventions related to MR often focus on education and training, standardizing workflows and processes, and removing some of the barriers previously outlined. Jones et al. (2022) describe a pharmacist-delivered MR educational program developed and implemented to improve provider knowledge and practice. Clinic personnel that participated were satisfied with the experience and felt the education applied to their everyday work. The authors stressed the importance of modifying the educational approach to meet the needs of a particular practice or individual to have the most benefit. After implementing the educational program, providers' behaviors in some areas improved long-term. Other studies also support consistent and ongoing provider education to drive engagement and deliver higher-quality MR (Garfield et al., 2021; Gionfriddo et al., 2021; McCahon et al., 2021).

There is substantial evidence in healthcare literature to support the use of Pharmacist-led MR interventions. Although much of it is focused on the inpatient setting, an increasing number of studies are aimed at ambulatory care, specifically in high-risk populations. Dobish et al. (2021) explored a pharmacist-led approach to conducting MR before clinic visits for new oncology patients. Allowing for some flexibility in timing and process to meet the patient's or the HCP's needs, the intervention eventually demonstrated improved efficiency of clinic visits. It became the preferred method of MR by HCPs studied. In a single center, observational cohort

study looking at MRPs in liver transplant patients, Mulder et al. (2022) found that patients receiving an outpatient pharmacist consult for MR had significantly fewer reported MRPs and an overall reduction in the number of medications taken than those who did not have a consult. Kane-Gill et al. (2021) implemented a quality improvement using Pharmacists, and telemedicine, where appropriate, to conduct initial and recurring MR on nursing home residents. The new Pharmacist MR service reduced MRPs substantially compared to residents who did not. There was no considerable difference in all-cause hospital admission or readmissions. Unfortunately, Pharmacist resources are limited in the ambulatory care setting, and Pharmacist-led interventions for MR are often not feasible. In a similar but alternative approach, a retrospective study by Deep et al. (2021) evaluated the efficacy of using 4th-year Pharmacy students to perform MR. Pharmacy students identified medication discrepancies in nearly 70% of patients. The study concluded that Pharmacy students can perform quality MR and improve patient safety. The students may be a beneficial resource to assist Pharmacists or other HCPs with MR.

Technology and EHRs

In modern healthcare, most MR is completed through the EHR. Broad adoption of EHRs has dramatically improved the quality and safety of healthcare. EHRs have reduced medical errors, reduced healthcare costs, decreased hospital readmissions, and contributed to lower inpatient mortality (Lin et al., 2020). Technological advances aimed at improving the act of MR are critical (Ebbens et al., 2021; Rangachari et al., 2019). Tech-related solutions to improving MR have historically focused on the inpatient setting but can translate to the ambulatory care setting. Several tech-related interventions applicable to ambulatory care have already been described in the previous sections, such as telemedicine approaches, engagement through a patient portal, and tools to support patient-held medication lists. EHR functionality and

standardization of processes related to MR are essential to HCPs (Gionfriddo et al., 2021; Yuan et al., 2022). Unfortunately, quantitative data and studies directly comparing EHR tools for MR are lacking. Many HCPs and healthcare organizations, including UPHS, focus their EHR-related MR interventions on overcoming barriers or addressing gaps outlined in the literature without solid evidence to guide best practices (Giondfriddo et al., 2021; Rangachari et al., 2019; Yuan et al., 2022). They develop their own EHR MR best practices based on the recommendations of their EHR product experts, information systems teams, and clinical experts.

Chapter Summary

Chapter Two outlined the search strategy and EBP model used to critically appraise the literature regarding MR in the ambulatory care setting. The benefits and challenges of performing high-quality MR were reviewed. A heterogeneous mixture of MR process interventions was presented. Despite all the available research, gaps still exist regarding the optimal processes to complete the best MR and the impact of MR on clinical outcomes. Multiple factors, including the specific needs of the practice area, must be considered, and providers should be at the forefront of initiating change. Using the ARCC model, this project sought to create change by standardizing and simplifying the approach to MR in the EHR and improving provider knowledge and engagement through the process.

The next chapter will describe the context of the project, measures used, budget, and ethical considerations.

CHAPTER THREE

METHODOLOGY

Context

This DNP project occurred within an academic, ambulatory ID office at the Perelman Center for Advanced Medicine (PCAM) in Philadelphia, Pennsylvania. This office is the largest of four, comprising the world-renowned ID division at UPHS. The division, established in 1977, provides the diverse urban community with access to various subspecialty services, including Human Immunodeficiency Virus (HIV), Viral Hepatitis, Skin and Soft Tissues Infections (SSTI), Travel Medicine, Transplant Support, Mycobacterial Infections, Co-Infections, and General ID (Penn Medicine, 2022). There are over sixty clinical faculty members within the division, in addition to ID fellows, APPs, pharmacists, registered nurses, medical assistants, and an administrative support team. The mission together is to "maintain the highest standards of clinical care; to work to advance our understanding, treatment, and prevention of disease; and to create an environment of educational excellence" (Penn Medicine, 2022, para. 1).

The PCAM location is open five days a week from 7:30 am to 5:00 pm and houses all the outlined clinics at different points in time throughout the week. On any given day, there are five to six clinical faculty, one to fellows, three to four APPs, one clinical pharmacist, one to two registered nurses, and three to five medical assistants delivering patient care to those 18 years of age and older. The patient volume is, on average, about 180 patients per day. Many HCPs at this location also provide inpatient consult services at the Hospital of the University of Pennsylvania (HUP), Pennsylvania Hospital, and Penn Presbyterian Medical Center. The clinical team is led by the medical director and physician champion for this project, Dr. Helen Koenig, in collaboration with the lead APP, Leah Turner, NP. The practice operational leadership consists

of a practice manager, who was out on medical leave for the course of this project, with indirect oversight provided by a divisional administrative director.

For the past several years, the issue of inconsistent completion of MR was identified by Dr. Koenig, the ID division, and the Department of Medicine as a medication safety concern and an opportunity to reduce risk to patients and for providers. Despite workgroups in place to actively address the issue, opportunities remained present. A lack of inconsistent processes, particularly with EHR MR, was identified through observation of patient care at the clinic. The DNP student also observed that HCPs and other care team members could benefit from additional support with knowledge, time, resources, and patient involvement surrounding MR. The DNP student believed that efforts to standardize the EHR would positively impact the behaviors of HCPs in performing MR.

A few barriers arose that complicated the course of the project. First, the DNP student was new to the healthcare organization, and it took a prolonged period to make contacts and establish relationships with key stakeholders to get the project launched. Fortunately, the student had a project mentor at UPHS, Angela Miller, who had vast institutional knowledge that made it possible to proceed. Additionally, the DNP student was concomitantly learning and growing in their new role as Director of APPs. This contributed to scheduling conflicts and limited availability for the student to be present in the clinic.

Additional barriers included staffing shortages and challenges with HCP engagement from within the ID practice. During the project implementation phase, the practice manager was out on medical leave, and there was a turnover of several support staff, including medical assistants and front desk staff. This all contributed to the additional administrative burden placed on providers. Due to a multitude of factors, including but not limited to competing clinic

schedules, increased administrative burden, lack of interest, and perceived time burden, it took several weeks longer than anticipated to schedule and engage providers for one-on-one sessions to review current workflows, discuss barriers to MR, and provide education of MR EHR best practice workflows. With Dr. Koenig's relentless support and collaboration, the DNP student eventually connected with all identified participants, except for one.

Key stakeholders for the project included all members of the clinical care team, office support staff, divisional leadership, quality and safety team members, and members of the PennChart expert team. All played a role in supporting the successful implementation of the project and will be essential to continue the practice change after the conclusion of the project period. This project aimed to improve the MR process in a complex population of patients. The project has the potential to benefit the organization, HCPs, and patients by increasing the efficiency of processes, reducing risk, reducing cost, and improving patient and provider experiences.

Interventions

The project team was comprised of the DNP student, a project advisor, a mentor (who also served as a team member), and a physician champion. The project advisor, Dr. Lisa Drews, was assigned by the course instructor. The mentor and additional team member, Dr. Angela Miller, was identified by the DNP student due to her involvement in UPHS MR improvement work and because of her many years of clinical experience and broad knowledge of the health system. Dr. Miller helped the DNP student contact a physician champion who was interested in and would support the project. They identified Dr. Helen Koenig, the medical director for ID, who accepted this responsibility.

The DNP student's role as project leader included initiating and continuing contact and communication with all parties involved throughout the project process. The student set up an initial meeting with Dr. Koenig in August of 2023 to review the project goals and identify a list of ID HCPs to target as participants. HCPs were considered for inclusion if they had a baseline MR completion rate <90%, saw patients in the PCAM office at least one full day per week, and did not have any planned leave > 1 week during the project period. Ten HCPs, consisting of 8 physicians and 2 APPs, were selected. The DNP student then constructed and distributed an email request to the targeted providers outlining the project's purpose and asking to schedule a time to observe each of them in the clinic, at the request of Dr. Koenig, and schedule 1:1 educational sessions to review the best practice EHR MR workflow. It took repeated email communications and direct outreach by Dr. Koenig to connect with all the providers. One physician declined to participate in the clinic observation and 1:1 educational session due to a perceived disruption to their clinic time. They did provide demographic information, shared their feedback on the current MR EHR process, and agreed to review the tip sheet via email.

