DEFINING THE CHARACTERISTICS AND INSTRUMENT DEVELOPMENT OF NURSE WORKAROUNDS DURING MEDICATION ADMINISTRATION

By

Marian Savage

MSN, George Mason University, 2001

BSN, The Catholic University of America, 1997

Submitted to the graduate degree program in Nursing and the Graduate Faculty of the University of Kansas in fulfillment of the requirements for the degree of Doctor of Philosophy.

Chairperson: Shin Hye Park

Marjorie Bott

Laverne Manos

Karen Wambach

Heather Gibbs

Date Defended: December 4, 2020

The dissertation committee for Marian Savage certifies that this is the approved version of the following dissertation:

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Chairperson: Shin Hye Park

Chairperson: Marjorie Bott

Graduate Director: Becky Christian

Date Approved: January 27, 2021

Abstract

Background. Nurses may use workarounds when they circumvent or eliminate a task during the medication administration process. Environmental, technological, and systemic barriers to following medication administration protocols are some of the reasons that nurses use workarounds. There is substantial qualitative research supporting the type of workarounds nurses use during medication administration, but currently there are no instruments available to quantify the type and frequency of workarounds that nurses use during medication administration.

Aim. The purposes of this study were to: (a) complete a comprehensive literature review to understand the state of the science related to nursing workarounds and medication administration; (b) conduct a concept analysis of workarounds during the medication administration process; (c) use the findings of the concept analysis to develop an instrument to quantify the type and frequency of workarounds; and (d) to conduct initial psychometric testing of the newly developed instrument.

Design and methods. A comprehensive literature search was conducted to understand workarounds and medication administration. A concept analysis, using the Walker and Avant (2005) method, was used to define the concept, and to identify defining characteristics, antecedents, and consequences of nursing workarounds during medication administration. Using the concept analysis findings, an instrument was developed and administered to a sample of acute care registered nurses. Content validity and face validity were assessed. Preliminary psychometric analysis was conducted through exploratory factor analysis. Construct validity was assessed with comparison to the Halbesleben, Rathert and Bennett instrument, a previously validated instrument measuring the construct of nursing workarounds.

Results. Study results were reported in three manuscripts to be submitted for publication in peer-reviewed journals. Presented in the first manuscript, the results of the review determined that there is a need for continued research of nursing workarounds and a lack of a validated instrument to measure the type and frequency of workarounds when administering medications. The second manuscript included findings from a concept analysis that elucidated antecedents, eight defining characteristics, and consequences of workarounds. Eight defining characteristics were identified as either human factors or system factors that described workarounds: (a) goal driven adaptation or improvisation of a current policy or process; (b) inconsistent practice with policy; (c) staff actions that do not follow explicit or implicit rules, assumptions, workflow regulations, or intentions of system designers; (d) intentional action outside of the process; (e) nonstandard method for accomplishing work; (f) informal or temporary practice adaptation; (g) bypassed work procedures; and (h) out of sequence or omission of one or more steps in a process. Included antecedents were poorly designed workflows and knowledge of expected policies and practices. Consequences included achieving efficiency, personal satisfaction, process revisions and possible patient harm.

The final manuscript presented the initial psychometric analysis of a newly created instrument containing three subscales that measured the type and frequency of workarounds. Based on exploratory factor analysis using principal axis factoring of eighteen items, twelve items were retained comprising three subscales: (a) defining characteristics, (b) type of workarounds, and (c) frequency of workarounds. Cronbach's alpha ranged from .83 to .92 for the three subscales. As hypothesized, convergent validity was supported by the Spearman Rho correlations ranging from .27 to .47 with the Halbesleben, Rathert and Bennett instrument total and subscales. Divergent

validity was supported with Spearman Rho correlations ranging from -.09 to .15 with the Halbesleben, Rathert and Bennett subscales.

Conclusion. The three studies provided a psychometric evaluation of an instrument measuring the type and frequency of workarounds that registered nurses may use when administering medications. Initial testing of the three subscales of the Savage Workaround Instrument demonstrated good reliability and initial evidence of validity. Future research should be conducted on a larger sample size to verify the testing results.

Keywords. workarounds, patient safety, medication administration, nursing, human factors, adverse event

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Chapter 1

Introduction

Workarounds are defined as a method of accomplishing an activity by circumventing the standard process, when the usual system or process is not working well (Morath & Turnbull, 2005). While all workarounds are not bad, some workarounds may lead to adverse events that impact the outcomes of patient care (Spear & Schmidhofer, 2005). When workarounds occur during the medication administration process, patients may be at risk for incorrect medications and doses, leading to potential and preventable patient harm. The Institute of Medicine (IOM) estimates that two out of every one hundred patient admissions in the acute care setting encounter a preventable medication error (Kohn, Corrigan, & Donaldson, 2000). An IOM report stated that close to 32% of medication errors may occur during the medication administration phase (Koppel, Wetterneck, Telles, & Karsh, 2008). The medication administration phase is the least likely phase to have barriers in place to prevent an error from occurring (Koppel et al., 2008). Examining and quantifying the types and frequency of workarounds nurses undertake during the administration of medications may identify safer medication administration processes that have the potential to increase overall patient safety.

Problem and Significance

In 2000, the IOM released a report named "*To Err is Human*", that identified at least 44,000 patients, possibly up to 98,000, die each year due to preventable medical errors in patient care (Kohn, Corrigan & Donaldson, 2000). More recent estimates state that close to 400,000 patients each year may be harmed due to preventable medical errors, including medication errors (James, 2013). A more recent study found that there were 157 to 311 medication errors per 1,000 patient days (Choi, Lee, Flynn, Kim, Lee, et al., 2016). It is estimated that annually adverse drug events may occur in over two million hospitalizations and can lead to increased length of stay and overall cost (Armstrong, Dietrich, Norman, Barnsteiner, & Mion, 2016; Choi et al., 2017). Furthermore, medication errors are commonly underreported, making estimates unreliable (Cescon & Etchells, 2008).

Since the IOM report was released, the total number of medication errors has decreased with the addition of technology, but there continue to be errors that result in direct patient harm (Bates et al., 2001; Bond, Raehl, & Franke, 2001). The IOM report outlined reasons for medical errors, and recognized that most medical errors are caused by inadequate systems and conditions that allow people to make mistakes or fail to prevent mistakes from occurring (Kohn et al., 2000). James Reason defines an error "as the failure of a planned sequence of mental or physical activities to achieve its intended outcome when these failures cannot be attributed to chance" (Reason, 1990, p. 9). According to the research, the consideration of intention is an important aspect of an error (Massetti & Conen, 2012). The IOM report suggested strategies to prevent medical errors, such as, designing medication delivery systems that make it difficult for nurses to do something incorrectly and force them to do something correctly. However, there is limited research to understand if preventative interventions are systemically effective (Kohn et al., 2000; Westbrook, Raban, Lehnbom, & Li, 2016).

The IOM Committee's research on Patient Safety and Health Information Technology suggests that design and human factors engineering play an important role in the safe design of healthcare technology. When systems are designed ineffectively within an already complex system, unintended errors may present themselves (Bennett, 2012; Probst et al., 2017). Systems may be designed ineffectively for several reasons but may include the design of a broken automated process or system designers that lack clinical knowledge (Bates et al., 2001).

Hospitals have introduced new technologies within patient care in an attempt to standardize the delivery process and prevent medical harm from human error (Bates et al., 2001). Prior to the implementation of new technology systems Bates and colleagues' (2001) recommendations included: (a) consideration of the consequences of adding technology on an existing workflow; (b) testing to understand the implications of the technology and to catch any unintended errors that the technology may add; and (c) using systems that measure and prevent adverse outcomes to patients. Technologies that have been implemented in hospitals to provide efficient care delivery and increase patient safety include computerized order entry, electronic prescribing, and barcoding during medication administration (Gaba, 2000). However, new technologies may have several issues including inadequate knowledge of user requirements, poor user interface design, lack of critical testing, complexity within the system, and incomplete analysis of completed implementations (IOM, 2011).

The introduction of barcoding is an example of a technology replacing a paper, human dependent process within nursing. Barcoding was introduced to increase patient safety efforts, but could have been implemented without understanding the complexity of nursing workflows during medication administration (Halbesleben, Savage, Wakefield, & Wakefield, 2010). One possible reason for an automated medication administration process would be the dramatic decrease in medication errors (Bates, et al., 2001). One complication with barcoding is that it is difficult to consider patient preference for the prescribed time of medication administration during the hospital stay. Physicians and pharmacists pre-determine medication timing, which may not correspond to the patient's timing of taking medications. When a mismatch occurs with timing, a nurse may use a workaround to accommodate patient preference; the nurse may decide to change the medication timing or administer the medication at a non-scheduled time. Changing the time of medication administration to meet a patient's needs represents one type of workaround that may be positive if it does not affect patient safety (Spear & Schmidhofer, 2005). However, there may be times that patient preference for taking a medication could present a safety issue.

Workarounds within the medication administration process are important to understand. While some may occur because of patient preference, there are multiple other reasons for workarounds. Research states that unreadable barcodes, battery issues with barcode scanners, unreadable patient identification bands, wireless connectivity issues, and emergencies are all reasons that nurses may use a workaround while administering medications (Koppel et al., 2008). Furthermore, research suggests that there are several categories of workarounds including technological, organizational, environmental, task-related and patient-related workarounds (Koppel et al., 2008).

While there is significant research to understand the causes of medication errors and the techniques to prevent them, there is no quantifiable method to determine the number and type of workarounds that nurses may use once a medication system is implemented. Understanding the number and type of workarounds that nurses use when administering medications will allow nursing leadership to effectively design future medication administration systems and potentially prevent patient harm.

Review of the Literature

Understanding the concept of patient safety and its relationship to patient outcomes has been a priority for nursing leadership (Botwinick, Bisognano, & Haraden, 2006). Hospitals create standard processes and procedures that define work for nurses. These processes guide nursing practice and provide a structured method in which their work should be accomplished

(Braithwaite & Donaldson, 2016). Patient safety is defined as the acts, practices and processes that lead to intended or unintended patient outcomes (Braithwaite & Donaldson, 2016). Deviations from standard processes and procedures impact patient safety and can result in adverse events, including medication errors (Beuscart-Zéphir, Pelayo, & Bernonville, 2010).

According to the IOM *To Err is Human* report " when large systems fail, it is due to multiple faults that occur together in an unanticipated interaction, creating a chain of events in which the faults grow and evolve" (Kohn et al., 2000, p. 52). Medication administration represents a complex system in which errors can occur. Nurses are individuals representing a specific component of the medication administration system, but many other components make up the entire process including physicians ordering medications, pharmacists filling orders, and technology products dispensing medications. Errors may occur along any point in the complex process and may go unnoticed until a patient elicits a negative response to the medication. Sometimes errors occur because of multiple breakdowns across several of these complex processes, but rarely occur because of a single human decision (Kohn et al., 2000). James Reason (2000) describes a Swiss Cheese Model, where mistakes result as a process of barriers, defenses, and safeguards that must be broken for an error to occur. While defense layers such as technology are created to prevent errors from happening, when several of the processes are broken or inadequately designed and line up correctly, an error occurs (Reason, 2000).

Adverse events are defined as unintended negative outcomes to patients that occur after processes or procedures were broken, unknown or not followed (Reason, 1995; Valentin, 2016). Several type of adverse events that occur include infections, surgical injuries, readmissions, and medication errors. Researchers estimate the preventable adverse events may occur 5.7 times per 1,000 patient days, with an increase in total cost of $5,857 (Cronenwett, Bootman, Wolcott, &

Aspden, 2007). While all adverse events do not lead to severe patient harm, understanding the type of events and the reasons they occur have led researchers to suggest solutions to prevent them.

Researchers suggest that there are several factors that must be examined to understand adverse events (Carayon, 2016; Valentin, 2016). Safety climate and ergonomic environmental factors, as well as workload and staffing play an important role in understanding why adverse events occur. The safety culture should be examined to understand an organization's response to error, error data collection methods, and how the organization analyzes errors and disseminates the learned information (Valentin, 2016). Environmental factors researched include access to equipment, noise and distractions and overall design space within an organization (Carayon, 2016). Some examples of workload and staffing factors that may influence events include fatigue, excessive hours worked, and understaffing. Researchers have examined the relationship between safety culture and adverse events, finding that a higher overall perception of safety culture correlated with less adverse events (Mardon, Khanna, Sorra, Dyer, & Famolaro, 2010; Xue et al., 2014).

Medication errors can lead to adverse patient events which include mistakes of unintended doses, incorrect medications and administration to incorrect patients; all of which may lead to patient injury and/or mortality (Aronson, 2009). Strategies to reduce medication errors include the use of increased technology through the use of smart pumps to administer medications, computerized physician order entry, and the adoption of barcoding for medication administration (Crist, 2014). Smart medication pumps are computerized pumps that are programmable, allowing only a specific amount of prescribed medication to the patient (Aronson, 2009). Computerized physician order entry is the use of a computer to enter patient orders, over a traditional paper order entry process. Barcoding is the process in which two-dimensional codes are used to scan medication and patient ID labels. Although all of the three methods are known to decrease medication errors, barcoding medications is the most direct method to prevent errors occurring during the medication administration process (DiPietro, 2005; Henneman, Marquard, Fisher, Bleil, & Walsh, 2013).

Barcoding supplements the nurse with the five rights of medication administration (right dose, right route, right time, right patient and right medication) and alerts the healthcare provider when one or more of the rights are incorrect. Literature suggests that the addition of barcoding during the medication administration process reduced medication errors from 55% to close to 1% (Sundhagen & Thorstenson, 2006). While barcoding is an important technology system to improve medication and patient safety, it has not eliminated medication errors. This may be due to technology issues, human workarounds, and design flaws within the operation of equipment.

In 2014, The Institute for Safe Medication Practices (ISMP) released a report outlining the progress of safety of medication administration within acute care healthcare institutions (Vaida, Lamis, Smetzer, Kenward, & Cohen, 2014). The authors examined the environmental factors that influence medication administration workflow including distractions, noises, and lighting, as well as systemic factors such as leadership and nursing acceptance of technology. The report concluded by stating that many hospitals have implemented technologies such as barcoding to decrease medication errors and that medication administration is generally safer in those hospitals, but not eliminated (Vaida et al., 2014).

Workarounds within the medication administration process are important to understand. While some workarounds may be positive, most workarounds signal a break in the intended process that warrants examination (Koppel et al., 2008). Workarounds sometimes occur when new technologies are introduced into processes. The introduction of barcoding is an example of a technology replacing a paper, human dependent process within nursing. Nurses may introduce a workaround in the medication administration process when the barcoding does not match their previous medication administration process (Seamen & Erlen, 2015). While examining 67 nurse interactions, Patterson, Cook, and Render (2002) found twelve different workarounds that nurses engaged in while delivering medications using barcode technology. The study concluded that system design examination and change should occur to increase safety related to barcode technology. An additional study reported over 31 different type of workarounds that nurses use when administering medications using barcode technology, with overall themes matching those of previous research (Koppel et al., 2008). Type of workarounds include unreadable barcodes, missing patient information, and nonfunctioning scanners.

Measuring the number of workarounds that a nurse may use while administering medications has been limited within research. Qualitative research studies have been conducted observing nurses and the type of workarounds they use during the medication administration process (Debono et al., 2013; Tucker, Heisler, & Janisse, 2014). There is only one quantitative instrument that recently was introduced and tested to understand reasons that nurses may undertake workarounds (Halbesleben, Rathert, & Bennett, 2013). While this instrument was aimed at quantifying the reasons workarounds occur, currently there is no instrument that measures the actual type and frequency of workarounds that nurses use during the medication administration process. Understanding the type and frequency of workarounds that nurses use may help future researchers implement strategies to increase patient safety during the medication administration process.

Research Study Purpose and Questions

The overall purpose of this study was the development of a reliable and valid instrument to be used to quantify the type and frequency of workarounds based on a concept analysis of workarounds during the medication administration process. To accomplish this, three manuscripts were developed, and the following research questions were explored in each manuscript.

Research Questions

1. What is the current literature related to nursing workarounds during the medication administration process?
2. Using Walker and Avant (2005) concept analysis approach, what are the defining characteristics, antecedents, consequences, and a model case of nurse workarounds during the medication administration process?
3. Developing a tool informed by findings from the concept analysis, what are the preliminary psychometric properties of the tool measuring the type and frequency of nurse workarounds during medication administration?

Research Purpose and Methods for Manuscripts

Three manuscripts will be submitted using the previous research questions. The purpose and method for each manuscript are described below.

Manuscript 1: Nursing Workarounds During Medication Administration: State of the Science

Purpose and Research Question

The purpose of the first manuscript was to provide an understanding of the current state of the literature of nursing workarounds and how the lack of systematic evaluation of new technology systems may lead to workarounds that contribute to potential patient harm. The following research question was explored: What is the current literature related to nursing workarounds during the medication administration process?