From mid-September 2023 through the end of December 2023, the DNP student arranged a few clinic observations with some of the remaining HCPs. The observation periods varied from 2-4 hours. During observations, the DNP student could view or hear about each HCP's current MR workflows and EHR processes. Many providers also provided insight into their experience with MR and the barriers they face. They suggested improving the MR workflows within the EHR and in the office. Concomitantly, the DNP student met routinely with members of the Penn Chart expert team and information systems (IS) support team to modify and finalize the best practice EHR workflow tip sheet (Appendix B). Once completed, the DNP student met with all but one of the ID HCPs for a 1:1 educational session. The initial plan was to perform the educational

sessions in person. However, due to repeated scheduling conflicts, the decision was made to transition to a virtual format using Microsoft Teams in conjunction with the project mentor and physician champion. Each HCP was asked to sign up for a session using a Sign-Up Genius. Each session lasted thirty minutes to one hour. At the beginning of each session, the DNP verbally requested permission to record the session, which all participants granted. Demographic data was collected, the HCP was reminded how to access their MR completion data, and the DNP student shared and reviewed the tip sheet in detail. The DNP student also used the screen share functionality in Microsoft Teams to demonstrate the EHR MR workflow live in Penn Chart for some sessions. All participants were given a digital copy of the tip sheet and asked to use the best practice EHR MR workflow moving forward.

Study of the Interventions

The DNP student opted to utilize the MR completion rates of each HCP to assess the impact of implementing a standardized EHR MR workflow. It was a metric with a standard data definition already monitored and commonly accepted within UPHS. The data was easily accessible to both the student and HCPs. The student checked in with the ID providers frequently and maintained contact with the project advisor, project mentor, and physician champion throughout the entire process.

Measures

MR completion is captured in EPICs PennChart by clicking the *Mark as Reviewed* button at the end of the EHR MR workflow. Utilizing an internally validated Tableau dashboard that directly imports data from PennChart, the DNP student examined MR completion rates for participating HCPs at baseline, reviewed periodically throughout, and then at the conclusion of the project period. The 1:1 educational sessions started the timeframe for measurement, and

lasted over the course of eight weeks. Descriptive statistics were used to analyze the collected data and to identify any change in participants' MR completion rates, thus providing a process to evaluate the differences between pre-and post-intervention states.

The demographics collected by the DNP student include the type of healthcare provider (nominal), gender (nominal), race (nominal), years of clinical experience (ratio), years of EPIC experience (ratio), and age (ratio). To examine the demographical variables, the DNP student used descriptive statistics to demonstrate what is typical within the sample data. The nominal variables, mode or frequency, will be used to paint a picture of the sample, for example, how many healthcare providers are physicians versus APPs. For the ratios, additional comparisons will be made, such as the mean, or average, age of providers (Kim et al., 2022).

Analysis

The independent variable for this project was the change in the MR EHR workflow process. The dependent variable was whether MR was completed (nominal), summarized as the percentage of MR completed by a provider (interval) pre- and post-intervention. The alternative hypothesis is that the change to the MR process will improve the percentage of MR completed, in other words, there is an association between completion of MR and the MR process change. A dependent or paired sample t-test was used to compare the percentage of MR completion by providers pre- and post-MR process change. A *dependent sample t-test* is a statistical analysis used to examine pairs of observations and will aid the DNP student in understanding the statistical significance of the comparison (Kim et al., 2022). If the MR process change positively influences the completion of MR, it may lead to a clinically significant change in patient care quality and safety. One constraint for this data may be the small sample size, which could

adversely impact the distribution and limit the benefit of a more detailed statistical analysis (Kim et al., 2022).

Budget

For this project, there was minimal cost. The focus was on improving an electronic EHR MR process already in place within UPHS. The interventions utilized the same staff and similar resources as previous practice. The DNP student, a current UPHS employee, managed the project implementation as a requirement to complete their degree; therefore, no cost was attributed to their time.

Projected costs related to the MR process change included visual aids outlining the new, standardized EHR MR process, and provider time for education. Initial consideration was given to printing antimicrobial visual aids for each exam room. Ultimately, the decision was made to keep it digital for easier access and maintenance. No additional cost was registered. Each provider, including eight ID physicians and two APPs, was asked to attend one hours of education before implementing the best practice workflow and one hour of continuing education annually after that. The initial hour education session was completed during already scheduled non-patient-facing time. The process change did not significantly impact the routine day-to-day provider patient-facing time or revenue generation. The established PennChart expert team can complete the one-hour continuing education for the subsequent years, requiring no additional staff. If unable to be arranged during administrative time, future sessions could lead to a loss of revenue per physician of approximately $407.36, or $346.26 per APP, based on the current fee schedule (CMS, 2023). As of fiscal year 2022, UPHS's annual operating revenue was $11.1 billion (Penn Medicine, 2023). The lost revenue outlined here will likely have minimal to no impact on their bottom line.

Quality MR has the potential to reduce ME and the associated costs. The annual cost of ME in the US is around $40 billion. That results in cost savings of about $5700 per ME (Rodziewicz et al., 2023). Avoiding even a single ME provides significant cost savings. If two MEs are avoided because of the improved EHR MR process, the savings alone would cover all the associated costs.

Ethical Considerations

To maintain high ethical standards during project implementation, the DNP student completed the Collaborative Institutional Training Initiative (CITI) on human study subjects (see Appendix C). Wilmington University's Human Subject Review Council (HSRC) approved this project (see Appendix D). The UPHS Institutional Review Board (IRB) completed an expedited review, approaching it as a quality improvement project. The IRB determined it did not meet the requirements for human subjects research and did not require a full IRB review (see Appendix C). Dr. Helen Koenig, the medical director for ID and Vice Chair of Quality for the Department of Medicine, approved the project to occur (see Appendix D). These documents support the fact that this DNP project was developed and implemented in an ethical manner.

Maintaining the privacy and confidentiality of the participating HCPs was also integral to successful and safe project implementation. It was determined that formal written consent was not required for this project. Verbal consent for participation in and recording the virtual education sessions was obtained at the time of each session. One HCP declined a video recording of the session. Demographic data for HCPs was collected and coded (Appendix E). MR completion data is internally available to UPHS employees with appropriate access. The data is pulled from EPIC into a Tableau Dashboard. All data was stored on a password-protected laptop requiring fingerprint recognition for access. The laptop was only accessed on a secure Penn

Medicine network on campus or via a virtual private network (VPN) off-campus. The password to the laptop is changed every ninety days. The only individual with access to the laptop is the DNP student who led the project.

Chapter Summary

Chapter three presented the context, interventions, data collection, and analysis measures used for this DNP project. Ethical considerations regarding the selection process were also outlined. Chapter four provides sample characteristics, results analysis, statistical data, and analysis of participants' improvement in completion rates of MR.

CHAPTER FOUR

RESULTS

Sample Characteristics

The project sample ultimately consisted of nine adult ID HCPs ranging in age from 34 to 66. Two of the HCPs were APPs and seven were physicians. There were three males and six females with four identifying as Caucasian, one as Black, two as Asian or Pacific Islander, and two as Other/Multiple. The HCP years of work experience ranged from four to thirty-six years, with an average of eighteen years. The HCP years of experience using EPIC ranged from four to fifteen, with an average of nine years. Table 1 below outlines the participant demographic data in detail.

Table 1

Participant Demographics

Sample Characteristics	*n*	%	Range	*M*
Provider Type				
APP	2	22		
Physician	7	78		
Race				
Caucasian	4	45		
Black or African American	1	11		
Hispanic or Latino	0	0		
American Indian or Alaskan Native	0	0		
Asian or Pacific Islander	2	22		
Other/Multiple	2	22		
Age			34-66	47
Gender				
Male	3	33		
Female	6	67		
Other	0	0		
Years of Provider Experience (YPE)			4-36	18
Years of EPIC Experience (YEE)			4-15	9

The sample of HCPs for this project were majority female, half were minorities, and the majority were physicians. Based on self-reported data collected by the Infectious Disease Society of America (IDSA), thirty-nine percent of ID providers identified as female and fifty-eight percent identified as Caucasian/White (Aberg et al., 2017). The sample for the project was more heavily representative of females and racial minorities. No APPs were captured in the aforementioned report. As part of its 2020-2024 strategic priorities the IDSA is focusing efforts on growing and developing the ID workforce. Mentoring and developing APPs is an integral part of that effort (Bieler et al., 2021).

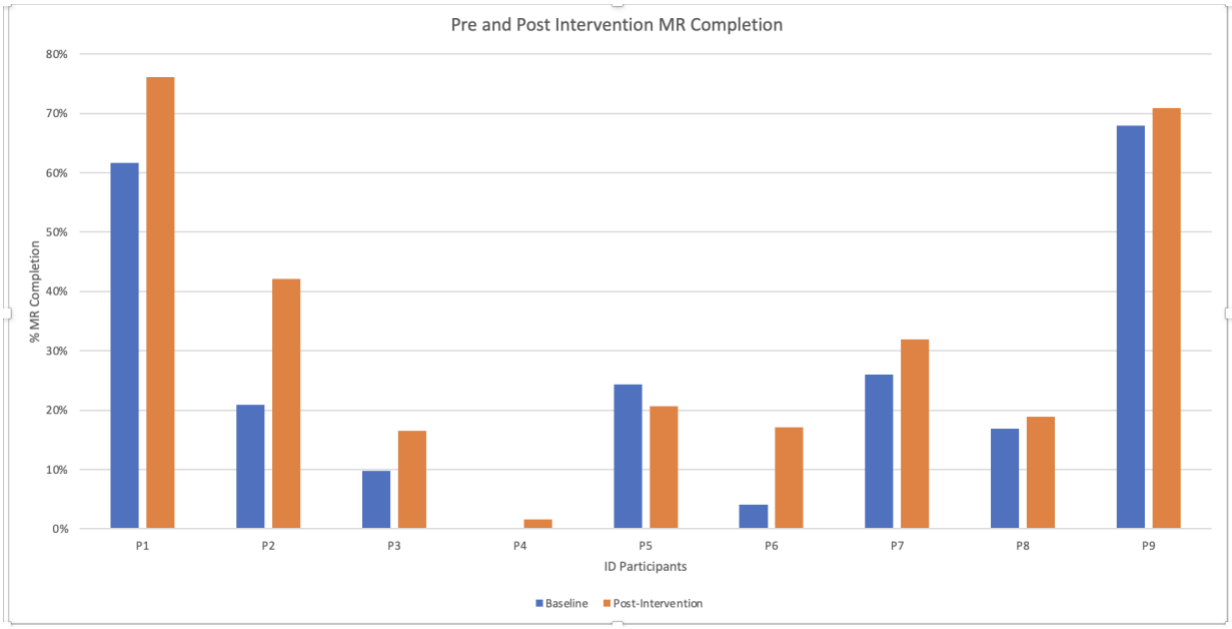
Comprehensive EHR functionality and years of HCP experience with utilization correlates positively with quality and safety (Upadhyay, S. & Opoku-Agyeman, 2023). Additionally, the longer HCPs have used an EHR and if given the opportunities to customize its use to their preferences, they are generally more satisfied and willing to consider alternative uses. The ID providers involved in the project had an average of eighteen years of overall provider experience and an average of 9 years of experience using EPIC. Most providers in the US today have at least five years of experience using an EHR (Mishra et al., 2022). Therefore, it can be surmised that most of the ID providers had sufficient experience with EHRs to make this change successfully.

Results

The DNP student collected participant MR completion percentage data at baseline and post-intervention for each ID provider participant. Data points were pulled from a Tableau dashboard previously created by UPHS to track progress of risk reduction initiatives. The baseline value was calculated as an aggregate total of the percentage of MR completion for July, August, and September 2023. The post-intervention MR completion percentage was an

aggregate total of October, November, and December 2023. Demographic data was collected throughout the project implementation period and stored in a spreadsheet created by the student. Once the project implementation was completed, the DNP student had the opportunity to review the data collected and analyze the results, using Microsoft Excel, to determine the impact of implementing a single, standardized EMR MR workflow on MR completion rates. Figure 3 illustrates the provider MR completion percentages pre and post intervention.

Figure 3



For the dataset with a sample size of nine, the DNP student compared the mean-average of baseline provider MR completion percentage, to the mean-average of the post-intervention provider MR completion percentage using a paired t-test, assuming equal variance and a 95% confidence interval. This resulted in baseline sample mean of 25.74% and a post-intervention sample mean of 32.89%. Using the t-test, the observed difference of 7.15% was tested to examine whether the true population difference was different from 0. The resulting p-value was 0.02 and indicates that because the p-value was <0.05 the project data rejects the null hypothesis. The data analysis concluded that there is statistical evidence to support that the mean averages

between baseline and post-intervention provider MR completion rates are notably different from one another.

Key Findings

The key findings of this project are depicted in Table 2 below. An improvement in MR completion percentage was seen in all ID provider participants, apart from one. The percentage improvement was statistically significant indicating that there was enough of an improvement to conclude that the intervention had a valuable impact on MR completion. Overall, within the Division of ID, the percentage of MR completion increased from 43% to 46% throughout the project period. Some ID providers appeared more engaged during the educational sessions than others. Additionally, some expressed more interest than others in prescribing to the benefits of the recommended MR EHR workflow. Either attitude may have contributed to better compliance with utilizing the recommended standard EHR MR workflow post-intervention.

Table 2

Pre and post intervention Provider MR completion percentages, YPE, and YEE

Participant	Baseline	Post-Intervention	YPE	YEE	Overall Change
1	62%	76%	8	8	Improved
2	21%	42%	30	7	Improved
3	10%	17%	36	15	Improved
4	0%	2%	9	9	Improved
5	24%	21%	18	5	Declined
6	4%	17%	15	11	Improved
7	26%	32%	14	9	Improved
8	17%	19%	4	4	Improved
9	68%	71%	31	9	Improved

The one ID provider that demonstrated a decline in MR completion post-intervention was on the low end of the range for years of EPIC experience. Outside of that, all the other participants demonstrated an improvement regardless of age, sex, race, YPE, or YEE.

Project Strengths

Strengths of this DNP project include its low cost and easily accessible data. Additionally, this project was in alignment with risk reduction initiative work already being done within UPHS, the Department of Medicine, and the Division of Infectious disease. Educational material was developed in conjunction with the PennChart expert team and modified from existing documents in line with best practice use that they recommended. This project can be readily adapted to roll out to all other ambulatory care settings, as medication review and reconciliation are key responsibilities of all HCPs. The project was focused on patient safety, but its results will also contribute to improving provider experience with EHR MR workflows.

Chapter Summary

The demographics for the selected participant group for this project was outlined and the potential impact of YPE and YEE were discussed. Overall, statistical significance was demonstrated related to the project intervention Analysis of project results shows that implementing a single, standardized EHR MR workflow and re-educating HCPs on the process can help to improve provider MR completion percentages. Project strengths, including low cost and ease of implementation, were reviewed. The next chapter will discuss the overall interpretation of the DNP project, its limitations, sustainability, and the implications for advanced nursing practice.

CHAPTER FIVE

DISCUSSION AND IMPLICATIONS

Interpretation

Quality MR is crucial to patient safety (TJC, 2021). This EBP and QI-based DNP project was supported by literature and performed to reduce patient harm, support NPSGs, and engage HCPs in realistic ways to improve MR workflows, specifically in the EHR. The literature supporting MR has historically been focused on inpatient care and MR at the time of hospital discharge. HCPs in the ambulatory care setting are faced with a unique set of challenges related to MR (Dobish et al., 2021; Gionfriddo et al., 2021). A priority goal was that this DNP project will contribute beneficially to the development of improved MR workflows in ambulatory care.

During observations, and 1:1 education process, the DNP student found that many of the participants did not recall ever having been taught a best practice MR EHR workflow. The DNP student anticipated that re-educating HCPs and recommending implementation of the best-practice MR EHR workflow would demonstrate an improvement in MR completion. Based on the results and data analysis, the project was a success. The DNP student did not anticipate how challenging it would be to engage the providers in the process.

The literature supports that a consistent, technology-supported approach to MR is the most likely way to enlist participation and invoke a positive response amongst HCPs (Anderson et al., 2019; Gionfriddo et al., 2021; Rangachari, 2019). Although the project addressed the lack of knowledge and inconsistent EHR MR processes surrounding best-practice workflows in PennChart, other barriers remained. In alignment with the literature, several participants reported discomfort in clicking the medication reviewed button as they perceived it as taking responsibility for all the patients' medications, not just the ones they prescribed. Also, several

participants felt that clicking the button only served to check off a proverbial box. That performing that function did not adequately capture all the work being done throughout the office visit related to medication review, or assure quality MR. A couple of participants with the most YEE and YPE expressed profound frustration with limitations of the current EHR overall and relayed a lack of confidence related to any change providing substantial long-term benefit based on their past experiences. It can be inferred that those attitudes and perceived barriers may have impacted engagement and limited the ability of this project to be as successful as it could have been.

Overall, this project contributed to incremental improvement in MR completion amongst participants and met the DNP student's fundamental goals. The results demonstrated that a simple and consistent approach to MR in the EHR does make a difference. Regardless, many opportunities for additional MR process improvements remain both within and outside of the EHR.

Limitations

There were several limitations identified over the course of project implementation. First, the DNP student recognized that the *Hawthorne Effect* may have come into play. The *Hawthorne Effect* was coined by Henry Landsberger in 1958 after reviewing several studies of the Western Electric Hawthorne Works plant in Chicago. It refers to an automatic, and often unconscious, improvement in participant performance while being observed by an individual in a position of power (Perera, 2023). While the role of the DNP student during project planning and implementation was that of a student, they served in a dual role as Director of APPs and had the sponsorship of the Medical Director of the ID Division. Therefore, it's possible that some of the improvement seen in MR completion was related to this effect rather than the intervention itself.

Additionally, observer bias may have been present. Observer bias refers to unintentional distortions of observations or the perceived effects of interventions based on the observer's expectations or personal biases (Simkus, 2023). As a HCP who performs MR and a leader within UPHS, the DNP student may have imprinted unintentional bias on observations and interpretation of project results.

Next, the participant sample size was small with a n = 9, and the project was performed in a single, highly specialized practice. Both the DNP student and the participants are busy HCPs facing multiple demands on their time and experiencing information overload on a daily basis. These time limitations contributed to difficulty in performing in-person observations and education and likely impacted provider engagement. Finally, the constrained functionality of the EHR and the inability to make any changes to the EHR process in a short timeframe limited the ability of the project to have a greater impact on MR process improvement.

Implications for Advanced Nursing Practice

Health care continues to evolve rapidly. Advanced practice nurses must assess and understand the needs of their communities and then utilize available resources to meet those needs. Doctorly prepared advanced practice nurses bring advanced knowledge and experience that should be directed towards continual improvement of local and national health goals through analyzing current practice, researching, and designing quality improvement practices.

This advance practice nurse driven DNP project has beneficial implications for the future of advanced nursing practice. It demonstrated that a simple, cost-effective change in workflow and provider behavior can positively impact the completion of MR and potentially lead to risk reduction for patients. This project can evolve into broader practice change and positively complement other MR process improvement initiatives having a cumulative impact on

improving patient outcomes in the long term. The DNP student, and other advance practice nurses, can and should help lead the way. Future areas of focus for doctorly prepared advance practice nurses to explore related to the MR process include incorporating Pharmacists or Pharmacy techs, reforming communication with external health systems and providers, improving patient involvement, sponsoring technological advancements, and identifying how to better capture the quality of MR.

Plan for Sustainability

The literature reviewed for this project demonstrated significant variability in health system approaches to MR making it difficult to compare process changes directly with other health systems. Continuing with additional PDSA cycles of this project in other UPHS ambulatory settings with high-risk populations will allow the health system to better compare within while contributing to the growing body of evidence regarding MR processes. Due to its low cost, readily available tips sheets, and IS education support, this process change can easily be sustained and expanded with adequate provider engagement.