Methods

A literature review was performed to understand the aspects of medication administration, patient safety and nursing workarounds. Key search terms included: medication administration, workarounds, patient safety and medications, human factors and patient safety, barcoding and medication safety, and implementation analysis. The literature review and analysis focused on the process and associated errors that occur specifically during the medication administration phase, excluding the other phases of medication delivery (ordering, preparation, or dispensing). The literature review examined the aspects of patient safety, the underpinnings of the culture, as well as the strategies to improve patient safety. Additionally, literature was reviewed to understand the type of workarounds, situations where they occur, and prevention mechanisms. Lastly, a literature review of technology implementation and the phases of implementation were reviewed. The manuscript synthesized the previous research and the progress made through the past fifteen years, highlighting current challenges, informatics and human factors recommendations.

The literature review was conducted using PubMed, PsycINFO, Medline and CINAHL electronic databases as well as the Institute of Medicine Quality Chasm reports. Manual searches were conducted using Google Scholar and reference lists from relevant articles. The search was limited to evidence-based literature and research studies written or translated in English from 2001 to 2015. It was relevant to use publications dating back to 1999 since the original Institute of Medicine (IOM) report that outlined the need to examine adverse events in healthcare was released at that time. The literature review was limited to acute care, hospital research studies. After literature was reviewed in all target areas based on a review of their abstracts, this author engaged a faculty expert in human factors to review the selected articles and finalize the list for inclusion in the manuscript.

Key ideas and concepts were abstracted and synthesized to provide an analysis of the importance of the concepts that make up a medication error, along with the causes of these type of events. The manuscript highlighted the addition of technology to decrease medication errors, the implementation and review process as well as the impact on current adverse error rates. Lastly, the manuscript described the challenges that surround medication errors and proposed solutions to decrease error rates.

Advantages to a comprehensive literature review included a complete understanding of what has been accomplished in patient safety and workarounds since the initial IOM report (Kohn et al., 2000), outlining the occurrences of preventable adverse events. While institutions are implementing many new computerized interventions to prevent medication administration errors, they have not been eliminated completely. Limitations to a literature review include inadvertent exclusion of relevant material and author bias. These were limited with a faculty expert review of the literature selection process.

Manuscript 2: Workarounds When Administering Medications: A Concept Analysis

Purpose

The purpose of the second manuscript was to report the findings of a concept analysis of nurse workarounds during the medication administration process.

Research Questions

1. What are the defining characteristics of a workaround during medication administration?
2. What are the antecedents and consequences that contribute to the decision to use a workaround during medication administration?
3. What is a model case that represents nurse workarounds during the medication administration process?

Methods

The Walker and Avant (2005) method was used to conduct a concept analysis of workarounds. A concept analysis is a generally accepted approach to understand the structure and function of a concept from published literature (Walker & Avant, 2005). The concept analysis was derived from the literature searches of the first manuscript, focusing specifically on nursing workarounds during medication administration. The literature was reviewed for similarities and differences. Various definitions of workarounds were examined, through multiple disciplines. The process used analyzed generic concepts of workarounds and became more precise as the process evolved. While literature was collected, clusters of phenomena related to nursing workarounds were combined through visual inspection, and each cluster was named with accurate descriptions. There was careful attention to ensure there were no overlaps of the workaround's definition, and that the term (i.e., workarounds) was reduced as much as possible, containing the characteristic that make them unique (Walker & Avant, 2005).

Next, the specific aim of the concept analysis was developed (Walker & Avant, 2005). Identifying the defining characteristics, antecedents and consequences of nurse workarounds occurred using the 8-step process including: concept selection, determining the purpose of the analysis, identifying uses of the concept that are discoverable, determining key characteristics, identifying antecedents, consequences, and developing a model case. The process was iterative in nature, with the goal of precise operational definitions of workarounds and preparation for instrument development.

The first step of the concept analysis was the selection of a concept. The concept of nursing workarounds during medication administration was isolated to understand its significance in different contexts, its boundaries and overall relevance (Walker & Avant, 2005). The second step of the process was to determine the aims of the concept analysis. The overall purpose of the concept analysis was to create an operational definition of workarounds. The third step of the process was to identify the uses of workarounds during medication administration. All aspects of workarounds were considered to validate the choices of defining characteristics. All aspects of workarounds were reviewed to prevent an incomplete analysis. This step was accomplished by developing a collection of circumstances that were like workarounds during medication administration and using this information to construct a related case of workarounds (Walker & Avant, 2005).

Defining the characteristics of workarounds during medication administration is a core component of the concept analysis. This step defined the characteristics that were most closely related to workarounds and provided overall insight into the concept (Walker & Avant, 2005). The process occurred by identifying the characteristics that appeared most frequently and subsequently, decisions were made to determine which characteristics would be most beneficial to support the aims of the research. During this step, multiple literature sources were used, from nursing and other fields of study.

Identification of the antecedents and consequences was the next step in refining the defining characteristics of workarounds. Understanding the events that must occur prior to a workaround were explored. For example, a nurse must be administering a medication to a patient for a workaround to occur. Additionally, consequences of workarounds were examined. Consequences are the events that occur because nurses used workarounds when administering medications. An outcome of a nurse using a workaround during the medication administration process may be that an incorrect medication was delivered to the patient.

Next, a model case of workarounds was constructed that demonstrate all the defining characteristics. Multiple literature examples of nursing workarounds during medication administration provided examples to aid in this process step (Koppel et al., 2008; Rack, 2012; Tucker et al., 2014).

Empirical referents are defined as categories of workarounds that demonstrate that workarounds occur. Empirical referents are an important aspect to measuring the type and frequency of workarounds during the medication administration process. The empirical referents that were identified and measured during the concept analysis included the type and frequency of workarounds that occurred prior to medication administration (Walker & Avant, 2005).

The advantage of conducting a concept analysis included the development of theoretical and operational definitions of workarounds that are used for instrument development. The concept analysis was a preferred process to understand and clarify the term workarounds, since there are multiple definitions present in the literature. The process is considered rigorous and is one method that can be used for instrument development (Walker & Avant, 2005). One disadvantage to the concept analysis process is the addition of extra defining characteristics that are not essential (Walker & Avant, 2005). Expert faculty were consulted to help establish guidelines and scope creep during this process.

The process of conducting a concept analysis was the preferred method for this study to understand the defining characteristics, antecedents, and consequences of workarounds during medication administration, along with the development of a model case that exemplified the defining characteristics. Concept analysis is a process that is logical and has been used in multiple disciplines studying multiple phenomena of interest as well as providing guidance to researchers in a structured manner (Walker & Avant, 2005).

Manuscript 3: Validity and Reliability of a Newly Developed Instrument to Measure Nursing Workarounds During Medication Administration

Purpose

The purpose of this study was to develop an instrument that quantifies the type and frequency of workarounds that nurses use when administering medications. Additionally, the instrument was pilot tested to assess reliability and provide preliminary evidence of validity of the newly developed instrument.

Research Questions

1. What are the items that represent an instrument type and frequency of workarounds that nurses may use when medications are administered to patients?
2. What is the content validity for the items and the subscales that are created to measure type and frequency of nurse workarounds during medication administration?
3. What are the psychometric properties of the instrument developed to measure the type and frequency of nurse workarounds during medication administration?

Instrument Development

The purpose of this study was to develop an instrument to measure the type and frequency of workarounds that nurses may use when they administer medications to patients. The process of instrument development followed the Waltz, Strickland and Lenz (2010) method and commenced after the concept analysis was completed as outlined in manuscript number two. The process of instrument development began with the selection of a measurement framework, i.e. use of a norm-referenced approach. This was an appropriate method to understand workarounds since the method compared the scores of all of the respondents (Waltz et al., 2010). A non-experimental, quantitative design was used for this study. This approach assigned categories representing the quantity of specific characteristics of a concept. This is an appropriate method as it seeks to understand human behavior through objective, quantifiable data, focusing on the accumulation of and the type of behavior (Waltz et al., 2010). The study of workarounds represents the accumulation of several behaviors of a nurse, prior to the administration of medications. When developing an instrument, it is more important to understand the construct of workarounds in whole, rather than the individual behaviors that compose a workaround. Items were developed with consideration given to wording and its impact on response variability. Using Pett, Lackey and Sullivan (2003) and Waltz et al. (2010), items were created containing strongly worded, declarative statements with little ambiguity allowed for responses.

To accurately measure the frequency of workarounds, selection-type scaled response method was used. A summated rating scale was used to understand the nurse's response to a specific item. This type of scale is made up of a set of items to understand a specific construct by summing a score across items to obtain a single score (Pett et al., 2003). The scale contained answers that range from always, occasionally, rarely, or never and numerical selections representing the frequency of workarounds. The respondents were asked to rate how much they agree or disagree with a specific statement, each response may be given an assigned numerical value, such as always = 7 through never = 0. Scores were summed to determine a nurse's individual score. Summated rating scales are generally reliable and provide flexible construction options, which make this type of scale a good option when measuring quantities and type of workarounds.

Consideration was given to the number of items and its impact on the reliability of the instrument (Waltz et al., 2010). Objective measures were used to construct the instrument since they decrease the amount of latitude in a nurse's response to the quantity of workarounds that they may use. The instrument was developed under the guidance of expert faculty members since there are no available instruments for use that measured the type and frequency of workarounds (Waltz et al., 2010).

Methods

Item development. Instrument creation involved several steps that are outlined below. The steps involved in the process of designing a norm-referenced measure included explicating objectives, development of a blueprint, and the construction of the instrument, including creation of measures and an item set, as well as scoring rules and procedures (Waltz et al., 2010).

The initial step in the development of the instrument was to explicate the objectives of the study. Behavioral objectives were used when creating norm-referenced measures. Examples of behavioral objectives that were used included a description of a workaround and delineation of the behaviors of nurses involved in workarounds. From the concept analysis, the defining characteristics that represent workarounds were used to develop the blueprint and establish the specific scope and measure. The measures were defined by the extent of the domain of items to be measured. Items were developed from the designed blueprint. The blueprint on workarounds contain the major content areas as well as the critical behaviors that were measured (Waltz et al., 2010). A total number of nineteen items were constructed from the blueprint. Generally, the longer the instrument, the higher the reliability estimates. Items were eliminated or revised after expert content validity validation (Waltz et al., 2010). Scaled items were used over open-ended questions for ease of data collection. During item construction, consideration was given to reading level of items, brevity of wording and impact of negatively worded items (Waltz et al., 2010). Questions were written following the guidelines by Pett et al. (2003) outlined for instrument item development.

Initial scoring was developed by a schema, which contained subscales. After dimension analysis, mean or summative scores were created. Summative scores were obtained by assigning a score to individual items, and then summing the individual items to obtain an overall score (Waltz et al., 2010). To interpret the scores, a reference chart was created to understand frequency distribution.

Content validity assessment. Based on the recommendations in the literature (Grant & Davis, 1997), three content experts from the patient safety and human factors engineering field were recruited to evaluate the items on the instrument for content validity. Content validity was an important aspect to determine whether the created items adequately represent the content and overall relevance to workarounds (Waltz et al., 2010). The experts were identified through authorship of research studies currently published in the field of patient safety, medication safety, and workarounds.

A content review form was sent to the content experts that contained the behavioral objectives, the definition of terms, along with the list of instrument items to be reviewed. Item analysis determined the actual number of items, with more items sent to the reviewers than what was used in the instrument based on the literature (Pett et al., 2003). The expert reviewers were asked to link each objective with an item and to assess the relevancy of the items in the instrument. Additionally, each reviewer was asked if the items accurately represent the behaviors of workarounds. The content review form contained a rating scale to understand the level of agreement between the experts. A four-point rating scale was used with the following headings: not relevant (1), somewhat relevant (2), quite relevant (3), and highly relevant (4).

After the content review sheets were returned, a content validity index (CVI) was calculated based on the expert ratings of the items. The CVI was computed as the proportion of experts who consider the item or scale as “quite” and “highly relevant” (Waltz et al., 2010). Each item was scored to determine the item level CVI (I-CVI); the content validity index for each item. Items that achieved a CVI scores of .67 or higher were considered useful and remained on the instrument (Polit & Beck, 2006). Items that did not meet the CVI threshold were revised, replaced, or deleted. Additionally, content validity for each subscale was determined using the scale CVI (S-CVI/Ave), computed by the average of I-CVI’s across all the items in each subscale. An S-CVI/Ave of .70 or higher was considered the criterion to achieve content validity of each subscale (Waltz et al., 2010).

Face validity. Face validity was accomplished by administering the instrument to ten RNs that had given medications to patients in the previous two weeks, since they were the target population for the newly developed instrument. The nurses were given an evaluation to complete that assessed accuracy that the items measured the construct, relevance of the items and workarounds; as well as completeness of the questions, ease of administration, clarity and readability of the individual items. The same nurses assessed the items for overall concept fit and applicability.

Pilot testing. Once content and face validity were established, the measure was pilot tested to examine the psychometric properties of the newly developed instrument.

Setting and sample. The setting for this study was at a Northern Virginia acute care hospital that has 430 beds and 18 acute care units, a behavioral health unit and an inpatient rehabilitation unit. The hospital employs approximately 1,500 registered nurses (RNs). Inclusion criteria to complete the survey included the ability to read and write in English, ability and access to a computer, and the RN must have administered a medication to a patient within the previous two weeks. Initial and then weekly reminder emails were sent to all RNs requesting participation until the desired sample size was achieved.

Procedures. Following Institutional Review Board (IRB) approval, the instrument was administered electronically to all RNs in the hospital using the REDCap® system for data capture. An invitation email was sent with implied consent (see Appendix A) to all RNs within the hospital. The survey was anonymous, as no personal identifying information was collected on any of the respondents. Demographic data were collected on all respondents who agreed to complete the survey to include type of unit, overall years of experience, years at the hospital, education level, gender, and age (see Appendix B). RN respondents who administered medications to patients within the previous two weeks were allowed to take the survey. RNs who did not administer medications in the past two weeks were not allowed to continue the survey, as they did not meet inclusion criteria. The demographic data from the inclusion and exclusion group of nurses were compared for any differences.

Measures. In addition to the newly developed instrument described in the item development section above, the Halbesleben, Rathert and Bennet Workaround tool was administered. The Halbesleben and colleagues' workaround tool measures a nurses' tendency to use a workaround (see Appendix C). Permission to use the tool is shown in Appendix D. A twenty-item tool that was developed by Halbesleben and colleagues (2013), measures the perceived blocks that create workarounds based on poorly designed processes. The instrument is the only quantitative tool that has been developed to assess any aspect of workarounds. The instrument measures four cognitive processes (i.e., factors) including: (a) a person must perceive that a block exists; (b) they must alter their work processes to get around the block; (c) they must prefer to perform the task in the intended way; and (d) their motive must be to assist a patient, rather than efficiency (Halbesleben et al., 2013); and also measure four context subscales (i.e., technology, equipment, rules/policies, people, and work process design). Respondents answered to the tool using a four-point Likert-type (strongly agree, agree, disagree or strongly disagree). Items were developed based on a comprehensive literature search.

For the Halbesleben, Rathert and Bennett Workaround tool, content validity was established by four registered nurses who rated each item for relevance, with an average rating of 3.65. The content validity index was .91, indicating that the instrument measures the construct being measured (Halbesleben et al., 2013). The instrument was then sent to 14,065 RNs in Minnesota with an initial response rate of 10.5% (Halbesleben et al., 2013). The participants were primarily women (90%) with an average age of 43.99 years. Factorial validity, via confirmatory factor analysis was assessed, using a multitrait-multimethod framework. Factor analysis results showed that all items loaded at acceptable levels (>.30) onto their respective factors. One item with less than .30 was retained, because of concerns with consistency. Confirmatory factor analysis testing for model fit was also completed to explore convergent and discriminant validity between their workaround tool with job crafting and deviance scales (Halbesleben et al., 2013). The hypothesized significant positive correlation between workarounds and job crafting ($r .= .045$, $p > .05$) was not supported but the significant negative correlation ($r = -.10$, $p < .05$) with deviance scale was supported. The researchers reported the finding supported the uniqueness of workarounds as a construct. Finally, criterion validity was supported through correlations between workarounds and the number of patient safety events reported ($r = .24$, $p < .01$).

Their study found that nurses were less likely to use a workaround when their environment felt psychologically safe. Cronbach’s alpha estimates were examined for each factor and ranged between .75 and .91 indicating high reliability of the tool. The instrument is the only quantitative tool that has been developed to assess any aspect of workarounds.

Data Analysis. The phases of psychometric evaluation of a new instrument include the following: (a) item analysis, (b) dimensionality, (c) reliability testing, and (d) validity testing. Each of these phases is described below.