The DNP student will disseminate key findings of the project at the divisional, departmental and health system levels including reiterating recommendation that all practice areas utilize the same, consistent best-practice MR EHR workflow. Clinical leaders, operational leaders, and champion HCPs in each practice setting will be asked to share the information with their teams. For providers in the project and those already utilizing the recommended workflow, ongoing education on MR EHR workflows at regular intervals will be critical to long-term success. As workgroups within UPHS and nationally continue to tackle the challenges in performing high-quality MR, both in the EHR and otherwise, process changes and educational material will require continuous re-evaluation. It will be essential to maintain workgroups with

passionate multidisciplinary team members that collaborate effectively with the quality and improvement teams at all levels to incorporate the newest EBP recommendations.

Application of the AACN DNP Essentials

The DNP Essentials, published by AACN in 2006, are a set of indicators that are used to assess quality and evaluate student learning in doctoral nursing education programs. These essentials are the foundation for the knowledge students acquire during the DNP program. The experiential engagement hours completed by the DNP student throughout the course of this project incorporated all the essentials, but those that are most pertinent to the project are outlined in this section.

Essential I: Scientific Underpinnings for Practice

A doctorly prepared advance practice nurse has a thorough understanding of the scientific basis and theories fundamental to nursing practice. These include nursing, psychosocial, biophysical, organizational sciences, and many others. A DNP graduate should be able to critically analyze and translate evidence to enhance their practice and improve health care delivery.

Throughout this project, the DNP student was able to integrate nursing science with knowledge from organizational, ethical, analytical sciences. This was critical to ensure that the project was implemented appropriately without harm to those involved and that the results were analyzed correctly so that the data disseminated was accurate. The student was able to utilize scientific underpinnings to determine the significance of performing medication reconciliation, extract a potential practice change to implement, implement that practice change, and then evaluate the outcomes. Additionally, having a background in studying and integrating

psychosocial sciences, learning about patterns of human behavior, and potential ethical concerns allowed the student to proceed with project implementation safely.

Essential II: Organizational and Systems Leadership for Quality Improvement and Systems Thinking

The basis of the second essential is for a DNP student to develop advanced leadership skills that will allow them to influence and drive organizational changes surrounding quality and improvement. Using the scientific underpinnings gained through the first essential a DNP graduate should be able to develop and appraise methods of care delivery that meet the needs of their patients now and into the future. They are expected to promote and take accountability for initiatives focused on improving healthcare quality and patient safety in a fiscally, and ethically responsible manner. This essential, in conjunction with Essential VI, were foundational to this DNP project.

From the beginning, the DNP student engaged with clinical leadership, members of the quality and safety team, and front-line clinicians to identify a problem and implement and EBP solution using the FOCUS-PDSA process. This project involved building relationships with key stakeholders to drive and implement change. The student had to be able to demonstrate an ethical and inclusive approach to build trust and engagement amongst a multidisciplinary team. The DNP gained crucial experience in navigating a complex organizational matrix and learned essential skills regarding building fiscally responsible business practices to support improvements in healthcare delivery through optimized MR workflow procedures.

Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice

The ability to collect, validate, analyze, and apply current research into clinical practice is a cornerstone of DNP education. The DNP student learns to critically evaluate current literature

and other available evidence to determine whether it is appropriate to systematically incorporate into practice. Incorporation is done in various ways such as the development of new processes or clinical practice guidelines, the application of evidence to quality improvement projects, or the adoption of new technology. Once current best practice is implemented it is also critical for the DNP graduate to be able to evaluate outcomes and disseminate findings to share their findings with the broader healthcare research community.

A primary goal of this DNP project was to develop an EBP initiative to improve the quality and safety of patient care. The DNP student performed an extensive literature search and spent significant time reviewing the evidence to determine the need for this project. The student determined that MR process issues were important and relevant enough to warrant a practice change. The evidence that was available was abundant, but the quality of evidence was variable, and findings were inconclusive. The body of literature that was evaluated contributed to overall design of the project with the goal being to improve the EHR MR process. The project was implemented by the student to improve patient safety related to medication use in a way that could be easily replicated in the future. The DNP student plans to disseminate their findings both internally within UPHS and externally to reach a broader audience.

Essential IV: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

A comprehensive understanding of technology is imperative in modern healthcare. The DNP graduate must be able to exhibit appropriate knowledge and understanding various healthcare information systems and patient care technologies that impact patient care and provider workflows. Technology is at the core of providing safe, high-quality, and efficient

patient care. Multifunctional EHRs are essential to improving MR processes (Upadhyay & Opoku-Agyeman, 2023).

The DNP student relied on their own clinical experience to guide them and built relationships with EHR and IS experts to further expand their acumen throughout all stages of the project. The literature search and experiential engagement hours on MR offered opportunities for the DNP student to learn about many new technologies aimed at imrpoving MR processes such as telemedicine visits by a Pharmacy Technician, engaging patients in MR through the patient portal, and utilization of a secure messaging SMMRT tool (Brady et al., 2022; Ebbens et al., 2021; Kane-Gill et al., 2020). Finally, the project offered an opportunity for the DNP student to gain in-depth knowledge of the EPIC EHR system, which is widely used throughout the US.

Essential VI: Inter-Professional Collaboration for Improving Patient and Population Health Outcomes

The ability to collaborate effectively with a multidisciplinary team is critical to improving healthcare delivery. The DNP graduate will be prepared to employ effective communication strategies, direct interprofessional teams, and provide consultative services to evaluate and identify solutions to complex clinical problems within multifaceted organizations. Essential VI was integral to the success of this DNP project and for its long-term ustainability.

Early on in DNP project development the DNP student enlisted the support of a physician champion and a clinical director of nursing, who also served as a subject matter expert on MR. These two team members served as pillars of support to recruit other key stakeholders including members of the quality and safety team, IS support, EPIC- PennChart experts, MR workgroups focused on QI initiatives, operational leaders, office support staff, and frontline clinicians. Using these connections, years of leadership experience and training, and skills obtained throughout the

DNP program the student was able to work in concert with the multidisciplinary team to develop, implement and evaluate a successful QI project in an emotionally intelligent way.

Essential VIII: Advanced Nursing Practice

The eight DNP essential involves combining clinical nursing expertise and the ongoing development of advanced nursing skills to deliver high-quality, patient-centered care. The complexity of health care today is unprecedented. The DNP graduate will be prepared to practice responsibly and confidently in an EBP format while understanding that practice will continue to change as technology and disease processes evolve. This project allowed the DNP student to utilize and build upon their clinical and leadership experience. They evaluated a complex problem and navigated many steps that allowed them to better understand the complexity of MR and identify ways to ensure their own competency moving forward. The role and impact of advanced practice nursing on this DNP project was outlined in detail in a previous section.

Conclusion

Overall, this project was deemed a success by the DNP student. Provider completion of MR in the EHR improved significantly. The student gained incredible knowledge and experience regarding EBP, organizational and systems leadership, and how to integrate quality improvement methodologies into everyday clinical practice. The project contributed to the body of evidence surrounding MR process improvement in a meaningful way. The standardized EHR MR workflow recommended during project implementation is a cost-effective and sustainable method that should continue to be utilized while additional opportunities and technologies to improve the quality and efficiency of MR workflows are explored. Continuous MR QI process evaluation and improvement efforts are critical to patient safety and provider well-being.

References

Aberg, J.A., Blankson, J., Marrazzo, J., & Adimora, A.A. (2017). Diversity in the US Infectious Diseases workforce: Challenges for women and underrepresented minorities. *The Journal of Infectious Diseases*, 216(5), S606-S610. https://doi.org/10.1093/infdis/jix332.

Abrahamsen, B., Hansen, R. N., & Rossing, C. (2020). For which patient subgroups are there positive outcomes from a medication review? A systematic review. *Pharmacy Practice (1886-3655), 18*(4), 1-8. https://doi.org/10.18549/PharmPract.2020.4.1976

Abuzied, Y., Alshammary, S. A., Alhalahlah, T., & Somduth, S. (2023). Using FOCUS-PDSA quality improvement methodology model in healthcare: Process and outcomes. *Global Journal on Quality and Safety in Healthcare, 6*(2), 70-72. https://doi.org/10.36401/JQSH-22-19

Agency for Healthcare Research and Quality (AHRQ). (2019, September 7). *Medication reconciliation*. Patient Safety Network. https://psnet.ahrq.gov/primer/medication-reconciliation

Agency for Healthcare Research and Quality (AHRQ). (2022, August). *What is patient experience?* https://www.ahrq.gov/cahps/about-cahps/patient-experience/index.html

Alghanem, S. S., Bayoud, T. P., Taher, S., Al-Hazami, M., Al-Kandari, N., & Al-Sharekh, M. (2022). Introduction of an ambulatory care medication reconciliation service in dalysis patients: Positive impact on medication prescribing and economic benefit. *Journal of Patient Safety, 18*(2), e489-e495. https://doi.org/10.1097/PTS.0000000000000853

American Association of Colleges of Nursing (AACN). (2006). *The essentials of doctoral education for advanced nursing practice*. http://www.aacn.nche.edu/DNP/pdf/Essentials.pdf

Anderson, L. J., Schnipper, J. L., Nuckols, T. K., Shane, R., Le, M. M., Robbins, K., Pevnick, J. M., & group, Members of the P. H. A. R. M. -D. C. (2019). Effect of medication reconciliation interventions on outcomes: A systematic overview of systematic reviews. *American Journal of Health-System Pharmacy, 76*(24), 2028-2040. https://doi.org/10.1093/ajhp/zxz236

Beieler, A. M., Yoke, L. H., Liu, C., Pergam, S. A., Wald, A., & Dhanireddy, S. (2021). Advanced practice providers in the infectious disease workforce: A nationwide utilization survey. *Journal of Interprofessional Education & Practice, 24*, 100448. https://doi.org/10.1016/j.xjep.2021.100448

Bitan, Y., Parmet, Y., Greenfield, G., Teng, S., Cook, R. I., & Nunnally, M. E. (2019). Making sense of the cognitive task of medication reconciliation using a card sorting task. *Human Factors, 61*(8), 1315-1325. https://doi.org/10.1177/0018720819837037

Brady, J. E., Linsky, A. M., Simon, S. R., Yeksigian, K., Rubin, A., Zillich, A. J., & Russ-Jara, A. L. (2022). The perceived effectiveness of secure messaging for medication reconciliation during transitions of care: Semistructured interviews with patients. *JMIR Human Factors, 9*(3), e36652. https://doi.org/10.2196/36652

Centers for Medicare & Medicaid Services (CMS). (2023). *Search the physician fee schedule*. https://www.cms.gov/medicare/physician-fee-schedule.