Item analysis. Item analysis began with descriptive statistics that assessed the data, percent of missing data, outliers, and normality of the response data. Descriptive statistics were analyzed including the mean, mode, median, central tendency and standard deviations of the items. Consideration was given to items with missing responses, as they were investigated further or deleted. Less than 5 percent of missing data was considered within the normal range. Univariate statistics for each item were analyzed via frequency distributions and histograms to aid in the inspection of outliers and overall distribution, specifically reviewing skewness and kurtosis of the items for normalcy.

Dimensionality. Exploratory factor analysis was used to understand the dimensionality of the instrument and to what extent the items match the construct of workarounds (Pett et al., 2003). This was an appropriate method to determine if there are fewer underlying constructs than items. Principal axis factoring was used to determine the underlying constructs. Bartlett's Test of Sphericity and a Kaiser Meyer Olkin (KMO) tests were used to determine if the item set was sufficiently related and if a factor analysis was the appropriate evaluation method. Inter item correlations were examined to determine the clusters of items and adequate relationship between items. This is an important step to understand how many dimensions are needed to explain the relationship between the items. Consideration was given to over- and under-extraction of factors.

Eigenvalues were used to determine the single factor solution and understand all total item variance explained by the factor. Eigenvalues closer to zero indicated multicollinearity and should be removed and the tests rerun. A scree plot was evaluated to determine the break point in which the eigenvalue above the curve was retained. Multiple analyses occurred to understand the true number of factors to be retained. Based on the correlations of the factors, varimax rotation would be used. Item loading tables were produced and factor loadings that scored higher than .30 were retained (Costello & Osborne, 2005). Item communality, described as the total variance of an item, explained by the factors, was examined (Pett et al., 2003). Careful consideration was given to non-error variance which may be attributable to a specific item. Exploratory factor analysis was an appropriate method to determine the shared variance among the entire set of items, since items have both individual variance and shared variance with other items (Waltz et al., 2010).

Reliability. Reliability testing provides information on the soundness and consistency of the instrument and the extent to which the items correlate (Ferketich, 1990; Waltz et al., 2010). Cronbach's alpha was used to determine internal consistency of the workarounds tool since this is the preferred method of measurement. Cronbach's alpha is a measure of the overall consistency of the items within the scale, measuring whether any one specific item is a good predictor of performance of any other item. Cronbach's alpha values greater than .70 are generally accepted for newly developed instruments. Consideration was given to the number of items, as reliability and homogeneity increases with more items. Items that did not correlate well with other items were examined and removed from the instrument (Ferketich, 1990). Testing was repeated once items were deleted. A correlation matrix was examined to assess inter-item and item-total correlations. Items that correlated below .30 should be considered not sufficiently correlated, and items that correlated over .70 should be considered redundant and unnecessary (Ferketich, 1990). Items that lacked reliability characteristics were deleted after descriptive examination of the item and scale, the inter-item and item-total correlations, along with the alpha and alpha if item deleted (Pett et al., 2003).

Validity. Overall validity occurred through the examination of the newly created instrument to ensure it achieved the purpose for which it is intended. The process for face and content validity assessment for the instrument was described above. Construct (convergent/divergent) validity was assessed by how well the newly developed instrument correlated with the Halbesleben, Rathert and Bennett workaround total scale and four subscales, an already validated instrument. It was expected that the newly created instrument would be moderately correlated with the total scale and two subscales (perception of a block and altering processes to work around block) in the Halbesleben, Rathert and Bennett instrument since the instruments are measuring similar constructs. It is expected that the other two subscales (preference for following procedures and motive to assist patient) will provide divergent validity with small correlations with the newly created instrument subscales. Spearman's Rho correlation was used for the analysis. Sufficient beginning evidence of construct validity would be established if there was moderate correlation (r = .3 to .5) between new scales and the subscales of the Halbesleben, Rathert and Bennett workaround tool (convergent validity) (Cohen, 1977).

Limitations

Limitations of the study included the possibility of a low response rate. Even though the survey was administered anonymously, workarounds are considered deviations from anticipated process and nurses may not want to participate in the survey. A noted limitation of the pilot study was that the instrument was only administered once. Since workarounds are highly sensitive in nature, nurses may tend to under report when they engage in workarounds. Continued administration of the instrument may provide for more precise reliability estimates. A test-retest reliability could be used in the future to understand instrument stability (Waltz et al., 2010).

Definition of Terms

The following terms will be used for the purposes of this study:

Adverse events: Adverse event means any untoward medical occurrence associated with the use of a drug in humans, whether or not considered drug related (CMS).

Barcoding: A barcode is an optical, machine-readable, representation of data; the data usually describes something about the object that carries the barcode.

Error: Those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when they cannot be attributed to something else. (Reason, 1990)

Human factors: The process that surrounds the links of human interaction, the systems in which we work, the environment and equipment, as well as the personal experiences of those who interact with the process (Rosenorn-Lanng, 2015).

Medication Errors: Medication errors are defined as any preventable event that occurs in the process of ordering or delivering medication, regardless whether an injury occurred or the potential for injury was present (Choi et al., 2016).

Patient Safety: Patient safety is defined as the acts, practices and processes that lead to intended or unintended patient outcomes (Braithwaite & Donaldson, 2016).

Workarounds: A workaround is a method of accomplishing an activity when the usual system/process is not working well. While a workaround provides a temporary solution to the immediate problem, it is also a symptom of a system that may need improvement (Debono et al., 2013).

Summary

Since the initial report from the Institute of Medicine (Kohn et al., 2000), nurses along with other healthcare providers have developed ways to mitigate preventable harm to patients. Medication errors make up a significant portion of preventable harm to patients in the acute care setting. When nurses administer medications to patients, situations may exist that prevent the nurse from giving the medication to the patient through the intended process. When this occurs, and nurses use a different, nonstandard approach to administer the medication, a workaround occurs. Understanding the type and frequency of workarounds have been difficult to establish in research. This study, through a comprehensive literature search, concept analysis, and instrument development will result in an instrument that identifies the type and frequency of nurse workarounds for the administration of medication. It is hoped that future researchers can use this instrument to study and employ interventions that may prevent workarounds that have the potential for harm to occur; thus, increasing patient safety for all patients.

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Chapter 2

Nursing Workarounds during Medication Administration: The State of the Science

The manuscript presents an integrative review of the literature for workarounds and patient safety.

Abstract

Medication administration is a frequent task required of nursing, which is error prone and highly complex. The process involves multiple steps and nurses encounter distractions and environmental challenges in their effort to provide medications to their patients. Multiple safety and advocacy agencies have advocated for safer processes, including the addition of technology to decrease errors associated with medication administration. One technology, barcoding, has been used by hospitals to decrease overall medication errors. While medication errors have decreased overall nationwide, serious medication errors continue to occur despite the use of technology. The design and implementation of technology enhancements must closely resemble workflow patterns of medication administration, or nursing will use a workaround and circumvent the barcoding system. More research is needed to understand the quantitative incidents that involve these types of workarounds and for organizations to use a complete project management cycle to review the process after implementation. One single medication error may have catastrophic impact on a patient and their outcomes, which makes this complex process an important research topic.

Introduction

Workarounds and Barcoding

In 2000, The Institute of Medicine released a report titled *To Err is Human,* stating that 44,000 to 98,000 patients are harmed annually by medical errors in the acute care setting (Kohn, Corrigan, & Donaldson, 2000). Current literature documents that those original estimates may actually be underrepresented, suggesting 1.6 medication events per 1000 patient days with an average cost of over $8000 per event (Choi et al., 2016). Medication administration errors represent the largest number of adverse events within a hospital. It is estimated that adverse drug events may occur in over 2 million hospitalizations yearly, which increase patient's length of stay and overall cost (Armstrong, Dietrich, Norman, Barnsteiner, & Mion, 2017). Since this report, there has been success on reducing the total number of medication errors, but even one medication error can have severe consequences. Additionally, there is limited quantifiable research to understand if preventative interventions are systemically effective (Westbrook, Raban, Lehnbom, & Li, 2016).

Strategies suggested by researchers to reduce medication errors include the use of increased technology, including barcoding for medication administration. Barcoding is the process in which two dimensional codes are used to scan medication and patient labels and have been found to decrease medication errors (DiPietro, 2005). Barcoding supplements the five rights of medication administration and alerts the healthcare provider when something is incorrect. Researchers suggests that the addition of barcoding during the medication administration process reduced medication errors from 55% to close to 1% (Sundhagen & Thorstenson, 2006). While barcoding is an important aspect of medication and patient safety, it has not eliminated medication errors because of several issues including technology issues, human workarounds and design flaws within the operation of equipment.

Patient Safety and Medications

Medication administration is one of the most frequent activities of nursing within acute healthcare. Medications provide therapeutic relief for many diseases and conditions, but researchers demonstrated that the acts of administering medications are frequently error prone (Keers, Williams, Cooke, & Ashcroft, 2013). An error in the medication administration process occurs when there is a "failure of a planned act or intention" (Aronson, 2009, p. 514). Aronson's (2009) research describes four type of medication errors, notably, knowledge based, rule based, action based and memory based errors. Knowledge based errors occur when medication is administered to a patient who has an allergy to the medication. The nurse may not realize that the patient has an allergy because the information may not have been properly identified before the medication was administered. Rule based errors occur when a nurse administers a medication to the incorrect location, such as a sustained oral release medicine that may have been crushed and administered. Action based errors occur when a nurse mistakenly selects the incorrect medication prior to administration. The nurse intends to give the correct medication, but factors such as similar packaging may contribute to these types of errors. The last type of medication error, memory-based errors, occur when the nurse has knowledge of something but forgets it. The nurse may have learned that a patient was allergic to a specific medication, but forgets the information when they go to administer it (Aronson, 2009).

Barcoding and Medication Administration

Barcoding is used extensively throughout hospitals and other industries for tracking purposes. The system uses handheld devices to scan a medication which then creates a positive (give the medication) or negative message (do not give the medication). The system verifies the patient's identification and medication order information within a few seconds. The original paper process of medication administration required a nurse to read and interpret a written physician order, to administer the medication and then chart that the medication was given. The paper-based system had an increased error risk associated with the process because it relied on human processes (Poon et al., 2010). The barcoding process is a change in workflow for a nurse with little research conducted to understand the time differences between the two processes, as well as the impact on workflow (Patterson, Cook, & Render, 2002).

The introduction of barcoding has significantly reduced the amount of medication errors within hospitals (Poon et al., 2010). While the noted reduction in errors is significant, the addition of barcoding has not eliminated medication errors entirely. Research has shown that nurses have implemented workarounds when using barcoding technology. Workarounds exist when the original system was developed, and the previous workflow was not used to create the system or reexamined once the system was implemented. When nurses use workarounds during the medication administration process using barcoding technology, they may be introducing potential patient harm.

Workarounds

Workarounds are defined as circumventing a process to achieve a specific result (Seamen & Erlen, 2015). While many people view a workaround as a negative process, workarounds may be positive when they are reviewed and may not introduce a risk to patient safety. Workarounds occur frequently when new technologies are introduced to processes. The introduction of barcoding is an example of a technology replacing a paper, human dependent process within nursing.

Rapid introduction of electronic technologies has occurred over the last 20 years within healthcare. Nursing has relied on evidence-based practice as a foundation since the inception of nursing. Evidenced based medicine seeks to incorporate patient preference into practice and process (Seamen & Erlen, 2015). The introduction of technologies, such as barcoding, were introduced to increase patient safety efforts, but may have been implemented without understanding the complexity of the nursing workflow during medication administration. It is sometimes difficult to consider patient preference in the hospital when medications are administered. Physicians and pharmacists predetermine medication timing, which may not correlate to the patient's preference for medication timing. When a mismatch occurs with timing, a nurse may use a workaround to accommodate patient preference and may decide to change the medication timing or administer the medication at a non-scheduled time. Changing the time of medications to meet a patient's needs represents a type of workaround that may not affect patient safety.

Other type of workarounds occurred because of technology issues such as equipment failures. When a nurse attempts to use a barcoding machine and the battery has died, the nurse must workaround the issue. The nurse should locate another barcoding machine but may use another nurse for verification to deliver the medications instead. Using another nurse for verification of the medication and patient is high risk with decreased reliability and more prone to errors than using barcoding. A common type of barcoding workaround that nurses encounter occurs when the barcoding machine displays the message "do not give the medication" and the nurse continues through the process and administers the medication. One possible reason for this type of error may be an un-scannable barcode on the medication because the barcode was inadvertently torn or destroyed.

While all workarounds are not inherently dangerous, there may be unintended consequences of them. While the intent of nurses is to create efficient and patient centric workflows, workarounds may introduce error into the process. Many times, the workarounds have no ill effects, but occasionally, the workaround causes a breach in patient safety and a serious medication error may occur.

Human Error

The science of human factors engineering has been used in other industries including aviation, boating and manufacturing since 1940 (Reason, 1995). Since the mid 1980's scientists started to investigate the human and organizational factors associated with medical errors. Reason (1995) determined that error existed at two different levels including the sharp end (patient interaction) and the organizational end (complex processes). At the sharp end, confusion with multiple sources of information, ill-defined goals, intense stress and advanced technology impact the patient if the system is not designed well. At the organizational level, complex relationships between multidisciplinary teams with institutional culture and policy affect processes (Reason, 1995). A human error occurs when there are slips, lapses or mistakes that may or may not reach the patient. In medicine, these errors are generally classified based on their consequences, where their causes are not as widely understood.

Errors can be defined as the failure of a planned action to achieve the desired goal (Reason, 1995). There are two type of errors that occur within healthcare. Slips and lapses occur when there is a good plan in place, but the plan is not executed as intended. Slips are noted to be actions that can be visibly seen, and lapses are generally related to a failure of memory. When the plan is not well defined, mistakes occur. Mistakes are further defined as knowledge and rule-based errors. Rule based errors occur when nurses know the process or policy but choose not to use it in practice. A knowledge-based error occurs when the clinician uses a predetermined mindset to problem solve. The nurse may ignore their own internal thoughts and deviate practice based on predetermined biases (Reason, 1995).

Improving patient safety and ultimately patient outcomes is an important evidenced based paradigm. The science of human factors engineering aims to focus on the system design in order to improve patient safety (Karsh, Holden, Alper, & Or, 2006). Managing healthcare design and delivery, using evidenced based practice and protocols leads to safer processes. While system redesign alone does not necessarily lead to a decrease in errors, the design of the system has a significant patient safety impact.

Understanding the inputs into systems allows researchers to study the elements of how nurses perform their jobs. Patient and nurses' specific traits are examples of inputs into a medication administration process. The experience of the nurse, language and knowledge barriers and the patient's personality and expectations may impact the medication administration process. Task factors include the nursing workflow, pressure and overall time to complete a task. Technology inputs include the availability and location of barcoding machines, as well as the scan ability of the medications. Organizational inputs include policies and organizational culture of the medication administration process. External factors that may impact the medication administration process include things outside of the system, like a patient who is off the unit at the time of administration or outside regulatory agencies that monitor medication events. Mastering each of these inputs and outputs plays a significant role in designing the most comprehensive safe medication delivery system.

Designing Future Systems

Considering the intersection between the need for reliable, safe systems and human factors is imperative to the implementation of new systems. Organizational culture plays an important role in supporting patient safety within an organization (Moody, Pesut, & Harrington, 2006). Specific characteristics of an organization must be identified to understand the culture. Patient acuity, staffing ratios and unit physical characteristics must be identified and understood prior to the implementation of a new technology such as barcoding. The process of understanding these considerations should involve bedside nurses, nurses specializing in informatics, information technology and administrative staff. Ideally, patient involvement should occur, but may not be realistic currently for some organizations. The project management lifecycle includes a review of the implementation after a new process or product is introduced. Successful implementation of barcoding should include a comprehensive review of the technology, safety aspects and data that supports the use (Project Management Institute, 2004). The data may include the number of medication errors pre-and post-implementation as well as the number of overrides or workarounds that are encountered post implementation.

Unertl and colleagues (2016) describes the current healthcare system environment as challenging with numerous inputs, outputs and a complex interwoven culture. In the center of this complex system is the patient, the reason that the system occurs (Unertl, Holden, & Lorenzi, 2016). Very few hospitals engage the patient in the adoption of new technologies and processes. The patient may be the missing link to understanding a safer, more efficient process. Engaging patients in the implementation stage takes time and resources, as well as a patient centered approach to care. Not all hospitals have the resources and ability to engage patients during technology implementation, but the patient’s input should not be ignored. Using the patient’s perspective and direction, along with the direct care nurses' insight, can only design more effective, safer processes for future technology implementations.

Conclusion

The process of medication administration is complex with multiple inputs and outputs. The sharp end of the process has multiple process steps that can be circumvented if the process is designed poorly. When technology systems are designed poorly, nurses may deviate from the written policies and practice and use a workaround during medication administration. The addition of barcoding technology has decreased the total amount of medication errors, but it has not eliminated it entirely. Successful implementation of barcoding should include examination of the process at specific stages to ensure compliance as well as identification of any failures in the system. The failures should be reviewed and evaluated for changes to create a safer process. Additionally, the type and frequency of workarounds used during medication administration should be determined.

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Chapter 3

Workarounds When Administering Medications: A Concept Analysis

This manuscript represents a concept analysis of nursing workarounds while administering medications. The concept analysis was used to develop an instrument to measures the type and frequency of workarounds used by nurses.

Abstract

Aim. This paper is a report of the analysis of the general concept of workarounds that ultimately can be used to develop an instrument to measure the type and frequency of workarounds used by nurses.

Background. According to patient safety literature, workarounds are used by nurses to circumvent a process that does not follow the intended workflow. Workarounds can be dangerous to patient safety and can increase the chance of adverse events, such as medication administration errors.

Design. Concept analysis

Data sources. Systematic literature searches were conducted through CINAHL, PubMed, MEDLINE, Google Scholar and reference lists of related journal articles between the years of 1999 to 2018. The keywords of workarounds, patient safety, and nursing workarounds were used.

Methods. Walker and Avant's method of concept analysis was used to identify the antecedents, defining characteristics, and the consequences of workarounds.

Results. Eight defining characteristics were identified as either human factors or system factors that described workarounds: (a) goal driven adaptation or improvisation of a current policy or process; (b) inconsistent practice with policy; (c) staff actions that do not follow explicit or implicit rules, assumptions, workflow regulations, or intentions of system designers; (d) intentional action outside of the process; (e) nonstandard method for accomplishing work; (f) informal or temporary practice adaptation; (g) bypassed work procedures; and (h) out of sequence or omission of one or more steps in a process. Included antecedents were poorly designed workflows and knowledge of expected policies and practices. Consequences included achieving efficiency, personal satisfaction, process revisions and possible patient harm.

Conclusions. Workarounds occur because of individual human behavior or because of system issues within the process. When workarounds are used, there may be unintended patient harm by the nurse. Workarounds should be identified and evaluated for potential patient harm, and revisions to the system as appropriate, as well as more research to understand the type and frequency of workarounds.

***Keywords*.** workarounds, patient safety, medication administration, adverse event, concept analysis

Introduction

Workarounds have been used in industry along with health care organizations to circumvent known or intended processes, especially when processes are complex. Nurses often encounter these complex processes in providing care for patients, and sometimes processes are designed that do not match task workflows, thus creating the use of a workaround to complete the task. Debono et al. (2013) defines workarounds as “circumventing or temporarily ‘fixing’ an evident or perceived workflow block” (p. 2). Workarounds may be negative and introduce a patient safety risk, but they also may introduce a new, more efficient process. With the addition of technology, workarounds have become more prevalent within healthcare (Seaman & Erlen, 2015). When a complex process involving technology does not match the original workflow, nurses may find a workaround to the proposed process (Debono et al., 2013; Halbesleben, Savage, Wakefield, & Wakefield, 2010). Sometimes, these workarounds may cause unintended risk to patients by bypassing deliberate safety mechanisms.

In 2000, the Institute of Medicine (IOM) released a report stating that between 44,000 and 98,000 preventable medical errors occur to patients each year (Kohn, Corrigan & Donaldson, 2000). A subset of preventable errors includes medication errors that can occur during the medication administration process. More current estimates of preventable harm suggest that medication errors may occur at a rate of 1.6 events per 1,000 patient days (Choi et al., 2016). The process of administering medications to patients is complex with the possibility of committing an unintended error (Halbesleben et al., 2010). Research suggests that the medication administration process averages fifteen minutes, and nurses are faced with distractions during a complex, inefficient process (Elganzouri, Standish, & Androwich, 2009). Preventable errors can occur by using workarounds, creating potential patient harm, increased length of stay and increased overall cost of care (Keers, Williams, Cooke, & Ashcroft, 2013). Nurses may use workarounds while administering medications, creating an unsafe situation that may lead to preventable harm.

The purpose of this study was to conduct a concept analysis of workarounds during medication administration in the health care setting by identifying the defining characteristics, antecedents and consequences. Understanding the concept of workarounds from the health care provider perspective can be useful in the development of instruments that will measure the type and quantity of workarounds for procedures, such as medication administration, that can affect patient safety.

Background

Patient safety is defined as the acts, practices and processes that lead to intended or unintended patient outcomes (Braithwaite & Donaldson, 2016). Patient safety has been a priority for health care professionals, including nursing, with the intention of the creation of safe practices that improve patient quality outcomes (Botwinick, Bisognano, & Harden, 2006). Organizations provide structured processes and policies to guide the practice of nursing and prevent patient harm. Common structured processes include department specific policies, standardized workflows, and structured orientation for nurses. Together, these processes provide the nursing profession with the foundation and expectation of the organization for safe patient care.

The IOM's report, *To Err is Human,* outlined the importance of structured processes and their impact on patient safety (Kohn et al., 2000). When organizational systems fail, multiple issues may have occurred that may result in unanticipated interactions, and ultimately a series of events that may harm patients (Kohn et al., 2000). James Reason's (2000) Swiss Cheese Model, describes how mistakes occur when processes breakdown. Designing systems that have reliable defense layers that prevent or stop process breakdowns is important in error prevention.

Adverse events occur when an intended process is broken or not followed (Valentin, 2016). Nurses encounters several different types of adverse events within their practice, including medication errors, infections and patient readmissions. Sometimes patient adverse events are unavoidable, but many are preventable. Preventable adverse events may occur as much as 5.7 times per 1,000 patient days, costing the healthcare system $5,857 per patient (Cronenwett, Bootman, Wolcott, & Aspen, 2007). Prevention of adverse events begins with understanding the factors that make an event. A recent study found that an improvement in the safety culture of an organization may lead to a decrease in adverse events (Wang et al., 2014).

Nursing care in hospitals is a complex process involving multiple process steps. Within this complexity, nurses frequently are challenged with operational failures that distract from direct patient care (Tucker & Spear, 2006). Examples of operational failures that affect patient care include equipment and technology failures, distractions and interruptions, and inadequate supplies. When nurses face operational challenges in caring for patients, research shows that they will adapt their behavior to overcome these barriers (Tucker & Spear, 2006). Workarounds are used by nurses use to overcome operational failures.

The introduction of technology has been an important step within healthcare, creating safety checkpoints and barriers to prevent patient harm. When technology is added, or used to supplement a process, workarounds may be used by nurses to circumvent the technology (Debono et al., 2013). This has the potential to lead to errors and adverse events that could be prevented.

Currently, little research is available to measure the type and frequency of workarounds used by nurses when providing patient care. For example, workarounds can be used during the medication administration process, but there are not quantitative tools available to measure the extent to which workarounds are used. Consequently, as a precursor to developing an instrument, a concept analysis of workarounds used during medication administration is needed to understand its defining characteristics, antecedents, and consequences.

Methods

Design

The purpose of the concept analysis was to identify the type and frequency of workarounds when administering medications. The Walker and Avant (2005) method of concept analysis was used to complete the concept analysis. The process included four steps: (a) selecting the concept, (b) defining the characteristics, (c) identifying antecedents and consequences, and (d) developing a model case (Walker & Avant, 2005).

Data Sources

A literature search was conducted to understand the concept of workarounds in health care. Full text electronic searches were conducted through CINAHL, PubMed, Medline and Google Scholar using the keywords workarounds, nursing workarounds, nursing and patient safety between the years of 1999 – 2018. A total of 441 journal articles were reviewed through titles and abstracts relating to patient safety. Industries other than healthcare, such as engineering and information technology, were included because the term, workarounds, was developed through the engineering and information technology industries. Articles (*n*=86) were excluded that were not written in English or published prior to 1999. Each article was carefully reviewed to determine relevance to patient safety and workarounds. Once the initial screening was completed, 81 articles were retained based on their relevance to the key words of workarounds, nursing workarounds, and patient safety (see Figure 3.1). Sixty-two articles were excluded due to saturation of definitions or concepts. Nineteen articles were retained for full review after saturation through definitions was obtained. These nineteen articles were used for completing the concept analysis.

Data Analysis

The Walker and Avant (2005) method of concept analysis was used to complete the analysis. The process included four steps: (a) selecting the concept, (b) defining the characteristics, (c) identifying antecedents and consequences, and (d) developing a model case (Walker & Avant, 2005).

Results

Walker and Avant (2005) was used as a guide to structure the concept analysis. The definitions of the concept described below were developed to determine the defining characteristics, antecedents, and consequences of nursing workarounds.

Definitions of the Concept

The term workarounds is commonly used in the information technology and engineering disciplines. The Oxford Living Dictionary (2016) defines workarounds as “a method for overcoming a problem or limitation in a program or system”. The project management guide defines workarounds as “responses that were not initially planned but are required to deal with emerging risks that were previously unidentified or accepted passively" (Project Management Institute, 2004, p. 336). Halbesleben et al. (2010) explain that workarounds "differ from rework in that they are not specifically repeating the work process but represent deviations from the approved work process to reach the same outcome" (p. 125).

There are some common definitions in the literature that represent workarounds. Informal or temporary practices that are used to handle normal workflow frequently is used to explain the nature of workarounds (Blijleven, Koelemeijer, & Jaspers, 2017; Kobayashi, Fussell, Xiao, & Seagull, 2015; Soares, Jacobs, Vassilakopoulou, Tsagkas, & Marmaras, 2012; van der Veen et al., 2017; Vogelsmeier, Halbesleben, & Scott-Cawiezell, 2008). Halbesleben et al. (2010) additionally defined workarounds as work procedures that are undertaken to bypass perceived or real barriers in workflow. Two authors defined workarounds in terms of goal attainment. Seaman and Erlen (2015) defined workarounds as an "action performed by an individual to circumvent a block to achieve a desired goal" (p. 235) and Alter (2014) defined workarounds as a "goal driven adaptation, improvisation or other change in order to overcome one or more aspects of a current system" (p. 1044).

Koppel, Wetterneck, Telles, and Karsh (2008) defined workarounds as "staff actions that do not follow explicit or implicit rules, assumptions or workflows, or the intentions of system designers" (p. 409). There is not a specific definition in the literature related to medication administration, but this general definition of workarounds is being used for the purpose of this concept analysis on workarounds related to medication administration in acute care systems. Table 3.1 displays the definitions provided in the literature.

Defining Characteristics of Workarounds

According to Walker and Avant (2005), defining characteristics are the basis of the concept analysis. To provide nursing care within the health care setting, there are many complex processes that follow specified policies, procedures, and protocols (e.g., medication administration and computerized order entry). Workarounds are used when specified processes are circumvented either to overcome barriers in the workflow or workflow design problems. From the concept analysis, workarounds contain both human factors and system factors as part of the defining characteristics (see Table 3.1).

Human factors. Human factor characteristics are defined as characteristics that involve the individual care provider within the health care setting (Alter, 2014). From the literature, four human factor characteristics were identified: (a) goal driven adaptation or improvisation of a current policy or practice; (b) inconsistent practice or actions surrounding policy; (c) staff actions that do not follow implicit or explicit rules, assumptions, regulations of the system designers; and (d) intentional actions outside of the intended process (see Figure 3.2).

Goal driven adaptation/improvisation of policy/process. Processes may be adapted or changed in order to accomplish a specific goal (Alter, 2014; Lalley et al., 2010). The improvisation of policies or processes may occur in order to achieve a specific end goal that staff understands as important. Seaman and Erlen (2015) give an example of this type of adaptation where a nurse must use another nurse's username and password to obtain laboratory labels because their own identification would not allow proper access.

Inconsistent staff actions with policy. Staff may not follow policies as they were intended to be executed (Stutzer et al., 2102). This may occur because policies were written unclearly, there was a lack of orientation to policies or normalized deviance to policies. When a nurse follows the norms of their unit instead of researching documented policies, there may be inconsistent practice. Roder et al. (2016) states that the reasons that staff are not consistent will provide insight into the type of workarounds.

Actions do not follow explicit or implicit rules, assumptions, workflow regulations, or intention of system designers. Staff may not follow the intended processes or regulations as the designer of the system intended. The actions of staff may follow a different workflow based on what they have learned through their experiences of caring for patients or their personal interpretation of the rules (Koppel et al., 2008). An example is when a nurse understands that she must obtain a second verification check from another nurse for a high-risk medication. The nurse may decide that the task is over burdensome, understanding that the requirement is the rule of the organization.

Intentional actions outside of the process. Staff may choose to follow a process that is directly oppositional to the intended policy or practice (Alter, 2014; Djalali et al., 2015; Miller et al., 2011; Seaman et al., 2015; Soares et al., 2012; Yoder-Wise, 2015). This occurs when staff makes an intentional choice to act against the known policy or process. Koppel et al. (2008) give an example of this characteristic when a nurse disables an alarm that is needed to alert clinicians of a problem with a patient.

System factors. System factor characteristics of workarounds include actions that are derived from a system or organizational origin. System factor characteristics included: (a) nonstandard method for accomplishing work, (b) informal or temporary practice adaptations, (c) bypassed work procedures, and (d) nursing care processes occur when steps are performed out of sequence, or there is an omission of one or more of the intended steps (see Figure 3.2).

Non-standard method to accomplish work. Non-standard methods to complete a task occur when informal practices were adopted, and the standard policies and procedures were not used. This may occur if standard processes are not readily available or are not introduced adequately (Cresswell et al., 2017; Djalali et al., 2015; Halbesleben et al., 2010; Koppell et al., 2008; Lally et al., 2010; Miller et al., 2011; Seaman et al., 2015; Stutzer et al., 2015). An example of this would be when a nurse scans a patient's arm band taped to the side rail, instead of the patient's wrist. Vogelsmeier et al. (2008) states that staff quickly are able to adapt and change workflows to produce their intended results.

Informal and temporary practice adaptation. Informal and temporary practice adaptation occurs when staff uses a different option for the workflow because of a specific situation (Blijleven et al., 2107; Cresswell et al., 2017; Kobayashi et al., 2005; Soares et al., 2012; van der Veen et al., 2017; Vitoux et al., 2015; Vogelsmeier et al., 2008). An example of this might be excluding the use of a barcoding machine because the cord does not reach the patient's arm. There may be extenuating factors that allow staff to use a temporary adaption during workflow.

Bypassed work procedures. Procedures may be bypassed or omitted from a standard policy or practice (Alter, 2014; Rack et al., 2012; von der Veen et al., 2017). This may occur because the staff is not aware of the standard process steps or may occur with intentionality. Rack, Dudjack, and Wolf (2012) state that bypassed work procedures may occur when the nurse feels that the barcoding process is perceived as too cumbersome when giving medications and bypass the protocols outlined for safe administration.

Steps are performed out of sequence. When steps are not performed in the intended order, a workaround occurs (Miller et al., 2011; Rack et al., 2012, Seaman et al., 2015). This may occur when a nurse scans multiple patients outside of the patients' rooms prior to preparing to administer medications, instead of inside each individual patient's room. Koppell et al. (2008) states that this practice may occur because the process is too complex and may contain unnecessary steps.

Antecedents of Workarounds

According to Walker and Avant (2005), antecedents are events that occur prior to the concept. Antecedents must be present and occur prior to the health care provider (e.g., nurse) using a workaround to circumvent the process. Antecedents were identified that occurred at the human factor and the system factor levels (see Figure 3.2).

Human factors. Antecedents for the human factors included the health care provider (e.g., nurse): (a) understanding the established policies and processes; (b) recognizing inefficiencies in the process; and (c) having the ability to recognize a workaround. For the purposes of this article the term nurse will be substituted for the health care provider representing the human factors.

Understanding the established policies and processes. For a workaround to occur, the nurse must understand what the established policies and procedures for the intended process are (Alter, 2014; Blijleven et al., 2017; Halbesleben et al., 2010; Lalley et al., 2010; Miller et al., 2011; Roder et al., 2016; Vitoux et al., 2015). The policies and processes would outline the requirements and dictate the sequence of events.

Recognizing inefficiencies in the process. Nurses would recognize that the intended process may not be the most efficient with regards to their normal workflow (Creswell, et al., 2017; Roder, et al., 2016; Stutzer, et al., 2015; Yoder-Wise, 2015). The standard process may have additional safety steps built in that is not understood by the nurse who sees the process as inefficient rather that established for the safety of the patient. Often if nurses are not asked to provide input into the design of the process, they may not understand all the steps of the process. Additionally, repetitive steps may be a part of the standard process, and input from nurses at the design stage may have prevented these extra steps.