Deep, L., Schneider, C. R., Moles, R., Patanwala, A. E., Do, L. L., Burke, R., & Penm, J. (2021). Pharmacy student-assisted medication reconciliation: Number and types of medication discrepancies identified by pharmacy students. *Pharmacy Practice (1886-3655), 19*(3), 1-6. https://doi.org/10.18549/PharmPract.2021.3.2471

Dobish, R., Baumgarten, C., Folkman, F., & Carole, R. C. (2021). Medication reconciliation in ambulatory oncology new patient clinics. *Journal of Oncology Pharmacy Practice, 27*(7), 1637-1643. https://doi.org/10.1177/1078155220964247

Ebbens, M. M., Gombert-Handoko, K. B., Wesselink, E. J., & van den Bemt, Patricia M.L. A. (2021). The effect of medication reconciliation via a patient portal on medication discrepancies: A randomized noninferiority study. *Journal of the American Medical Directors Association, 22*(12), 2553-2558.e1. https://doi.org/10.1016/j.jamda.2021.03.022

Elbeddini, A., Almasalkhi, S., Prabaharan, T., Tran, C., Gazarin, M., & Elshahawi, A. (2021). Avoiding a Med-Wreck: a structured medication reconciliation framework and standardized auditing tool utilized to optimize patient safety and reallocate hospital resources. *Journal of Pharmaceutical Policy and Practice, 14*(1), 10. https://doi.org/10.1186/s40545-021-00296-w

Famiyeh, I. M., Jobanputra, N., & McCarthy, L. M. (2021). Best possible medication histories by registered pharmacy technicians in ambulatory care. *The Canadian journal of hospital pharmacy*, *74*(2), 149–155.

Garfield, S., Furniss, D., Husson, F., Etkind, M., Williams, M., Norton, J., Ogunleye, D., Jubraj, B., Lakhdari, H., & Franklin, B. D. (2020). How can patient-held lists of medication enhance patient safety? A mixed-methods study with a focus on user experience. *BMJ Quality & Safety, 29*(9), 764. https://doi.org/10.1136/bmjqs-2019-010194

Gionfriddo, M. R., Duboski, V., Middernacht, A., Kern, M. S., Jove Graham, & Wright, E. A. (2021). A mixed methods evaluation of medication reconciliation in the primary care setting. *PLoS One, 16*(12), e0260882. https://doi.org/10.1371/journal.pone.0260882

HealthIT.gov. (2019). *Frequently asked questions: What is an electronic health record?* https://www.healthit.gov/faq/what-electronic-health-record-ehr

Herledan, C., Baudouin, A., Larbre, V., Gahbiche, A., Dufay, E., Alquier, I., Ranchon, F., & Rioufol, C. (2020). Clinical and economic impact of medication reconciliation in cancer patients: a systematic review. *Supportive Care in Cancer, 28*(8), 3557-3569. https://doi.org/10.1007/s00520-020-05400-5

Infectious Disease Society of America (IDSA). (2023). *Value of ID.* https://www.idsociety.org/value-of-id/

Institute for Healthcare Improvement (IHI). (2023). *Science of Improvement: Testing changes: Model for improvement: Plan-Do-Act-Study cycles*. https://www.ihi.org/resources/Pages/HowtoImprove/ScienceofImprovementTestingChanges.aspx

Institute for Patient- and Family-Centered Care (IPFCC). (n.d.). *Defining ambulatory care*. https://www.ipfcc.org/bestpractices/ambulatory-care/defining-ambulatory-care.html

Jarrett, T., Cochran, J., & Baus, A. (2020). Applying the medications at transitions and clinical handoffs toolkit in a rural primary care clinic: Implications for nursing, patients, and caregivers. *Journal of Nursing Care Quality, 35*(3), 233-239. https://doi.org/10.1097/NCQ.0000000000000454

Johansson, K. S., Kornholt, J., Bülow, C., Petersen, T. S., Perrild, H., Rungby, J., & Christensen, M. B. (2023). Physician-led medication reviews in polypharmacy patients treated with at least 12 medications in a type 2 diabetes outpatient clinic: A randomised trial. *Diabetic Medicine*, 40, e15052. https://doi.org/10.1111/dme.15052

Kane-gill, S. L., Wong, A., Culley, C. M., Perera, S., Reynolds, M. D., Handler, S. M., Kellum, J. A., Aspinall, M. B., Pellett, M. E., Long, K. E., Nace, D. A., & Boyce, R. D. (2020). Transforming the medication regimen review process using telemedicine to prevent adverse events. *Journal of the American Geriatrics Society*, 69(2), 530-538. https://doi.org/10.1111/jgs.16946

Kim, M., Mallory, C., & Valerio, T. D. (2022). *Statistics for evidence-based practice in nursing*. Jones & Bartlett Learning.

Lin, H. L., Wu, D. C., Cheng, S. M., Chen, C. J., Wang, M. C., & Cheng, C. A. (2020). Association between electronic medical records and healthcare quality. *Medicine*, *99*(31), e21182. https://doi.org/10.1097/MD.0000000000021182

Linkens, A. E. M. J. H., Milosevic, V., Van der Kuy, P. H. M., Damen-Hendriks, V. H., Mestres Gonzalvo, C., & Hurkens, K. P. G. M. (2020). Medication-related hospital admissions and readmissions in older patients: an overview of literature. *International Journal of Clinical Pharmacy*, *42*(5), 1243–1251. https://doi.org/10.1007/s11096-020-01040-1

McCahon, D., Denholm, R. E., Huntley, A. L., Dawson, S., Duncan, P., & Payne, R. A. (2021). Development of a model of medication review for use in clinical practice: Bristol medication review model. *BMC Medicine*, *19*(1), 1-262. https://doi.org/10.1186/s12916-021-02136-9

McCahon, D., Duncan, P., Payne, R., & Horwood, J. (2022). Patient perceptions and experiences of medication review: qualitative study in general practice. *BMC Primary Care*, *23*, 1-10. https://doi.org/10.1186/s12875-022-01903-8

Melnyk, B.M., Tan, A., Hsieh, A.P. and Gallagher-Ford, L. (2021). Evidence-based practice culture and mentorship predict EBP implementation, nurse job satisfaction, and intent to stay: Support for the ARCC© Model. Worldviews on Evidence-Based Nursing, 18: 272-281. https://doi.org/10.1111/wvn.12524

Miller, D., Ramsey, M., L'Hommedieu, T. R., & Verbosky, L. (2020). Pharmacist-led transitions-of-care program reduces 30-day readmission rates for Medicare patients in a large health system. *American Journal of Health-System Pharmacy, 77*(12), 972-978. https://doi.org/10.1093/ajhp/zxaa071

Mishra, V., Liebovitz, D., Quinn, M., Kang, L., Yackel, T., & Hoyt, R. (2022). Factors that influence clinician experience with electronic health records. *Perspectives in health information management*, *19*(1), 1f.

Mulder, M. B., Doga, B., Borgsteede, S. D., Van den Burg, A. M., Metselaar, H. J., Den Hoed, C. M., & Hunfeld, N. G. M. (2022). Evaluation of medication-related problems in liver transplant recipients with and without an outpatient medication consultation by a clinical pharmacist: A cohort study. *International Journal of Clinical Pharmacy, 44*(5), 1114-1122. https://doi.org/10.1007/s11096-022-01423-6

Nicosia, F. M., Spar, M. J., Stebbins, M., Sudore, R. L., Ritchie, C. S., Lee, K. P., Rodondi, K., & Steinman, M. A. (2020). What is a medication-related problem? A qualitative study of older adults and primary care clinicians. *Journal of general internal medicine*, *35*(3), 724–731. https://doi.org/10.1007/s11606-019-05463-z

Penn Medicine (2022). *Division of Infectious Diseases*. https://www.pennmedicine.org/departments-and-centers/department-of-medicine/divisions/infectious-diseases/about-us

Penn Medicine (2023). *Facts & figures of 2023: The makings of medical milestones.* https://www.pennmedicine.org/news/publications-and-special-projects/facts-and-figures.

Pereira, F., Bieri, M., Maria del Rio Carral, Martins, M. M., & Verloo, H. (2022). Collaborative medication management for older adults after hospital discharge: a qualitative descriptive study. *BMC Nursing, 21*, 1-16. https://doi.org/10.1186/s12912-022-01061-3

Perera, A. (2023, September 7). *Hawthorne effect: Definition, how it works, and how to avoid it*. Simple Psychology. https://www.simplypsychology.org/hawthorne-effect.html

Rangachari, P., Dellsperger, K. C., Fallaw, D., Davis, I., Sumner, M., Ray, W., Fiedler, S., Nguyen, T., & Rethemeyer, R. K. (2019). A mixed-method study of practitioners' perspectives on issues related to EHR medication reconciliation at a health system. *Quality Management in Health Care, 28*(2), 84-95. https://doi.org/10.1097/QMH.0000000000000208

Rodziewicz, T.L., Houseman, B., & Hipskind, J.E. (2023, May). *Medical error reduction and prevention*. StatPearls: National Library of Medicine. https://www.ncbi.nlm.nih.gov/books/NBK499956/.