The ability to recognize a workaround. For a nurse to use a workaround, there must be an idea of a workaround that could be completed (Halbesleben et al., 2010; Miller et al., 2011; Roder et al., 2016; van der Veen et al., 2017; Vogelsmeier et al., 2008). Whether an omission of a step or circumventing the intended process, the idea of a workaround must originate from the nurse. Alter (2014) states that the ability to recognize a workaround is the step that appears directly after the recognition of the need for a workaround. If a nurse is caring for a patient who requires immediate pain medication and the patient's armband is unable to be scanned, the nurse may visualize a type of workaround to accomplish the task.

Systems factors. System level antecedents affect more than an individual and may involve institutional design. Antecedents as system factors include: (a) poorly designed workflows; (b) implementation barriers in training, design, or people; (c) barriers to workflow; and (d) dysfunctional processes that contain obstacles, exceptions, management expectations or structural constraints.

Poorly designed workflows. Workflows and processes that do not match how nurses do their work are areas that are open to workarounds (Blijleven et al., 2017; Koppel et al., 2008; Kobayashi et al., 2005; Soares et al., 2012; Yoder-Wise, 2015). Because of the complex nature of patient care and having goals for efficiency in the delivery of care, nurses are allowed to circumvent cumbersome processes, and workarounds are accepted (Miller et al., 2011). Not involving nurses in the design of workflows related to the delivery of patient care also could lead to poorly designed systems (Koppel et al., 2008).

Implementation barriers in training, design or people. Workarounds may occur when people are not adequately trained on the intended process (Djalali et al., 2015; Kobayashi et al., 2005; Soares et al., 2012; van der Veen et al., 2017). When there is inadequate training and design, individuals find creative solutions that may bypass specific steps. It is important for nurses to understand the rationale of specific steps in the process so that they are not circumvented, especially with unintended consequences affecting patient safety. Rack et al. (2012) found that nurses may omit barcoding when patient barriers are present, including isolation for certain disease processes.

Barriers to the workflow. Barriers may include new technology, technology breakdowns, or lack of technology. Additionally, distractions and interruptions often may create a barrier for a nurse intending to use a standardized process (Halbesleben et al., 2010; Soares et al., 2012). Seaman and Erlen (2015) provide an example when new technology is added to enhance a process, like the addition of a new laboratory system, but the label printers are out of paper, creating an avenue for nurses to use a workarounds to complete their tasks.

Dysfunctional processes that contain obstacles, exceptions, management expectations or structural constraints. Management expectations are important and set the tone for patient safety (Kobayashi et al., 2015; Roder et al., 2016; Stutzer et al., 2015). If workarounds are not identified and examined, errors may lead to adverse events. Koppel et al. (2008) describe these dysfunctional processes as incompatible with patient safety.

Consequences of Workarounds

Walker and Avant (2005) describe consequences as an event that occurs as a result of the concept. Consequences of workarounds include both human and system factors and can be negative as well as positive (see Figure 3.2).

Human factors. Human factors involve an individual deciding on a personal level. Human factor consequences of workarounds include: (a) achieving efficiency, (b) personal accomplishment, (c) rationalization of the workaround, and (d) patient satisfaction.

Achieving efficiency. When workarounds are used during inefficient processes, omitting steps may increase efficiency and be an intrinsic reward to a nurse (Alter, 2014; Creswell et al., ; 2017, Djalai et al., 2015; Miller et al., 2011; Seamen et al., 2015; Soares et al., 2012). This may lead a nurse to feel that the workaround is a more desirable option because of the increased efficiency. Nurses may omit steps in the process that they deem duplicative or unnecessary in order to increase efficiency.

Personal accomplishment. Workarounds may create a sense of personal accomplishment as a task that was cumbersome has been made more efficient (Creswell et al., 2017; Roder et al., 2016; Stutzer et al., 2015). Accomplishment may leave the nurse thinking that the workaround is a positive choice. Administering a pain medication to a patient quickly, even while omitting safety steps, may increase the nurse's satisfaction of task accomplishment. Rack et al. (2012) describe the nurse's accomplishments as an increase in time savings that may be consciously or unconsciously understood.

Rationalization of the workaround. A nurse may rationalize their choice of a workaround because it achieved efficiency or brought a patient satisfaction (Blijleven et al., 2017; Roder et al., 2016). When this occurs, the nurse may be more likely to use the workaround in the future for the same patient or additional patients.

Patient satisfaction. Patient satisfaction is important to nursing, from a personal and a regulatory perspective (Halbesleben et al., 2010; Koppel et al., 2008; Rack et al., 2013; Stutzer et al., 2015; van de Veen et al., 2017). When a nurse utilizes a workaround, there may be increased patient satisfaction through delivery of specific medications or from the speed of delivery.

System factors. Consequences of system factors may have positive or negative impacts on the organization or the patient. System factor consequences included: (a) identification of system needs/revisions/problems; (b) revision of the system; (c) possible patient harm; and (d) achieving a desired level of efficiency, effectiveness, or organizational goals.

Identification of system needs/revisions/problems. When a workaround is used, the consequence may include the need to revise policies and procedures that govern the current process (Cresswell et al., 2017; Seaman et al., 2015). Identification of problems in a system may be understood after a workaround has been used or may be the product of a flaw in the design (Alter, 2014). For example, prior to barcoding, many organizations required nurses to obtain "double verification" such as double check and dual signatures. These steps are redundant once barcoding is introduced and should be identified and eliminated.

Revision of the system. The use of workarounds may have highlighted a defect in the system and the need for a system revision (Alter, 2014; Blijleven et al., 2017; Djalali et al., 2015; Roder et al., 2016; Soares et al., 2012; Yoder-Wise, 2015). Workarounds may demonstrate process steps that are unnecessary or overly cumbersome to the user. Koppel et al. (2008) state that revisions should occur after regular post implementation assessments. Nurses can provide input into the needed changes based on their experience of using the designed system. Patterson (2002) notes that system redesign after implementation is important to reducing workload burdens and decreasing a nurse's ability to circumvent the system.

Possible patient harm. Workarounds may cause unintended harm to patients through the omission of patient safety steps (Blijeven et al., 2017; Koppel et al., 2008; Miller et al., 2011; Roder et al., 2016; Soares et al., 2012; Stutzer et al., 2015; Vitroux et al., 2015; Vogelsmeier et al., 2008). When a step in the process is omitted or bypassed, a patient may experience harm that was unintended. A patient may be harmed if the nurse chooses to scan one medication for several patients, instead of scanning each individual medication. The incorrect medication may be delivered to the patient causing harm.

Achieving a desired level of efficiency, effectiveness, or organizational goals. Organizations may measure metrics related to timing and efficiency (Djalali et al., 2015; Seaman et al., 2015). Sometimes goals create unintended workarounds that were unknown in process development. Alter (2014) states that systems should be aligned in order to discourage unintentional misalignments.

Model Case Development

According to Walker and Avant (2005), a model case provides an example of the concept in an exemplar format and includes all the defining characteristics of workarounds. Consider the following model case of a nurse who uses a workaround while administering medications to a patient.

> The agency nurse is assigned to a unit, but he/she has not been trained on the policies and procedures of the unit, she only has been working on the unit for a few weeks. There is an *inconsistent practice* that occurs on the unit with a nonstandard orientation process. Since the agency nurse is not given a standard orientation, he/she decided to *adapt and improvise the process* by following a process from a previous employer.
>
> The nurse verifies the electronic order that the physician entered for Lorazepam 2mg IV every twelve hours. The nurse removes the medication from the automated dispensing cabinet and takes the medication to the patient's room. The nurse begins the process of medication administration by using the barcode scanner to read the patient's identification band. The band does not scan, and the barcoding machine gives an alarm that the identification band cannot be identified, an example of a technology barrier that may prevent the process from occurring as intended. The nurse *bypasses the standard work procedures* and decides to scan a patient label that is not attached to the patient, *circumventing the intended process*, as the information is the same as the identification band on the patient. The barcoding machine accepts the scan of the label. The nurse then scans the barcode on the medication and the machine allows the nurse to give the

medication to the patient. The patient begins to relax and take an active role in her care. The nurse is happy that her decision to improvise has caused the patient to achieve their intended outcome. The nurse is relieved and happy with the decision. The nurse then realizes that the label that was used to identify the patient was left in the room from a previous patient. The patient should not have received the dose of Lorazepam, as that patient had received it one hour earlier. The patient is monitored closely for any adverse reactions from excessive medication administration.

The nurse was able to *omit a step in the process* and use an *intentional step out of the process* because of the *informal and temporary orientation practice adaptation and nonstandard method for accomplishing the administration of the medication.* When nurses do not follow the *workflow regulations and the intention of the system design*, workarounds occur. These workarounds can create additional care requirements for the patient that was given the wrong medication, and in some case cause actual harm to the patient.

Empirical Referents

The final step in concept analysis is using empirical referents to validate the characteristics of the concept analysis (Walker & Avant, 2005). Empirical referents help to conceptualize the defining characteristics through measurable means such as surveys. Empirical referents for workarounds would include any previous studies that attempted to measure or quantify any aspect of workarounds (Walker & Avant, 2005).

In 2013, Halbesleben et al. developed an instrument to measure the intention of a nurse to use a workaround. The instrument measures the perceived blocks that nurses encounter when processes are poorly designed. The instrument measures four cognitive processes including: (a) nurses must perceive that a block exists; (b) they must alter their work process; (c) they must prefer to perform the task in the intended way; and (d) their motive must be to assist the patient (Halbesleben et al., 2013). This instrument represents the only current measurement tool of workarounds in the literature. However, the instrument does not measure the type and frequency of workaround that are done in the process of delivering nursing care.

Multiple observational studies have been conducted to understand the type and frequency of workarounds in healthcare. The most common observational studies look at medication administration and their potential for errors. In 2018, van der Veen et al. conducted a prospective observational study determining that the most common type of workarounds during medication administration were incorrect scanning, omission in scanning, and not scanning because the patient was not wearing an armband. Additionally, Rack (2012) used direct observation to understand the type of workarounds nurses use during medication administration. The research found that workarounds occurred when nurses omitted process steps, performed steps out of sequence, or used unauthorized steps.

Additional research has been conducted in other professional areas as well as to improve processes. Patterson (2018) conducted a literature review to understand the reasons for workarounds and their impact on patient safety. The review determined that there are multiple type of workarounds and that there is unlikely a way to predict a specific type of workaround that may be used. Interruptions and distractions as well as workarounds in supply management also have been explored using time-in-motion study methods (Tucker & Spear, 2006).

There is an abundant amount of qualitative research that has been conducted to understand the type and frequency of workarounds. The qualitative research suggests the type of workarounds occur because of technology and system failures, and that they may occur more frequently than seen through observational studies (Rack, 2012). However, quantitative research lags behind qualitative studies and is evolving, as there is a need for additional tools that measure the type and frequency of workarounds.

Discussion

The addition of technology within healthcare has improved efficiency and assisted in the risk mitigation to patients. Unfortunately, the technology additions have increased the complexity of patient care; consequently, health care providers are susceptible to using workarounds in processes using technology. While workarounds may aid in improving the efficiency of the overall process, they may cause unintended consequences and patient harm. It is important to recognize the type and frequency of workarounds that nurses undertake to determine ways to prevent unintended consequences, improve patient safety, and modification of processes when applicable.

This concept analysis focused on the characteristics that make workarounds unique and define the characteristics for a specific nursing context. The antecedents included in the concept analysis will assist nursing leaders to identify the high-risk situations that may be prone to workarounds. These processes should be reviewed for gaps and inconsistencies that may allow potential harm to patients. The consequences of workarounds can be both positive and negative; it is important the organizations use this information to revise systems, policies, and goals that will ultimately improve outcomes for both the patient and the health care provider.

Future Research

The next steps in research include development of an instrument that will quantitatively measure the type and frequency of workarounds. This concept analysis serves as a basis for instrument development. The completed instrument will aid nurse leaders understand the type and frequency of workarounds within their own practice areas. Nursing researchers would be able to use the instrument to quantify workarounds in different processes such as order entry, medication administration or infection prevention.

Relevance to Clinical Practice

While the prevention of harm in patients is a priority of healthcare professionals, especially nurses, unknowingly workarounds can present unsafe situations for the patient. Understanding the type and frequency of workarounds nurses use will lead to safer, more efficient processes that will in turn promote better care for patients. In addition to nursing, pharmacy and information technology professionals would benefit from understanding unsafe practices that may lead to medication errors. Multiple observational studies have been conducted to understand the type and frequency of workarounds, but there are no available instruments to validate the observations. When the type and frequency of workarounds are identified, nursing leaders will be able to understand patterns and reevaluate their workflows to create a safer environment for patients.

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Table 3.1

Review of Literature and Definitions and Defining Characteristics of Workarounds

Author(s) (year) Industry	**Definition of Workarounds**	**Defining Characteristics of Workarounds**							
		System Factors				**Human Factors**			
		Non-standard method for accomplishing work	Informal and temporary practice adaption	Bypassed work procedures	Out-of-sequence or omission of one or more steps in the process	Goal-driven adaptation/ improvisation of current process/ policy	Inconsistent practice/ staff actions with policy	Staff actions that do not follow explicit or implicit rules, assumptions, workflow regulations, or intentions of system designers	Intentional action outside the process
Alter (2014) Business/IT	Goal-driven adaptation, improvisation, or other change to one or more aspects of an existing work system in order to overcome, bypass, or minimize the impact of obstacles, exceptions, anomalies, mishaps, established practices, management expectations, or structural constraints that are perceived as preventing that work system or its participants from achieving a desired level of efficiency, effectiveness, or other organizational or personal goals.			X		X			X
Blijleven et al. (2017) Healthcare	Informal temporary practices for handling exceptions to normal workflow		X						
Cresswell et al. (2017). Healthcare	Non-standard method to accomplish a task	X	X						
Djalali et al. (2015) IT	No formal definition	X							X
Halbesleben et al. (2010) Healthcare	Work procedures that are under-taken to bypass perceived or real barriers in work flow	X							

Author(s) (year) Industry	**Definition of Workarounds**	**Defining Characteristics of Workarounds**							
		System Factors				**Human Factors**			
Kobayashi et al. (2005, April) Human Factors	Informal temporary practices for handling exceptions to normal workflow		X						
Koppel, et al. (2008) Healthcare	Staff actions that do not follow explicit or implicit rules, assumptions, workflow regulations, or intentions of system designers	X						X	
Lalley et al. (2010) Nursing	Plan or method to circumvent a problem (as in computer software) without eliminating it	X				X			
Miller et al. (2011) Nursing	No formal definition	X			X				X
Rack, et al. (2012) Healthcare	No formal definition			X	X				
Rathert et al. (2012) Nursing	Situation in which an employee devises an alternative work procedure to address a block in the flow of his or her work								
Röder et al. (2016) IT	Actual practices are not consistent with the designed use and official rules						X		
Seaman et al. (2015) Nursing	An action that is performed by an individual to circumvent a block in workflow and thereby achieve a desired goal	X			X				X
Soares et al. (2012). IT	Informal temporary practices for handling exceptions to normal workflow		X						X
Stutzer et al. (2015) Healthcare	No formal definition	X					X		
van der Veen et al. (2017) Healthcare	Informal temporary practices for handling exceptions to		X	X					

Author(s) (year) Industry	**Definition of Workarounds**	**Defining Characteristics of Workarounds**							
		System Factors				**Human Factors**			
	normal workflow								
Vitoux et al. (2015) BioMedical	No formal definition		X						
Vogelsmeier et al. (2008) Nursing	Informal temporary practices for handling exceptions to normal workflow	X	X						
Yoder-Wise (2015) Nursing	No formal definition								X

Figure 3.1

Search strategy and article selection process

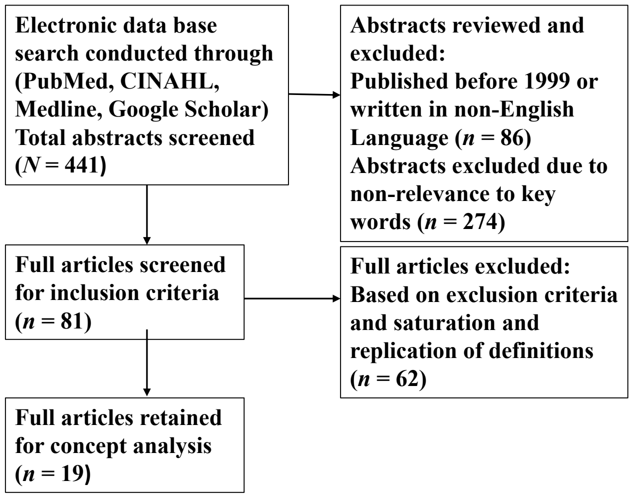
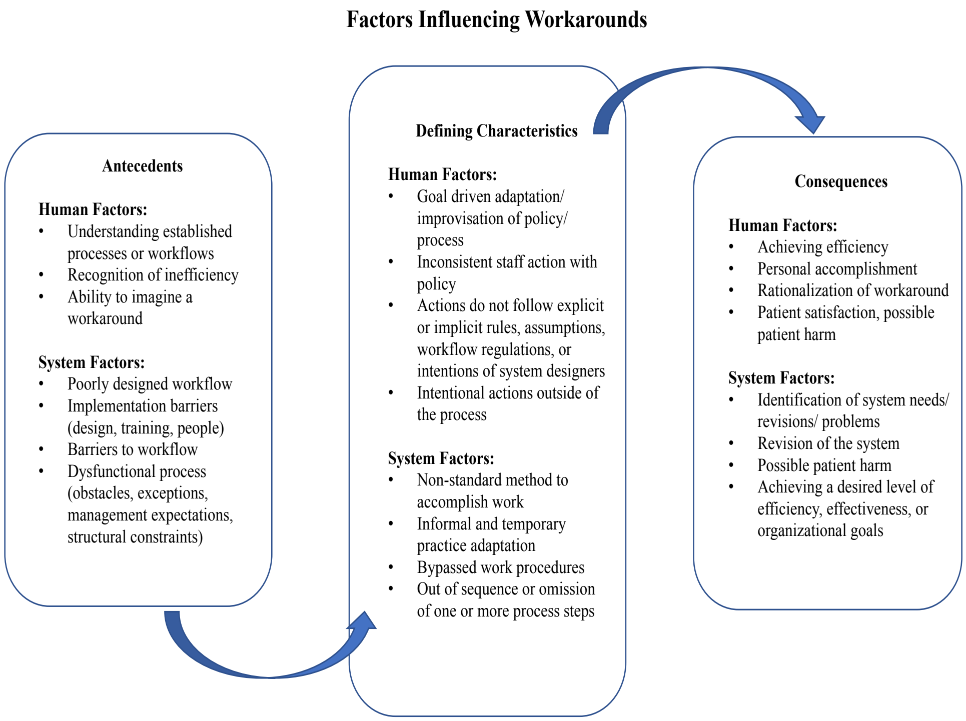


Figure 3.2

Human and System Factors Influencing Workarounds



Chapter 4

Validity and Reliability of a Newly Developed Instrument to Measure Nursing Workarounds During Medication Administration

This manuscript represents the development and preliminary psychometric testing of a newly developed instrument to measure the type and frequency of workarounds used by nurses when administering medications.