Simkus, J. (2023, July 31). *Observer bias: Definition, examples, and prevention*. Simple Psychology. https://www.simplypsychology.org/observer-bias-definition-examples prevention.html

The Joint Commission (TJC). (2021). *National Patient Safety Goals® effective January 2021 for the ambulatory health care program.* Department of Standard and Survey Methods (DSSM). https://www.jointcommission.org/-/media/tjc/documents/standards/national-patient-safety-goals/2021/npsg_chapter_ahc_jan2021.pdf

Upadhyay, S. & Opoku-Agyeman, W. (2023). Implementation levels of electronic health records and their influence on quality and safety. *Online Journal of Nursing Informatics (OJNI), 26*(3), https://www.himss.org/resources/online-journal-nursing-informatics.

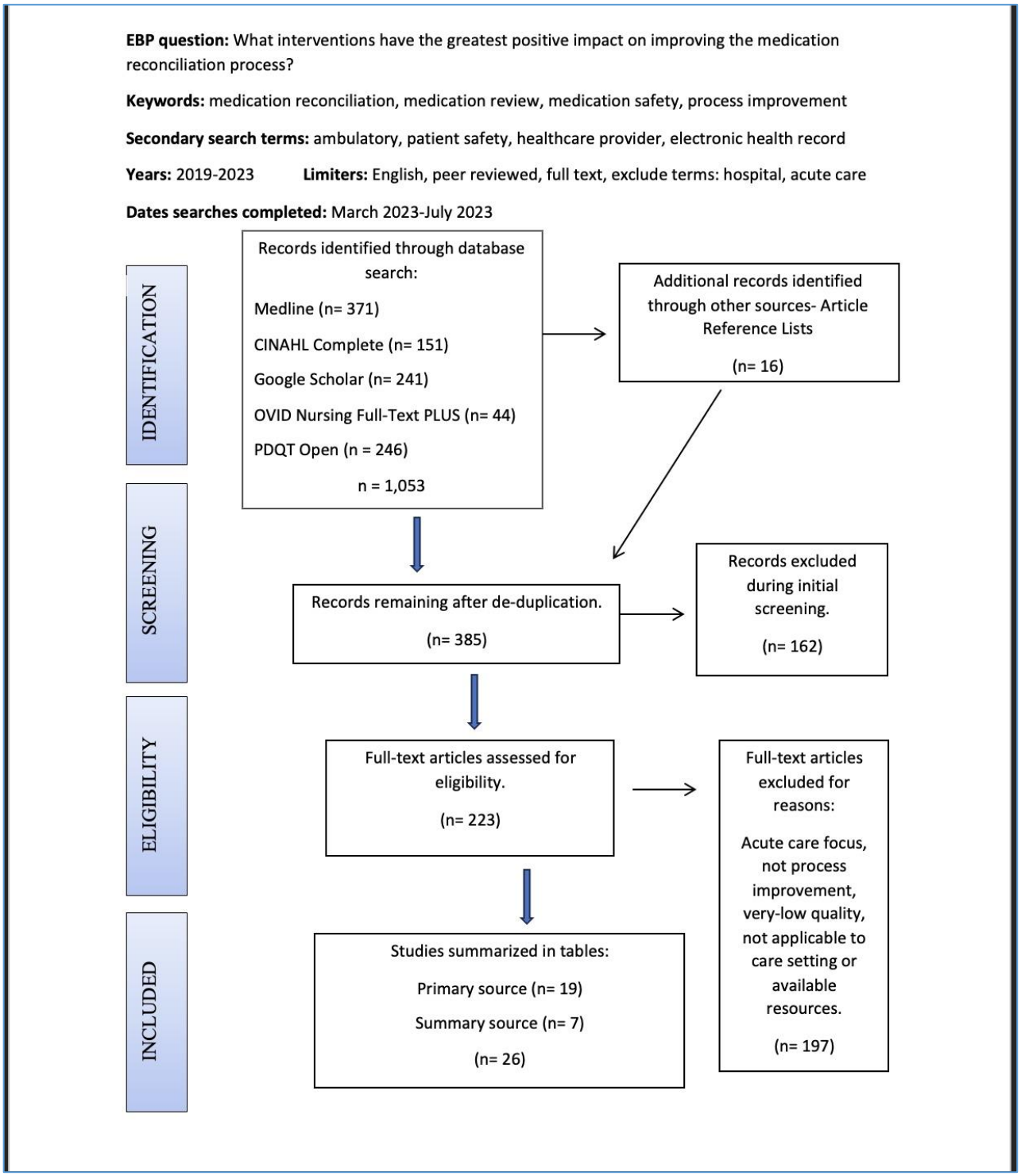
Van der Nat, D. J., Huiskes, V. J. B., Van der Maas, A., Derijks-Engwegen, J., Van Onzenoort, H. A. W., & Van den Bemt, Bart J. F. (2022). The value of incorporating patient-consulted medication reconciliation in influencing drug-related actions in the outpatient rheumatology setting. *BMC Health Services Research, 22*(1), 1-10. https://doi.org/10.1186/s12913-022-08391-7

Vega, T. G., Sierra-Sánchez, J. F., Martínez-Bautista, M. J., García-Martín, F., Suárez-Carrascosa, F., & Baena-Cañada, J. M. (2016). Medication reconciliation in oncological patients: A randomized clinical trial. *Journal of Managed Care & Specialty Pharmacy, 22*(6), 734-740. https://doi.org/10.18553/jmcp.2016.15248

Yuan, C. T., Dy, S. M., Yuanhong Lai, A., Oberlander, T., Hannum, S. M., Lasser, E. C., Heughan, J., Dukhanin, V., Kharrazi, H., Kim, J. M., Gurses, A. P., Bittle, M., Scholle, S. H., & Marsteller, J. A. (2022). Challenges and strategies for patient safety in primary care: A qualitative study. *American Journal of Medical Quality: The Official Journal of the American College of Medical Quality, 37*(5), 379-387. https://doi.org/10.1097/JMQ.0000000000000054

Appendix A

Search Strategy Schematic



Appendix B

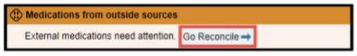
Best Practice EHR MR Workflow Tip Sheet

PennChart Tip Sheet

Medication Reconciliation: Best Practice Workflow

WILMINGTON UNIVERSITY

1. If there are new medications from outside sources, an orange banner will appear at the top of **Meds & Orders**. If the banner shows, this is where to start medication reconciliation.To access, *click* **Go Reconcile**.



   a. This opens the medications tab in the **Reconcile Outside Information** activity.
   b. A list of medications, along with the reporting source and date will display. Detailed information about functionality in this activity is available in this tip sheet: Care Everywhere Reconciler.
2. Review each medication listed in **Medication Management** tab.
3. Columns selected during customization will display to the right on each row. Hover over an icon if you're not sure what it represents.
   a. *Click* the check box to verify the patient is taking a medication.
   b. *Click* the **X** to remove a medication.
   c. To reorder, *click* on the clockwise circle arrow.
   d. *Click* the downward chevron to reveal more medication detail.

4. Add medications to the list by *clicking* on the **Patient-Reported** button at the top.

PennChart Tip Sheet

5. The final step in medication reconciliation is to *click* **Mark as Reviewed.** This confirms review was completed by the user and time stamps when it was performed. **This is how the department measures completion of medication reconciliation.**

Appendix C

CITI Training Certificate

CITI PROGRAM

Completion Date 07-May-2023
Expiration Date 07-May-2026
Record ID 55670139

This is to certify that:

Elizabeth Walls

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Human Subjects Research
(Curriculum Group)
Health Professions - Human Subjects Research
(Course Learner Group)
1 - Basic
(Stage)

Under requirements set by:

Wilmington University

CITI
Collaborative Institutional Training Initiative

101 NE 3rd Avenue, Suite 320
Fort Lauderdale, FL 33301 US
www.citiprogram.org

Verify at www.citiprogram.org/verify/?w7d6da2b3-50a6-477d-a888-b8ee5b304833-55670139

Appendix D

HSRC Application- includes Organization and IRB Approval

WILMINGTON UNIVERSITY
HUMAN SUBJECTS REVIEW COMMITTEE (HSRC) HSRC-1

RECORD AND REVIEW OF DOCTOR OF NURSING PRACTICE (DNP) PROJECT

Researcher: Walls (Last) Elizabeth (First) J (Middle Initial)

WilmU Student Email: ewalls005@my.wilmu.eduClick or tap here to enter text.

Student ID W00348999

DNP Project Advisor: Dr. Lisa Drews

DNP Project Advisor's Email: lisa.m.drews@wilmu.edu

Academic Level

☒ 1. DNP Project

Forms Check List

☒ 1. CITI Training Certificate*
*Check with your DNP Program Chair for training requirements
*Training certificate cannot be older than three years

☐ 2. Instrument(s)

☒ 3. Internal and/or External Research Approval Letter

☐ 4. Other: Click or tap here to enter text.

This section is to be completed by the HSR Committee

Archive Number: Click here to enter text.

Research Category: Choose an item.

Final Approval Date: Click here to enter a date.