Abstract

Aim. The aim of this study was to assess the psychometric properties of a newly developed instrument that measured the type and frequency of workarounds when nurses administer medications to patients.

Background. According to patient safety literature, workarounds are used when processes are not clear and may not match intended workflows. There is no available quantitative instrument to measure the type and frequency of workarounds when nurses administer medications.

Design. Instrument development and psychometric evaluation descriptive study.

Methods. Items for the newly developed instrument were derived based on the concept analysis of workarounds, the psychometric evaluation included content validity, face validity, item analysis, dimensionality, reliability, and construct validity testing. The instrument was administered to registered nurses (RNs) in an acute care hospital in Northern Virginia.

Results. Psychometric evaluation of the newly developed instrument demonstrated adequate content and face validity. Based on exploratory factor analysis using principal axis factoring of the eighteen items, twelve items were retained comprising three subscales: (a) defining characteristics, (b) type of workarounds, and (c) frequency of workarounds. Cronbach's alpha ranged from .83 to .92 for the three subscales. As hypothesized, convergent validity was supported by Spearman *Rho* correlations ranging from .27 and .47 among the Halbesleben, Rathert and Bennett total and two subscales. Divergent validity was supported with *Spearman Rho* correlations ranging from -.09 to .15 with two other Halbesleben, Rathert and Bennett subscales.

Conclusions. The findings provided beginning evidence for the reliability and validity of the newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool comprised of three subscales—defining characteristics, types of workarounds and frequencies of workarounds.

Keywords. Workarounds, patient safety, medication administration, instrument

Introduction

Nurses who administer medications to patients participate in a complex process that can be prone to error. The process for medication administration involves multiple steps where nurses may encounter distractions and other environmental challenges in their effort to provide medications safely to their patients. Multiple patient safety and advocacy agencies have advocated for safer processes, including the addition of technology to decrease errors associated with medication administration (Cronenwett, Bootman, Wolcott, & Aspden, 2007; Morris et al., 2009). Barcoding was added to the medication administration workflow as an attempt to reduce errors and increase patient safety. While medication errors have decreased overall nationwide, serious medication errors continue to occur despite the use of technologies like barcoding (Truitt, Thompson, Blazey-Martin, NiSai, & Salem, 2016).

Workarounds are used when new technology is introduced and may not mirror the previous manual workflow (Debono et al., 2013). Nurses may seek to administer medications following a process flow that introduces unexpected steps or deletes important safety processes. While all workarounds are not bad, some may have an adverse impact on patients, including death. Understanding the type and frequency of workarounds used by nurses during the medication administration process may lead to improved outcomes that increase patient safety and reliability.

Background

Medication administration errors represent the largest source of adverse events within a hospital. It is estimated that adverse drug events may occur in over 2 million hospitalizations yearly, which increase the patient's length of stay and overall cost (Armstrong, Dietrich, Norman, Barnsteiner, & Mion, 2017). In 2000, the Institute of Medicine (IOM) released a report titled *To Err is Human,* stating that 44,000 to 98,000 patients are harmed annually by medical errors in the acute care setting (Kohn, Corrigan, & Donaldson, 2000). Current estimates state that those original estimates may be underrepresented. In 2007, the Institute of Medicine (Aspden, Wolcott, Bootman, & Cronenwett, 2007) estimated that each patient in as hospital might be subject to at least one medication administration error per day. Additionally, other estimates suggest 1.6 medication events per 1,000 patient days with an average cost of over $8,000 per event (Choi et al., 2016).

Since the IOM report, preventable interventions have been introduced with some success reducing the total number of medication errors, but errors still occur with direct patient harm and even death. Additionally, there is limited quantitative research to understand if preventative interventions are systemically effective (Westbrook, Raban, Lehnbom, & Li, 2016). Cescon and Etchells (2008) state that medication errors are common and underreported. Barcoding was introduced into the medication administration process to help confirm the five rights of administration (Koppel, Wetterneck, Telles & Karsh, 2008). While the technology to aid in medication administration has increased, a new patient safety issue has become apparent, introducing workarounds into an already error prone process.

Workarounds circumvent or temporarily change a process in order to meet a specific goal (medication administration) or bypass a specific step that is perceived as unneeded or cumbersome (Debono, et. al, 2013). Workarounds may potentially alter an intended process and sometimes directly affect patient safety. While all workarounds are not bad, some omissions in process may lead to patient harm. Generally, these deviations occur when nurses make assumptions or do not follow the prescribed workflow or implicit rules associated with the process (Koppel et al., 2008).

There has been little research to understand the type and frequency of workarounds while nurses administer medications. When any new technology is introduced, it is important to understand the changes in the medication administration process and examine any workarounds that may occur. The purpose of this study was to develop an instrument that would assist in identifying the type and frequency of nursing workarounds while administering medications. Understanding the type and frequency of workarounds will guide patient care leaders to design safer systems, potentially decrease safety risks for patients, and aid in future research.

Methods

Design

A quantitative, non-experimental design was used to examine the psychometric properties of the instrument that was developed to measure the type and frequency of workarounds when administering medications. An original instrument was developed from a concept analysis on workarounds (Savage, Park, Bott, & Wambach, 2020).

Instrument Development

Concept analysis. The development of the Savage Barcode-Assisted Medication Administration Workarounds Tool was derived from a concept analysis following the Walker and Avant method (Walker & Avant, 2005). A description of workarounds was created using relevant literature searches. For the purposes of this study, workarounds were defined as a method for overcoming a problem or limitation in a process or system during medication administration. Workarounds may be good or bad, but they represent an issue within the process or system.

Through the concept analysis, eight defining characteristics of workarounds were developed. They were: (a) goal driven adaptation or improvisation of a current policy or process; (b) inconsistent practice with policy; (c) staff actions that do not follow explicit or implicit rules, assumptions, workflow regulations, or intentions of system designers; (d) intentional action outside of the process; (e) nonstandard method for accomplishing work; (f) informal or temporary practice adaptation; (g) bypassed work procedures; and (h) out of sequence or omission of one or more steps in a process.

The delineation of a nursing behavior (e.g., administering medications) was developed based on a literature search and validation through registered nurses that currently administer medications. The medication administration process was defined and included the following five steps: (a) nurse takes medication to patient's room; (b) nurse identifies the patient (through patient room, verbal communication with the patient or reading the patient's armband); (c) nurse scans patient's arm band that is physically on the patient; (d) nurse scans medication; and (e) nurse administers the medication to the patient.

Item development. Using the defining characteristics from the concept analysis, a blueprint was developed to understand the scope and measure of workarounds. Items developed from the designed blueprint measured the major content areas of workarounds. Items for inclusion in the instrument were developed from the eight defining characteristics of workarounds and the five steps of the medication administration process. Nineteen items were created from the blueprint following the Waltz, Strickland, and Lenz (2010) method and were then combined with nine additional items of interest that may be used for future research for a total of twenty-eight items.

The instrument was divided into four sections. This first section contained a seven-item subscale that attempted to understand the characteristics of workarounds that nurses may use when administering medications based on the defining characteristics of workarounds. The first seven items (subscale 1) were rated using eight Likert-type options ranging from never (0) to always (7). The second and third sections had six items each and were developed to understand the type and frequency of workarounds when nurses administer medications. The second subscale asked the type of workarounds used by nurses with a response of “yes”, or “no”; and the third subscale asked the frequency of each specific workaround ranging from none (0) to seven or more (7). The three subscales are denoted as the Savage Barcode-Assisted Medication Administration Workaround Tool.

The last section of the instrument contained nine items that were not used for this study. The items were developed to understand the reasons that nurses used workaround and to clarify policies and procedures that nurses understood when administering medications and may be used for future research.

Content validity. Content validity can be defined as the ability of the proposed items to reflect the construct of workarounds (Grant & Davis, 1997). The Savage Barcode-Assisted Medication Administration Workarounds Tool was sent to three content experts that were identified as experts in workarounds, patient safety, or medication administration through research or professional position. The content experts were sent an email with the proposed items along with a description of the defining characteristics of workarounds that were derived from the concept analysis as well as the five steps of medication administration. Additionally, a scoring schema was sent to each expert to evaluate each item. Experts rated each item’s relevance on a scale of one to four, with “1” indicating non relevant to “4” indicating highly relevant. Experts were invited to add comments and complete an overall assessment of the tool relating to relevance, readability and grade level. Items were added, deleted, or revised based on feedback from the content experts. After the review sheets were returned from the content experts, a content validity index (CVI) was calculated based on the expert ratings. Each item was scored to determine item level CVI (I-CVI). Items that achieved a score of .67 were retained and considered useful. Items that did not meet the threshold were revised or deleted based on expert feedback. The subscale CVI (S-CVI) was calculated by computing the average of I-CVI's within each subscale. An S-CVI/Ave of .70 or higher was considered the criterion for achieving content validity.

Face validity. Face validity was conducted to understand the applicability of the tool with respondents that could potentially be administered the survey. The newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool was evaluated for face validity by recruiting ten registered nurses (RNs) that administered medications to patients within the previous two weeks. The ten RNs were identified by their nursing leader and were unknown to this researcher. The RNs were given a form to complete, rating each item on structure, readability, and applicability. After completion of the form, the RNs were interviewed by this researcher to understand their responses. The structure and wording of items were adjusted based on the feedback from the RNs that were interviewed after completing the survey.

Pilot Testing

Once content and face validity were established, the measure was pilot tested to examine the psychometric properties of the newly developed instrument.

Setting and sample. The acute care hospital used for recruitment was in Northern Virginia and had 18 acute care inpatient units and 430 beds. The hospital employs approximately 1,500 registered nurses (RNs). Exclusion criteria included RNs that could not read or write in English, and RNs that had not administered medications within the previous two weeks. Instrument design theory suggests a minimum sample size should be equal to 5-10 times the number of items, or 95 participants in this pilot study (Hair, Black, Babin, & Anderson, 2010). A response rate of 8.6% (174 RNs) was noted.

Procedures. Institutional Review Board approval was obtained through the University of Kansas. RNs were invited to participate in the survey by email using a link to the REDCap® survey. Participants gave implied consent by agreeing to complete the anonymous survey. Completion of the survey was allowed by answering "yes" to the following question, "Have you administered medications in the previous two weeks?" Initial and weekly email reminders requesting participation were sent to all RNs. Demographic information was collected on all participants including gender, age, and years of practice, years at the hospital, and years of education. No identifying information was collected on any participant. Demographic data were used to compare differences between the inclusion and exclusion groups.

Measures. In addition to the newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool on type and frequency of workarounds described above, the Halbesleben, Rathert, and Bennet Workaround tool (2013) measured the nurses' tendency to use a workaround. The instrument was administered in conjunction with the Savage Barcode-Assisted Medication Administration Workarounds Tool to assess convergent and divergent validity. The Halbesleben, Rathert and Bennett instrument included 20 items and used a four-point Likert-type scale ranging from strongly agree (1) to strongly disagree (4), with an average rating of 3.65. The instrument measured how RNs respond to their environment when engaging in a workaround, which could be environmental, social or operational. The Halbesleben, Rathert and Bennett scale was the most closely aligned instrument available after an extensive literature search.

Nine subscales measured four processes of workarounds, including: (a) perception of a block, (b) altering processes to work around block, (c) preferences for following procedures, (d) motive to assist a patient, and (e) four context subscales (i.e., technology, equipment, rules/policies, people, and work process design). A higher score represented a higher tendency to use a workaround. The subscales had strong internal consistency reliability with Cronbach's alphas ranging from .75 to .91.

Data analysis. Data analysis included content and face validity assessment, item analysis, dimensionality examination, reliability, and convergent and divergent validity assessment.

Content validity. The item content validity index (I-CVI) was calculated by dividing the sum of scores of the three experts for each item by the total score when the expert rated the item highly relevant and quite relevant (Waltz et al., 2010). Because there were only three raters, an item was determined to have item-level content validity if it scored greater than 0.67. Additionally, the average scale content validity index (S-CVI/ave) was calculated for each subscale. This calculation is completed by taking the sum of the I-CVIs divided by the total number of items in each subscale.

Item analysis. Descriptive statistics were assessed including percent of missing data, outliers and normality of the responses, means, medians, modes and ranges. Frequency and distribution statistics were evaluated.

Dimensionality. Exploratory factor analysis was completed, using principal axis factoring to understand what extent the newly created items matched the construct of workarounds in medication administration using barcoding. Bartlett's test of sphericity and

Kaiser Meyer Olkin test were conducted to determine if the item set was sufficiently related and if the factor analysis was the most appropriate method of evaluation. Inter-item correlations were examined to determine the relationship between items (Pett, Lackey, & Sullivan, 2003). Eigenvalues were reviewed to determine a factor solution and understand the total item variance explained by the factor. The scree plot was evaluated to determine break points for retention. Varimax rotation was to be used based on the correlation of the factors, however, due to sample size, each factor was analyzed separately. Items with factor loadings that scored greater than 0.30 were retained (Costello & Osborne, 2005).

Reliability. To understand the consistency and soundness of the instrument, data were examined using descriptive statistics and Cronbach's alpha (i.e., a measure of internal consistency) for each of the three subscales. A Cronbach's alpha value equal to or greater than .70 indicates that the items are correlated within the subscale. As the average inter-item correlation increases, the Cronbach's alpha increases (Cohen, 1977). Examination was conducted to assess inter-item and item-total correlations. Items that scored below 0.30 were removed and considered not sufficiently correlated.

Validity. Using the previously validated Halbesleben, Rathert and Bennett instrument, a convergent/divergent validity assessment was conducted to examine correlations with the newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool. Spearman's correlation was used due to non-normal distributions of the Savage Barcode-Assisted Medication Administration Workarounds Tool scores. For convergent validity, it was hypothesized that the newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool subscales would moderately correlate to the Halbesleben, Rathert and Bennett total scale and two subscales: (a) perception of a block and (b) altering processes to work around block to support convergent validity. For divergent validity, it was hypothesized that there would be low correlations between the newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool subscales and the Halbesleben, Rathert and Bennett two subscales: (a) preference for following procedures and (b) motive to assist patient since they were measuring different constructs.