REV May 1, 2023 version 1.0

WILMINGTON UNIVERSITY

WILMINGTON UNIVERSITY
HUMAN SUBJECTS REVIEW COMMITTEE (HSRC) HSRC-2

Complete This Worksheet Prior to Completing This Form

Purpose: The purpose of this worksheet is to provide support for making Quality Improvement Project determinations when there is uncertainty regarding whether the quality activity contains Human Subjects.

Directions: For a proposed DNP project to be classified as containing only Quality Improvement activities—which permits use of the DNP HSRC form—answers to all of the questions in the worksheet must be 'TRUE' for each activity proposed in the DNP project. If one or more answers is 'FALSE', the project requires completion of the HSRC standard form and committee review.

TRUE	FALSE	
☒	☐	The intent of the proposed activity is to assess and/or improve the quality of a practice, product or program to ensure established educational, clinical or program service standards are met or best evidentiary practices attained.
☒	☐	No activity proposed provides less than standard of care, services or instruction to participants.
☒	☐	No practice, product or program changes proposed are experimental and no test interventions or research questions are added that go beyond established or evidentiary best practice.
☒	☐	The proposed activity does not: (1) include a 'control group' in whom care, products, services or educational instruction are intentionally withheld to allow an assessment of its efficacy or (2) assign participants to receive different procedures, therapies or educational instruction based on a pre-determined plan such as randomization.
☒	☐	The proposed activity does not involve the prospective evaluation of a drug, procedure or device that is not currently approved by the FDA for general use (including "off-label" indications).
☒	☐	The proposed activity does not test an intervention or add research questions that go beyond established evidentiary best practice and/or are intended to generate generalizable knowledge.
☒	☐	The proposed activity would not increase harm—physical, psychological, social or economic—than would normally be encountered by the individual if s/he was not participating in this activity.
☒	☐	The lead person on the project has organizational responsibility and authority to recommend or impose a corrective action plan based on the outcome(s) of the activity, as applicable.
☒	☐	Interpretation of the data or any feedback to those who would benefit from the findings will not be deliberately delayed.
☒	☐	The proposed activity has merit and will likely be conducted regardless of any possibility of publication or presentation that may result from it.

REV May 1, 2023 version 1.0

WILMINGTON UNIVERSITY

WILMINGTON UNIVERSITY
HUMAN SUBJECTS REVIEW COMMITTEE (HSRC) HSRC-3

Adapted from Rutgers HRP-309 (2017) with permission from Judith Neubauer, PhD.

DNP Project Information

Working title of DNP Project:

Development and Evaluation of a Nurse Practitioner-Directed Standardized Medication Reconciliation Process in an Ambulatory Infectious Disease Practice

Problem Description: provide a short summary of clinical practice problem you will address with your DNP project. What is the gap in practice and what evidence will you be translating to practice? What is the evidence-based practice change purpose? Include key literature citations (references) and information (1 paragraph)

Medication reconciliation (MR) is the process of comparing a healthcare provider's (HCP) list of prescribed medications to a list, or bottles, of the medications that the patient has been taking. MR is most crucial during periods of transition such as at hospital discharge, from rehab to home, or when transitioning between various HCP for care (Medication Reconciliation, 2019). The goal of MR is to identify and address medication discrepancies, avoid medication errors, and ultimately reduce patient harm. It is a critical aspect of safe patient care (Anderson et al., 2019). Currently, the ambulatory Infectious Disease (ID) practice of focus approaches MR through variable electronic health record (EHR) processes. MR is inconsistently completed by the HCPs. The department had a goal of 90% completion rate per HCP and most HCPs did not come close. The literature demonstrates a variety of different interventions for improving MR process in the ambulatory setting, but quality of evidence is limited and for many (i.e., pharmacist-led) there are resource barriers (Anderson et al., 2019; Herledan et al., 2020). A common theme found is that consistency in approach, despite the actual intervention, is positively correlated with improved MR and that is this student's focus (Gionfriddo et al., 2021; Herledan et al., 2020). This student intends to develop and implement a best practice, standardized electronic health record (EHR) process. ID patients often take one or more high-risk medications and have complex medical comorbidities, thus are likely to have significant benefit from a more effective MR process (Herledan et al., 2020).

External Projects

If the DNP project will involve other organizations, it is necessary to obtain permission from these organizations prior to collecting data. Some organizations have Institutional Review Boards (IRBs), and it may be necessary to obtain formal approvals from these IRBs. In other cases, a document from an appropriate organizational executive specifically approving the DNP project would be sufficient. The DNP student is responsible for determining what type of approval is required and obtaining the approval.

In cases where approval from Wilmington University's HSRC is required as a precondition to obtaining approval from another organization, the HRSC's approval will be provisional, requiring the additional step of obtaining DNP project approval documents from other organizations before receiving full approval from Wilmington University's HSRC.

	YES	NO
Does the DNP project involve other organizations?	☒	☐

If the DNP project involves other organizations, please answer these questions.

	YES	NO
Do these organizations require approval by their IRBs?	☒	☐
Has IRB approval been obtained? If **YES**, please attach the approval to this submission	☐	☒
Have other permission documents been obtained? If **YES**, please attach the approvals to this submission.	☒	☐

Other relevant information or comments:

It was determined that this project does not meet the definition of human subjects' research through Penn Medicine and therefore, further IRB review is not required (documentation attached)

Internal Research

If the DNP project will involve collecting quantitative (including survey) and/or qualitative data from Wilmington University, its students, or employees, it is necessary to obtain permission from the University. The appropriate WilmU Academic Affairs AVP will render consideration of permission for the DNP project via the HSRC Internal Research Request process. The approval email (document) must be attached to this protocol submission.

	YES	NO
Does this DNP project involve collecting Wilmington University data?	☐	☒

*If **YES**, please attach the approval email to this submission.*

Population Information

Population of DNP project: Gender Mixed Age 18+ Race/ethnicity Mixed

PICOT Question:
Include the PICOT Question in a complete sentence and then break down each section, Population -; Intervention -; Comparison -; Outcome -; Time -. Include sufficient detail so that someone unfamiliar with the project would understand all aspects of the proposed DNP project.

For Advanced Practice Providers (APPs) and Physicians in an ambulatory Infectious Disease (ID) practice, how does implementing one standardized electronic health record (EHR) medication reconciliation process, compared with the current variable practice, impact their completion rate of MR, over a period of six weeks?

P- APPs and Physicians in Ambulatory ID practice
I- Single Standardized EHR MR process
C- Current three variable EHR MR processes
O- Provider completion rate of MR in the EHR
T- Six weeks

How many participants (patients, providers, etc.) are anticipated for the DNP project?

Approximately 10 Advanced Practice Providers (APP) and Physicians

What inclusion criteria will be used to identify the DNP project participants (how will participants be selected for participation from PICOT question)?

Physicians/APPs with an MR completion percentage of ninety percent or less at baseline (> 90% is system goal). Physicians/APPs are responsible for final sign off on MR completion. Must provide care for patients within the ambulatory ID practice at the Perelman Center (Penn Medicine) in Philadelphia, PA.

What criteria will be used to exclude the DNP project participants (how will participants be excluded from participation?

Physicians/APPs that do not see patients in clinic at least 1 day/week. Physicians/APPs that will have parental leave, paid time off, or other leave of absence of > 1 week during the intervention period.

What are the procedures the participants will undergo in the proposed DNP project including the physical location and duration of participation? Provide a step-by-step outline of the project from start to finish.

Describe where the DNP instruments are derived; if using a validated tool, explain its origin, authors, and attach acquired permissions (email or letter).

Attach a copy of all DNP instruments, e.g., surveys, questionnaires, interview questions (if being utilized).

Current process: 3 variable processes to complete MR within the EHR that do not consistently result in completion of MR.

Proposed Intervention: Outline a single best practice EHR MR process in conjunction with the Department Quality and Safety committee. Create laminated visual aids and tip sheets to be posted throughout the office. Provide education to Physicians/APPs responsible for completing the MR process.

Student will identify baseline completion rates of MR by ID provider. Data already available via Tableau dashboard.

Over a period of 6 weeks, all clinical staff participating in the project will be asked to consistently use the same, single EHR process for every patient encounter for MR data entry.

At the end of six weeks, the student will reexamine the MR completion Tableau dashboard and identify any significant change.

Student will analyze data and share findings with physician champion, the ID HCP and staff, clinical operations team, quality and safety committee, and any other key stakeholders within the organization. Findings will be presented to the meeting of the Vice Chairs of Quality for all of the faculty practices. The student plans to publish findings in a peer-reviewed journal and/or present at a local or national conference.

Confidentiality and Security

Select **YES** to certify that:

	YES	N/A
Procedures have been taken to ensure that individuals cannot be identified via names, digital identifiers (e.g., email address, IP address), images or detailed demographic information.	☒	☐
Code to name association data/information is securely and separately stored. (Participants are given codes and the codes are securely stored separately from their answers.)	☒	☐
All data is maintained in encrypted and/or password protected digital/electronic files.	☒	☐
Individually identifiable information will be securely maintained for three years past the completion of the research, and then destroyed rendering the data unusable and unrecoverable.	☒	☐

Describe the procedures you are taking to maintain anonymity, confidentiality, or information security.

MR completion data is already readily available and pulled from EPIC into a Tableau Dashboard. All survey data analysis will be stored on a password protected laptop. Tableau dashboard will only be accessed on the same laptop on a secure Penn Medicine network on campus or via a virtual private network (VPN) when off campus. The password will be changed at least every 90 days

WILMINGTON UNIVERSITY

WILMINGTON UNIVERSITY
HUMAN SUBJECTS REVIEW COMMITTEE (HSRC) HSRC-8

DNP Protocol

Does this DNP project involve?