Results

Content Validity

Based on the I-CVI for the defining characteristics subscale, one of the seven items was deleted from the subscale as all three experts did not rate this as relevant, retaining six items for subscale one (See Table 4.1). Originally, there were five items on each of the type and frequency subscales. The items were revised based on the suggestion of the content experts and a review with the research team; the item with an I-CVI of .33 was revised rather than deleted as it was one of the steps of the administration process, and one item related to scanning the patient armband ID was split into two new items based on the experience of the research team. The result was six items each for the type and frequency subscales. Comments from the content experts included adding an “I can’t remember” response to the yes/no items for types of workarounds and the frequency of workarounds. The S-CVI/ave for the defining characteristic subscale was .89 following the removal of the one item; and the S-CVI/ave for the type and frequency subscales was .73 for each. Consequently, there were 18 items on the revised subscales that would be used for pilot testing (see Table 4.1 for the revised Savage Barcode-Assisted Medication Administration Workarounds Tool).

Face Validity

The revised eighteen-item scale was given to 10 RNs to establish face validity. The RNs assessed the items for readability, and each RN was timed while completing the survey to determine an average amount of time for the pilot study. The RNs responded that the items were relevant and applicable to the medication administration process. No revisions were made to the items after the face validity was conducted.

Pilot Testing

The eighteen-item revised Savage Barcode-Assisted Medication Administration Workarounds Tool survey was distributed to approximately 1,500 RNs and was responded to by 174 RNs with a response rate of 8.6%. After data cleaning and the removal of subjects with missing data, the final sample of 112 RNs who administered medications within the past two weeks was used for data analysis. The participants were predominantly female (93.8%), worked on a medical-surgical unit (37.5%), and had less than five years of total nursing experience (51%). Demographic characteristics are displayed in Table 4.2. The analysis revealed that the group that answered ‘yes’ to having administered medications in the previous two weeks were significantly younger, had less overall work experience and less experience at the pilot hospital; additionally, more reported their education level was a Bachelor’s degree or lower. Frequency and distribution statistics revealed less than 5% missing data. Item characteristics were examined and are shown in Table 4.3.

Item analysis. The newly created instrument was pilot tested with eighteen total items that were used for analysis, each subscale containing six items. The mean of the defining characteristics subscale was 1.90 and the standard deviation was 1.00. Summed subscale score means were evaluated for the type of workaround subscale (M = 0.82, SD = 1.19) and the frequency of workaround subscale (M = 2.1, SD = 4.10). A summed scale mean was calculated since the subscales contained frequency responses. The defining characteristics subscale responses ranged from 0-7, with the actual response range noted to be 1.5-7. The type of workaround subscale response ranged from 0-3, with actual responses the same range. The last subscale, frequency of workaround, had a response range of 0-21 with and actual response range of 0-21.

Dimensionality. Because of the small sample size, each subscale was analyzed separately. The Bartlett's test of sphericity, which tests the overall significance of the correlation within the correlation matrix, was significant for all three subscales ($p < .001$). Additionally, Kaiser Meyer Olkin statistics for each subscale ranged from .721 to .809, indicating that it was acceptable to proceed with a factor analysis solution. Exploratory factor analysis using principle axis factoring was undertaken to examine the items in relationship to the three subscales of the workaround construct. The results are reported in Table 4.4.

One factor was associated with each subscale. In the Defining Characteristics subscale, one factor explained 49.2% of the variance. In this subscale, one item did not meet minimum factor loading (0.22), but when removed there was no significant increase in factor loadings, so the item was retained (Costello & Osborne, 2005). For the Type and Frequency of Workarounds subscales, three items explained 69.4% and 79.4% of the variance, respectively, after three of the items were deleted from each subscale that did not meet the minimum factor loading requirement. Six items were retained for the Defining Characteristics subscale (items 1-6); and three items each were retained for the Type (items 7, 9, & 11) and Frequency (items 8, 10, & 12) of workarounds subscales for further analysis.

Reliability. Inter-item and item-total correlations were examined (see Table 4.5). Items that did not correlate well (below .30) were removed, except for item five in the first subscale (Defining Characteristics). This item was retained as it did not change the correlation significantly when deleted. High reliability (Cronbach's alpha of .83) was supported as the Defining Characteristics Subscale (items 1-6). The Type of Workarounds subscale (items 7, 9, & 11)) had a Cronbach's alpha of .87, and the Frequency of Workarounds subscale (items 8, 10, & 12) had a Cronbach's alpha of .92 (see Table 4.4).

Validity. Convergent and divergent validity were assessed using the Halbesleben, Rathert and Bennett total scale and four subscales. As hypothesized, the three subscales of the Savage Barcode-Assisted Medication Administration Workarounds Tool had moderate correlations with the Halbesleben, Rathert and Bennett total scale (*Spearman Rho* =28-.35) and the two subscales—perception of a block (*Spearman Rho* = .35-.39) and altering work processes (*Spearman Rho* = .37-.48) (see Table 4.6). Additionally, divergent validity was supported by weak correlations with the two additional Halbesleben, Rathert and Bennett subscales—preference for following procedures (*Spearman Rho* = .02-.15) and motive to assist patient (*Spearman Rho* = -.09-.07).

Discussion

The Institute of Medicine's (Kohn, 2000) research discussed the implication of adverse medication events on patients. The advent of barcoding has decreased the amount of medication errors, but it has not eliminated them completely (Bates et al., 2001). An extensive literature search demonstrated that there was no instrument that was able to measure the type and frequency of workarounds. One instrument, The Halbesleben, Rathert and Bennett, was the closest instrument that measured a specific construct of workarounds, not specific to medication administration.

In this study, the type and frequency of workarounds nurses used while administering medications was examined by creating a newly developed instrument. The instrument was developed after a concept analysis was completed to understand the underlying defining characteristics of workarounds, specific to administering medications. Three content experts provided content validity, and face validity was assessed by RNs that had administered medications within the previous two weeks. The results were used to retain, revise or delete items. Internal consistency was measured using Cronbach's alpha and was supported by Cronbach's alpha values were greater than .8 for the retained items on the three Savage Workaround Barcode-Assisted Workaround Tool subscales.

Exploratory factor analysis, using principal axis factoring yielded a one-factor solution for each subscale with the initial solutions accounting for 49.2%, 69.4% and 79.4% of the variance. Convergent and divergent validity were supported by assessing the correlations among the newly developed subscales with the total scale and four subscales of the Halbesleben, Rathert and Bennett instrument. As hypothesized, the three subscales were moderately correlated with the overall Halbesleben, Rathert and Bennett scale, as well as the first two subscales that measured similar constructs showing support for convergent validity. Divergent validity was demonstrated when the Savage Barcode-Assisted Medication Administration Workarounds Tool subscales had low correlations to the last two subscales of the Halbesleben, Rathert and Bennett instrument. The content of the last two subscales was not relevant to the purpose of the Savage Barcode-Assisted Medication Administration Workarounds Tool.

Overall, the results of the psychometric testing demonstrated preliminary evidence of internal consistency and validity. These results were similar to findings from Halbesleben, Rathert and Bennett (2013) in the development of their instrument, the only workarounds instrument available for convergent validity testing at the time of this study. In the future the instrument should be validated using a larger, more diverse sample.

Limitations of the Study

There are several limitations to the study providing preliminary evidence of the reliability and validity of the Savage Barcode-Assisted Medication Administration Workarounds Tool. Though efforts were taken to increase survey participation, the sample size was smaller than expected. The pilot organization had recently issued a cyber-warning from the Information Technology office, asking employees to refrain from clicking on surveys and links that were unknown to them. A more comprehensive sample size would have strengthened the study even though good reliability and validity were achieved.

Additionally, the length of the survey may have limited the participation. Participants were asked to answer a total of 47 questions (including demographic information), which is a long survey for busy registered nurses. Lastly, the concept of workarounds may be challenging for nurses to discuss because of the negative connotation associated with the term workarounds as well as the modification of nursing practice from what is expected by procedure and policy.

Implications for Future Research

We created and evaluated a newly developed instrument that may provide insights into the type and frequency of workarounds. The instrument demonstrated good reliability and validity through exploratory factor analysis. Further evaluation using the Workarounds instrument with a larger and more diverse sample should be considered.

The results of this study provide implications for future research and nursing practice. The instrument has the potential to provide important information for nursing leaders when implementing new processes such as medication administration using scanners and barcoding. Since the process of administering medications is error prone, understanding the possible process steps that may be used as a workaround will assist nursing leaders understand potential problem steps. Understanding the type and frequency of workarounds that nurses may participate in while administering medications will allow nursing leaders to evaluate their processes and make modifications as appropriate. All workarounds should be examined and evaluated for potential patient safety risks and used to assist in redesigning the process to avoid error prone steps and possible injury to patients

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Table 4.1
Item and Scale CVI and Revisions to Items

Original Item **Domain: Defining characteristics**	**Item CVI**	**Revision to item based on review of content expert feedback**
Have you ever changed the process to administer medications in the past week?	1.00	In the past week, have you changed the accepted process at your organization to administer medications?
Have you ever administered medications and not followed the policy in the past week?	1.00	In the past week, have you administered medications and not followed the accepted policy at your organization?
Have you ever left out steps of the process when you administered medications in the past week?	1.00	In the past week, have you left out steps of the accepted process when you administered medications at your organization?
Have you ever added steps in the process when you administered medications in the past week?	1.00	In the past week, have you added steps to the accepted process when you administered medications at your organization?
Have you ever followed a different workflow when administering medications in the past week?	0	Item deleted
Have you ever performed the steps out of sequence when administering medications in the past week?	0.67	In the past week, have you performed the steps out of sequence when administering medications at your organization?
Have you had to adjust your normal process for administering medications to patients in the past week?	0.67	In the past week, have you had to adjust your standard practice when administering medications at your organization?
Subscale CVI	**0.89**	General comment: Move “In the past week” to the beginning of each question.
Original Item **Domains: Types (T) and Frequencies (F) of Workarounds**	**Item CVI**	**Revision to item based on review of content expert feedback**

Have you used the patient's room number to identify a patient prior to medication? (T)	0.33	In the past week, have you used the patient's room number to identify a patient prior to administering medications?"
How often in the past week have you entered the incorrect patient's room? (F)	0.33	In the past week, how many times have you used the patient's room to identify the patient prior to administering the medication?
Have you ever identified the incorrect patient when attempting to administer medication? (T)	0.67	In the past week, have you administered medications to patients without verifying their armband ID?
How often in the past week have you ever identified the incorrect patient? (F)	0.67	In the past week, how many times have you administered medications to the patient without identifying the armband ID?
Have you administered medication to a patient without using a barcode scanner in the past week? (T)	1,00	In the past week, have you administered medications to a patient without using a barcode scanner?
How often in the past week have you administered medication without using a barcode scanner? (F)	1.00	In the past week, how many times have you administered medication without using a barcode scanner?
Have you ever not scanned the patient's armband prior to administering medications in the past week? (T)	1.00	In the past week, have you administered medications and not scanned the patient's armband ID?
How often in the past week have you not scanned the patient's arm band? (F)	1.00	In the past week, how many times have you administered medication and not scanned the patient's armband ID?
New item (T)	NA	In the past week, have you scanned a patient's armband ID that was not physically attached to the patient prior to administering medications?
New Item (F)	NA	In the past week, how many times have you scanned a patient's armband ID that was not physically attached to the patient prior to administering medications?
Original Item **Domains: Types (T) and Frequencies (F) of Workarounds**	**Item CVI**	**Revision to item based on review of content expert feedback**

Have you ever not scanned the medicine barcode prior to administering the medication in the past week? (T)	0.67	In the past week, have you administered medications and did not scan the barcode on the medication?
How often in the past week have you not scanned the medicine barcode? (F)	0.67	In the past week, how many times have you administered medications and did not scan the barcode on the medication?
Subscale CVI	**0.73**	General Comments: Move "In the past week" to the beginning of each questions. Add a "I don't know" or "I can't remember" option for the response options for the type and frequency items.

Table 4.2
Demographic characteristics (N=112)

Variable		n	%
Gender			
	Male	7	6.3
	Female	105	93.8
Age*			
	Under 31	38	33.9
	31 - 40	39	34.8
	41 -50	15	13.4
	51 and older	18	16.1
Education			
	Bachelors and under	99	88.4
	Masters and over	13	11.6
Unit			
	Medical Surgical	42	37.5
	Intensive Care	23	20.5
	Womens and Children	16	14.3
	Other	31	27.7
Years at facility			
	<3 Years	43	38.4
	3 -5 Years	37	33
	6 - 10 Years	15	13.4
	11 -15 Years	8	7.1
	16 and over years	9	8
Total years nursing			
	<3 Years	21	18.8
	3 -5 Years	37	33
	6 - 10 Years	15	13.4
	11 -15 Years	13	11.6
	16 and over years	26	23.2

Note. **n*=110

Table 4.3
Item characteristics

Scale	Item	*M*	*SD*	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Scale Factor Cronbach's alpha
Defining Characteristics Scale		1.90*	1.00			.83
Subscale[a]						
	1	2.06	1.64	.61	.81	
	2	1.80	1.42	.66	.80	
	3	1.77	1.29	.74	.78	
	4	1.74	1.16	.48	.83	
	5	2.03	1.36	.42	.84	
	6	1.93	1.17	.80	.77	
Type of Workaround Scale		0.82**	1.19			.87
Subscale[b]						
	7	0.29	0.46	.80	.76	
	8	0.21	0.41	.71	.85	
	9	0.31	0.47	.74	.82	
Frequency of Workaround Scale		2.1**	4.10			.92
Subscale[c]						
	10	0.80	1.63	.88	.85	
	11	0.57	1.34	.80	.91	
	12	0.73	1.44	.84	.88	

** Mean subscale score*

*** Summed subscale score*

[a]Subscale Range = 0-7; Actual range = 1-5.7

[b]Subscale Range = 0-3; Actual range = 0-3

[c]Subscale Range = 0-21; Actual range = 0-21

Table 4.4
Factor analysis

		Factor *	Communality
Item 1		.673	.452
Item 2		.719	.516
Item 3		.821	.675
Item 4		.542	.294
Item 5		.472	.222
Item 6		.889	.791
	Eigenvalue	2.951	
	% total variance	49.187	
	Total variance	49.187	
Item 7		.913	.834
Item 8		.77	.592
Item 9		.81	.655
	Eigenvalue	2.082	
	% total variance	69.413	
	Total variance	69.413	
Item 10		.955	.912
Item 11		.833	.695
Item 12		.880	.775
	Eigenvalue	2.382	
	% total value	79.402	
	Total variance	79.402	

*Items 1- 6: Defining Characteristics subscale;

*Items 7, 9 & 11: Type of Workarounds;

*Items 8, 10 & 12: Frequency of Workarounds

Table 4.5
Inter-item correlation

Defining characteristics Subscale Items

	Item 1	Item 2	Item 3	Item 4	Item 5
Item 1					
Item 2	0.66				
Item 3	0.545	0.612			
Item 4	0.306	0.324	0.42		
Item 5	0.257	0.237	0.429	0.261	
Item 6	0.53	0.579	0.712	0.6	0.505

Types of Workaround Subscale Items

	Item 7	Item 8	Item 9
Item 7			
Item 8	0.703		
Item 9	0.74	0.622	

Frequency of Workarounds Subscale Items

	Item 10	Item 11	Item 12
Item 10			
Item 11	0.797		
Item 12	0.841	0.733	

Table 4.6
Convergent and divergent validity

		Convergent			Divergent	
		Halbesen Total[a]	Halbesen Part 1[b]	Halbesen Part 2[c]	Halbesen Part 3[d]	Halbesen Part 4[e]
Defining Characteristics Scale	Correlation coefficient	.348**	.374**	.475**	0.148	0.077
	p-value	0.001	0.00	0.00	0.183	0.489
	n	89	89	88	83	83
Type of Workround Scale	Correlation coefficient	.276**	.345**	.389**	0.024	-0.09
	p-value	0.008	0.001	<.001	0.83	0.417
	n	90	90	89	84	84
Frequency of Workaround Scale	Correlation coefficient	.278**	.388**	.370**	0.024	-0.091
	p-value	0.008	0.001	<.001	0.832	0.409
	n	90	90	89	84	84

[a] Halbesleben, Rathert and Bennett Total Scale
[b] Halbesleben, Rathert and Bennett Subscale/ Perception of a block
[c] Halbesleben, Rathert and Bennett Subscale/Altering processes to workaround
[d] Halbesleben, Rathert and Bennett Subscale/Preference for following procedures
[e] Halbesleben, Rathert and Bennett Subscale/Motive to assist patient
**Spearman Rho correlation is significant at the 0.01 level (2 tailed)

Chapter 5

This chapter includes a summary and discussion of the major findings of the research presented in chapters two through four. Study strengths and limitations are presented along with the implications for nursing practice and future research.

Summary

Workarounds occur when a process is circumvented because of several factors. The reasons to circumvent a process may be environmental, personal or systemic in nature. Not all workarounds are bad, but some may contribute to adverse events and even patient harm. During the comprehensive literature search, it was noted that there were no quantifiable instruments available to measure the type and frequency of workarounds when nurses administer medications. While there is an abundance of available research attempting to understand the qualitative aspect of workarounds in nursing, quantitative research methods were lacking. This study sought to examine the current research and develop an instrument to understand the type and frequency of nursing workarounds when administering medications.

Initially a comprehensive literature search was conducted to understand the concepts of workarounds, human factors engineering, medication administration, and patient safety. The literature demonstrated a moderate amount of research to understand workarounds and the reasons that nurses encounter and participate in them. Workarounds occur when a process is circumvented because the process does not match the process flow or because the process is cumbersome or lacking structure. Workarounds can contribute to adverse patient outcomes or even death. Qualitative research has attempted to understand the reasons that nurses use workarounds, mainly by direct observation or interview techniques.

A concept analysis was conducted to understand the constructs of workarounds and medication administration. The concept analysis was used to develop a definition of workarounds and provide construct development. The concept analysis provided a blueprint for item creation. Items were created and used to develop a newly developed instrument which was ultimately used in a study to evaluate the preliminary psychometric properties. Three manuscripts were developed to present and disseminate the findings of this dissertation study. The following summary discusses the purpose and importance of each manuscript in understanding workarounds while administering medications.

Results

Manuscript One

This manuscript presents the findings from a comprehensive literature search to understand the current state of research on workarounds and medication safety. The manuscript summarizes the research that has been conducted and identifies the current gaps in the literature. The manuscript was submitted to the *Journal of the American Medical Informatics Association*.

A comprehensive literature search was conducted to understand the state of the science. During the literature review, research articles were retrieved using the key search words of patient safety, workarounds, nursing and medication administration.

Administering medications is a multistep process that can be error prone. Research has shown that patients suffer harm and even death when mistakes are made during the medication administration process. Recently, increased technology like barcoding has improved the safety of medication administration, but the process is still not error free. Nurses sometimes participate in workarounds to circumvent steps in the medication administration process. After a comprehensive review of the literature, it was noted that there were no instruments available to measure the type and frequency of workarounds when nurses administered medications to patients. The manuscript identified the gap of quantifiable research and the need for nursing leaders to be able to determine the type and frequency of workarounds while nurses administer medications. This type of research would aid nursing leaders in preventing future errors and patient harm.

Manuscript Two

The Walker and Avant (2005) method of concept analysis mapping was used to understand the antecedent, defining characteristics, and the consequences of using workarounds to circumvent a process step or multiple steps when administering medications. The manuscript will be submitted to the *Journal of Advanced Nursing.*

Eight defining characteristics were identified as either human or system factors that described workarounds: (a) goal driven adaptation or improvisation of a current policy or process; (b) inconsistent practice with policy; (c) staff actions that do not follow explicit or implicit rules, assumptions, workflow regulations, or intentions of system designers; (d) intentional action outside of the process; (e) nonstandard method for accomplishing work; (f) informal or temporary practice adaptation; (g) bypassed work procedures; and (h) out of sequence or omission of one or more steps in a process. Additionally, the antecedents of poorly designed workflows and understanding expected policies and procedures were identified. The antecedents were poorly designed workflows and knowledge of expected policies and practices.

Consequences of the workarounds during medication administration included efficiency, personal satisfaction, process revisions and possible patient harm.

The findings of the study provide important information for the development of an instrument that measures the type and frequency of workarounds that nurses use when administering medications to patients. Given the lack of available quantitative methods to measure the type and frequency of workarounds while administering medications, the concept analysis provided a blueprint for item development for a newly created instrument. An instrument would allow nursing leaders to quantify workarounds and determine if their nurses were participating in error prone processes that may impact patient care and safety.

Manuscript Three

Manuscript three presents content and face validity and the psychometric evaluation of a newly developed instrument to measure the type and frequency of nursing workarounds while administering medications. The manuscript will be submitted to the *Journal of Nursing Measurement.*

Using the defining characteristics from the concept analysis, a blueprint was developed to understand the concept of workarounds. Items were developed from the blueprint containing the eight defining characteristics from the concept analysis and the five steps of the medication administration process. Twenty-eight items were developed, of which nine were not used for this study. They were designed for a future study to understand the reasons that nurses used workaround and to clarify policies and procedures that nurses understood when administering medications.

Content validity was established when the remaining 19 items were sent to three reviewers identified as experts in patient safety, nursing and medication administration. Each expert rated each item on a scoring schema and items were deleted or revised based on their assessment. As a result, 18 items made up three subscales: (a) defining characteristics (6 items), (b) type of workarounds (6 items), and (c) frequency of workarounds (6 items) that were used for data collection and further testing. After content validity the new instrument was presented to registered nurses that administer medications to patients for face validity. Ten registered nurses that had administered medications to patients within the previous two weeks evaluated the instrument for structure and readability and provided feedback.

Once content and face validity were accomplished, the survey containing the newly developed Savage Barcode-Assisted Medication Administration Workarounds Tool with eighteen items was completed by 174 RNs from a Northern Virginia acute care hospital. After data cleaning and checking for missing data, a final sample of 112 RNs had complete data that could be analyzed for this study. Demographic data were collected on all survey participants, and both groups were examined noting that the group that administered medications to patients in the previous two weeks were statistically younger, had less work and hospital experience, and held a Bachelor's degree or lower.

Exploratory factor analysis, using principal axis factoring with Varimax rotation yielded a one factor solution for each subscale (i.e., defining characteristics, type of workarounds, and frequency of workaround) with the initial solutions accounting for 49.2%, 69.4% and 79.4% of the variability, respectively. Examining the factor loadings, three items each were removed from the Type and Frequency of workarounds subscales. The final Savage Barcode-Assisted Medication Administration Workarounds Tool contained twelve items—defining characteristics

(6 items), type of workaround (3 items), and frequency of workaround (3 items). The three subscales showed Cronbach's alpha values ranging from .83 to .92, indicating good internal consistency reliability of the subscales.

Validity testing was completed by examining correlations between the Halbesleben, Rathert and Bennett total score and four subscales with the three subscales of the Savage Barcode-Assisted Medication Administration Workarounds Tool. As hypothesized, there were moderate correlations (*Spearman Rho = .28- .48*) between the three subscales of the Savage Barcode-Assisted Medication Administration Workarounds Tool with the total scale and the first two subscales of the Halbesleben, Rathert and Bennett instrument. Divergent validity also was demonstrated with weak correlations (*Spearman Rho = -.09 - .15*) between the three subscales of the Savage Barcode-Assisted Medication Administration Workarounds Tool with the third and fourth subscales of the Halbesleben, Rathert and Bennett instrument.

The revised instrument demonstrated content and face validity as well as preliminary evidence of reliability and validity. There was also evidence of convergent/divergent validity. Further research should be explored to confirm the results with a larger, more diverse sample size.

Discussion

Strengths of the Study

An extensive literature search was conducted to understand the research on workarounds and patient safety. This literature search was used to create a concept analysis to understand meaningful constructs related to workarounds. The instrument contains three subscales totaling twelve items that easily could be administered to front line nurses when new technology is introduced to the medication administration process. The Savage Barcode-Assisted Workarounds Instrument showed positive results that should guide future research of workarounds during medication administration.

Limitations of the Study

Limitations of the studies in Manuscript One and Manuscript Two may include missed relevant research pertaining to workarounds and medication safety. The concept analysis was completed based on a comprehensive literature search. A limitation of the analysis would be limited to the current literature search and may not reflect additional research that was in the process of development. Therefore, while a comprehensive literature search was completed, some of the available research may not have been included.

One major limitation of the psychometric evaluation study (Manuscript Three) was the sample size of the respondents. Only one acute care hospital was used to recruit participants. Sample diversification should be considered in future research. Confirmatory factor analysis testing with a broader, more diverse sample may be warranted to validate the items to the construct of medication administration workarounds.

The number of questions for this study (47 items which included demographic information) that respondents were asked to answer may have been a barrier to completion and contributed to a lower completion rate. Another limitation was that this hospital recently had a warning from their Information Technology department to refrain from clicking on links that were unknown to the user. This warning prevented more nurses from accessing the survey and may have led to decreased response rates.

Additionally, workarounds are difficult for nurses to discuss, as they generally represent deviance from policies or practice and are sometimes associated with a negative connotation. “Normalization of deviance” is a phase that Dr. Diane Vaughan (2004) used to describe the Challenger space shuttle disaster. The phrase describes when a behavior becomes normal even if it deviates from the correct procedure. This concept has been researched in multiple areas as well as healthcare to understand why these deviations occur. The reasons that registered nurses deviate from approved policies and protocols should be researched to understand if normalized deviance is a contributing factor to medication administration errors. Consideration should be given to face validity and the complexity of the term workarounds. Since workarounds may have a negative connotation and given the low mean scores of the pilot study, additional face validity might be beneficial to understand RN’s comfort in honestly answering questions related to this sensitive topic. Future research might seek to understand if RN’s are likely to rate their answers honestly or if the items would benefit from additional changes.

Implications for Practice and Research

Practice implications

The review of the literature demonstrated a moderate amount of research to understand nursing workarounds and their impact on patient safety. While researchers have demonstrated that workarounds may be dangerous and affect patient safety, there was no research available to quantify the type and frequency of workarounds when administering medications. Findings from this study have important implications for clinical practice and medication administration. The identification of the type and frequency or workarounds when nurses administer medications will allow leaders to examine their processes when new technologies are introduced that involve medication administration. The comprehensive literature review demonstrated that processes should be examined to understand where workarounds may occur within specific areas. The newly developed Savage Barcode-Assisted Medication Workarounds Instrument would enable nursing leaders to measure the types of workarounds used currently and the frequency of their use.

Additionally, pharmacists may be interested in this type of research because of the multiple steps of medication administration. Pharmacists monitor the ordering and dispensing of medications which are closely interrelated to the administration steps. Informatics professionals may be interested in the human factors engineering aspect of this research. Understanding the workflow and technology challenges of medication administration will drive professionals to design more efficient and safer medication administration systems.

When developing new technologies to aid nurses, sometimes the process does not follow the regular practice of nursing. It is important to understand not only how the system is intended to function, but how nurses interact with the process. The development of this instrument will grant easy access to leaders to inform them of unintended breaks or consequences within their processes.

Future research implications

This study revealed implications for future research. While the study focused on the type and frequency of workarounds while administering medications, more research is needed to understand the reasons nurses use workarounds in general. Knowing the reasons that nurses use workarounds may give insight to designers who develop systems to understand the implications.

The newly created Savage Barcode-Assisted Medication Workarounds Instrument may be used to identify workarounds in other areas of technology. Since this instrument only reviewed workarounds from a medication administrative perspective, additional instrument modification and testing would need to occur in order to see if the instrument could be widely used beyond the scope of medication administration.

Conclusion

In conclusion, this study identified the state of the literature, created a concept analysis and developed a new instrument to measure workarounds while nurses are administering medications to patients. Based on the results of the concept analysis, a new instrument was developed, and psychometric testing demonstrated preliminary evidence of reliability and validity. The revised instrument demonstrated content and face validity as well as preliminary evidence of reliability and validity. There was also evidence of convergent/divergent validity. Further research should be explored to confirm the results with a larger, more diverse sample size. The results of this study will provide an instrument for nursing leaders to use when evaluating new technology during medication administration that has the potential to improve patient safety and prevent adverse medication events.

References

Halbesleben, J., Rathert, C., & Bennett, S. (2013). Measuring nursing workarounds: Tests of the reliability and validity of a tool. *Journal of Nursing Administration, 43*(1), 50-55.

Vaughan, D., (2004). Theorizing disaster: Analogy, historical ethnography, and the Challenger accident. *JSTOR, 5*(3), 315-347.

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Appendix A

Consent for Recruitment

Dear [XX]

My name is Marian Savage and I am a student in the PhD program at the University Of Kansas School Of Nursing. We are contacting you because you are a nurse who works at Virginia Hospital System (VHC). We are recruiting research participants to help us determine the type and number of workarounds that nurses may use when they administer medications to patients. Participation involves completing a survey that will take about 20 minutes. No identifiable information will be collected about you, and the survey is anonymous. In addition to the survey questions, we will request information on the type of unit you work on, your number of years of experience, your number of years at VHC, education level, gender, and age. The survey link is provided below.

There are no personal benefits or risks to participating in this study. Participation is voluntary, and you can stop taking the survey at any time. Participation or declining will have no impact on your work or performance at VHC.

If you have any questions, please contact Marian Savage at msavage3@kumc.edu. For questions about the rights of research participants, you may contact the KUMC Institutional Review Board (IRB) at (913) 588.1240.

Sincerely,

Marian Savage, MSN, RN, NEA-BC, CPHQ, PMP

Doctoral Student

The University of Kansas, School of Nursing

Appendix B

Demographic Data

Unit that you work on currently:

1) Medical Surgical
2) Intensive Care Unit
3) Labor and Delivery/ Mother and Baby
4) Inpatient Rehabilitation
5) Behavioral Health
6) NICU
7) Other, please list:___________________

Overall years of nursing experience:

1) < 1 year
2) 1-2 years
3) 3-5 years
4) 6-10 years
5) 11 -15 years
6) 16 or greater years

Overall years of nursing experience at VHC:

1) < 1 year
2) 1-2 years
3) 3-5 years
4) 6-10 years
5) 11-15 years
6) 16 or greater years

Highest education level attained:

1) Associates degree/ Diploma
2) Bachelor's degree
3) Master's degree
4) Doctoral degree

Gender:

1) Male
2) Female

Age:

1) 25 and under
2) 26 - 30
3) 31 - 40
4) 41 – 50
5) 51 years or greater

Have you administered medications to a patient within the previous two weeks:

1) Yes
2) No

Survey will not continue for respondents that answer “no” to the medication administration question.

Appendix C

Halbesleben, Rathert and Bennett Workaround Tool

Halbesleben, J., Rathert, C., & Bennett, S. (2013). Measuring nursing workarounds: Tests of the reliability and validity of a tool. *Journal of Nursing Administration, 43*(1), 50-55.
Used with permission and reprinted here in whole.

Four-point Likert-type scale from (1) Strongly agree to (4) Strongly disagree

1. Problems with technology prevent me from completing tasks as well as I would like to.

2. Problems with equipment prevent me from completing tasks as well as I would like to.

3. Rules or policies prevent me from completing tasks as well as I would like to.

4. Other people prevent me from completing tasks as well as I would like to.

5. Poorly designed work processes prevent me from completing tasks as well as I would like to.

6. I have to alter my work process because of problems with technology.

7. I have to alter my work process because of problems with equipment.

8. I have to alter my work process because rules or policies keep me from doing my job efficiently.

9. I have to alter my work process because other people keep me from doing my job efficiently.

10. I have to alter my work process because my work processes are not well designed.

11. When possible, I follow procedures regarding use of technology.

12. When possible, I follow procedures regarding use of equipment.

13. When possible, I follow rules and policies at work.

14. When possible, I follow intended work processes even when they are poorly designed.

15. When given the choice between following procedures or taking a shortcut, I prefer to follow procedures.

16. When I have to alter my work process because of problems with technology, I do so to better assist a patient.

17. When I have to alter my work process because of problems with equipment, I do so to better assist a patient.

18. When I have to alter my work process because rules or policies, I do so to better assist a patient.

19. When I have to alter my work process because other people keep from doing my job, I do so to better assist a patient.

20. When I have to alter my work process because my work processes are not designed, I do so to better assist a patient.

Appendix D

Savage Barcode Assisted Medication Administration Workarounds Tool©

Response options for items 1 - 6: Never (0), Very Rarely (1), Rarely (2), Occasionally (3), Frequently (4), Very Frequently (5), Always (6)

1) In the past week, have you changed the accepted process at your organization to administer medications?
2) In the past week, have you administered medications and not followed the accepted policy at your organization?
3) In the past week, have you left out steps of the accepted process when you administered medications at your organization?
4) In the past week, have you added steps to the accepted process when you administered medications at your organization?
5) In the past week, have you performed the steps out of sequence when administering medications at your organization?
6) In the past week, have you had to adjust your standard process when administering medications at your organization?

Note:

Items 1-6 are a mean scale.

Response options for items 7, 9 & 11: Yes (1), No (2), I can't remember (3)

Response options for items 8, 10, & 12: None (0), Once (1), Twice (2), Three (3), Four (4), Five (5), Six (6), Seven or more (7), I can't remember (8)

7) In the past week, have you administered medications to a patient without using a barcode scanner?
8) In the past week, how many times have you administered medication without using a barcode scanner?
9) In the past week, have you administered medications and not scanned the patient's armband ID?
10) In the past week, how many times have you administered medications and not scanned the patient's armband ID?
11) In the past week, have you administered medications and did not scan the barcode on the medication?
12) In the past week, how many times have you administered medications and did not scan the barcode on the medication.

Note:

Items 7, 9, & 11 are a summed scale.

Items 8, 10, & 12 are a summed scale.