	YES	NO
Prisoners, probationers, pregnant women (if there is a medical procedure or special risk relating to pregnancy), fetuses, the seriously ill or mentally or cognitively compromised adults, or minors (under 18 years) as participants	☐	☒
The collection of information regarding sensitive aspects of the participants behavior (e.g., drug, or alcohol use, illegal conduct, sexual behavior)	☐	☒
The collection or recording of behavior which, if known outside the research, could place the participants at risk of criminal or civil liability or could be damaging to the participant's financial standing, employability, insurability, or reputation	☐	☒
Procedures to be employed that present more than minimal risk[1] to participants	☐	☒
Deception	☐	☒
Possible or perceived coercion (e.g., a concern in power relationships such as teacher/student, employer/employee, senior/subordinate)	☐	☒
Benefits or compensation to participants (beyond the general benefits of the knowledge to be gained or small gifts/lottery prizes)	☐	☒
A conflict of interest/grant funded research (e.g., the researcher's material or other interests may bias collection, interpretation, or use of data)	☐	☒

If you answered "**NO**" to all of the questions, please proceed to the next page.

If you answered "**YES**" to any of the questions, provide evidence that you have taken the training module(s) that relate to this risk and discuss what you learned about reducing the risk or mitigating bias from the training in the textbox below and/or by attaching the evidence to this document.

Click here to enter text.

[1] Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the proposed research are not greater than those ordinarily encountered in everyday life or during the performance of routine physical or psychological examinations or tests

REV May 1, 2023 version 1.0

DNP data, including signed consent form documents, will be retained for a minimum of three years past the completion of the research in accordance with federal regulations	☒
The DNP student will submit document and form revisions and updates, as appropriate	☒
The DNP student will submit a renewal petition if the data collection has not been completed within one year of the most recent HSRC approval*	☒

* **Note**: HSRC approval expires after one year, requiring renewal of the HSRC Protocol

The DNP student's signature below certifies that they have (a) read and understand the obligations as a DNP student, (b) DNP project approval expires one year after the final approval date shown on page 1, and (c) that the information contained in and submitted with this HSRC protocol is accurate and complete.

DNP Student:

Print name: Elizabeth J Walls

Signature:  Date: 8/5/2023

Obligations of the DNP Project Advisor

The DNP project advisor has two major obligations. First, the DNP project advisor must ensure the DNP student completes all relevant training courses. Second, the DNP project advisor must ensure the DNP student submits all document and form revisions and updates, as appropriate for the research.

The DNP project advisor's signature below certifies that they have (a) read and understand the obligations as a DNP project advisor and (b) that the information contained in and submitted with this HSRC protocol is accurate and complete. **A revised signature and date are required with modifications/each submission.**

DNP Project Advisor:

Print name: Dr. Lisa Drews

Signature: Dr. Lisa Drews signature Date: 8/6/2023

DNP Project advisor's CITI certificate expiration date: Click or tap to enter a date.

WILMINGTON UNIVERSITY

WILMINGTON UNIVERSITY
HUMAN SUBJECTS REVIEW COMMITTEE (HSRC) HSRC-10

PROTOCOL REVIEW

This section is to be completed by the HSR Committee.

DNP Student: Elizabeth J. Walls

Date Submitted: 8/12/2023

The protocol and attachments were reviewed:

The proposed research is approved as:

☒ Exempt ☐ Expedited ☐ Full Committee

☐ Provisional (see External Research section) Provisional Date: Click or tap to enter a date.

The proposed DNP project was approved pending the following changes:

☐ See attached letter

☐ Resubmit changes to the HSRC chairperson

The proposed research was disapproved:

☐ See attached letter for more information.

HSRC Chair or Representative Angela Herman, DNP, RN
Printed Name

Angela Herman, DNP, RN
Signature Date 8/14/2023

HSRC Chair or Representative Click here to enter text.
Printed Name

Signature Date Click here to enter a date.

REV May 1, 2023 version 1.0

References

Anderson, L. J., Schnipper, J. L., Nuckols, T. K., Shane, R., Le, M. M., Robbins, K., Pevnick, J. M., & group, Members of the P. H. A. R. M. -D. C. (2019). Effect of medication reconciliation interventions on outcomes: A systematic overview of systematic reviews. *American Journal of Health-System Pharmacy, 76*(24), 2028-2040. https://doi.org/10.1093/ajhp/zxz236

Gionfriddo, M. R., Duboski, V., Middernacht, A., Kern, M. S., Jove Graham, & Wright, E. A. (2021). A mixed methods evaluation of medication reconciliation in the primary care setting. *PLoS One, 16*(12), e0260882. https://doi.org/10.1371/journal.pone.0260882

Herledan, C., Baudouin, A., Larbre, V., Gahbiche, A., Dufay, E., Alquier, I., Ranchon, F., & Rioufol, C. (2020). Clinical and economic impact of medication reconciliation in cancer patients: a systematic review. *Supportive Care in Cancer, 28*(8), 3557-3569. https://doi.org/10.1007/s00520-020-05400-5

Medication Reconciliation. (2019, September 7). *Patient Safety Network.* https://psnet.ahrq.gov/primer/medication-reconciliation

Appendix 1- Penn Medicine QI IRB Review

From: IRB Quality Initiative <PROVOST-IRB-QUALITY@pobox.upenn.edu>
Sent: Thursday, July 20, 2023 1:28 PM
To: Walls, Elizabeth J <Elizabeth.Walls@Pennmedicine.upenn.edu>; IRB Quality Initiative <PROVOST-IRB-QUALITY@pobox.upenn.edu>
Subject: RE: QI/PI Determination Form for Review

Hello Beth,

It was determined that this project does not meet the definition of human subjects' research and therefore, further IRB review is not required.

This email should suffice as your documentation. Please save a copy of it for your records.

NOTE: Changes to the purpose, methods, or design of this project may alter the QI status and may require re-review.

Thank you,
Human Research Protections Program
Office of the Institutional Review Board
University of Pennsylvania
3600 Civic Center Blvd., 9th Floor
Philadelphia, PA 19104
www.upenn.edu/IRB

From: Walls, Elizabeth J <Elizabeth.Walls@Pennmedicine.upenn.edu>
Sent: Tuesday, July 18, 2023 1:09 PM
To: IRB Quality Initiative <PROVOST-IRB-QUALITY@pobox.upenn.edu>
Subject: QI/PI Determination Form for Review

Good afternoon-

Attached is a QI/PI Project Determination Form for review.
Thank you in advance for your time and consideration.

Best,
Beth Walls

Elizabeth Walls, MSN, CRNP, AACC
Director of Advanced Practice for CPUP
CPUP Administration 4W-200-11
3600 Civic Center Blvd
Philadelphia, PA 19104
Mobile: 267-854-6929
Elizabeth.Walls@pennmedicine.upenn.edu
Penn Medicine

REV May 1, 2023 version 1.0

Appendix 2- Organizational Approval Letter

UNIVERSITY OF PENNSYLVANIA HEALTH SYSTEM

Helen C. Koenig, MD, MPH
Professor of Medicine

Director, MacGregor Infection Medicine & Travel Program
University of Pennsylvania School of Medicine

Division of Infectious Diseases
Department of Medicine

July 11, 2023

College of Health Professions and Natural Sciences
Doctor of Nursing Practice Program
Wilmington University
320 N. Dupont Highway
New Castle, DE 19720 dnp@wilmu.edu

Dear DNP Program Leadership,

As the medical director for the MacGregor Infection Medicine and Travel Program at the Hospital of the University of Pennsylvania, and the Medical Director for Ambulatory Operations for the Department of Medicine, I approve the following DNP project to be completed within our ambulatory ID practice:

Elizabeth Walls, MSN, CRNP, DNP Candidate

Development and Evaluation of a Nurse Practitioner-Directed Standardized Medication Reconciliation Process in an Ambulatory Infectious Disease Practice

Please feel free to reach out with any questions.

Sincerely,

DocuSigned by:
EF097CC982554E0...

Helen C. Koenig, MD, MPH

3400 Civic Center Boulevard • 4S PCAM • Philadelphia, PA 19104 • 215-662-6932 • FAX: 215-662-7899
Email: helen.koenig@pennmedicine.upenn.edu

REV May 1, 2023 version 1.0

Appendix 3- Proposed Standard EHR Workflow for Penn Chart (EPIC)

Based on Best Practice Tip Sheet created by EPIC Team Experts

1. Access ***Medication Management*** section of Plan Activity to view, reconcile, and reorder medications.
2. Customize ***Medication Management*** section to meet individual workflow needs (tip sheets will be provided)
3. Review and confirm patient preferred pharmacy.
4. Review and reconcile any new medications from outside sources through ***Care Everywhere*** reconciler add-in.
5. Review each medication listed in ***Medication Management:***
   a. If taking, check box to verify.
   b. If not taking, click X to remove.
   c. To reorder, click clockwise circle arrow.
6. Add any medications to list through ***Patient Reported*** button at top of ***Medication Management*** section.
7. Final step: Click ***Mark as Reviewed*** button at the bottom of the section.
8. **DO NOT** reconcile medications through the **Medication History** section.

Appendix E

Data Collection Code Book

Variable	Label	Code	Data Type
Provider Type			
Physician	P	1	Nominal
Advanced Practice Provider	APP	2	
Race			
Caucasian	C	1	Nominal
Black or African American	B	2	
Hispanic or Latino	HL	3	
American Indian or Alaskan Native	AI	4	
Asian or Pacific Islander	AP	5	
Other/Multiple	OM	6	
Age	Actual Age	Actual Age	Ratio
Gender			
Identifies as Male	M	1	Nominal
Identifies as Female	F	2	
Identifies as Other	O	3	
Years of Provider Experience	YPE	Actual Value	Ratio
Years of EPIC Experience	YEE	Actual Value	Ratio
Baseline Provider MR Completion %	BMR	Actual Value	Ordinal
Post-intervention Provider MR Completion %	PIMR	Actual Value	Ordinal