IMPLEMENTATION STRATEGIES TO IMPROVE CRITICAL CARE NURSES' KNOWLEDGE OF AND ADHERENCE TO EVIDENCE-BASED GUIDELINES

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Healthcare workers are responsible for providing evidence-based care to patients; however, many patients receive unnecessary or harmful care. Successful implementation of evidence-based guidelines can improve patient outcomes, particularly among vulnerable neuroscience patients. Focused efforts to improve nursing knowledge of and adherence to these guidelines are warranted. The purpose of this dissertation was to determine the most effective strategies for implementing evidence-based guidelines into nursing practice. First, an integrative review of the literature was conducted to explore studies addressing implementation of evidence-based guidelines in nursing. Implications from the review suggested further research to better understand which strategies should be utilized to best implement evidence-based nursing practices. Two pre- and posttest studies were then designed to identify a bundle of implementation strategies to improve neurocritical care nurses' knowledge of and adherence to stroke and spinal cord injury guidelines. The tailored, multi-faceted strategies consisted of local opinion leaders, printed educational materials, and educational outreach. Improvements in nursing knowledge of and adherence to these guidelines were noted. Lastly, program evaluations were conducted using a mixed-methods study to understand neurocritical care nurses' perceptions of the usefulness of the strategies employed during the two studies. Findings from this research provided support for the most effective implementation strategies to

enhance knowledge development and guideline adherence among neurocritical care nurses for implementation of stroke and spinal cord guidelines.

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CHAPTER ONE: FOUNDATION

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History

Despite growing evidence for nursing practice, implementation of evidence-based guidelines continues to be a major challenge with many patients receiving less than optimal care (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012). This chapter describes the scope and significance of implementing evidence-based practices and describes the concept of implementation science. The author's interest in this topic began when, as a direct care nurse on a neurocritical care unit, variations among nursing practices were noted. As this neurocritical care unit cared for vulnerable patient populations, a quest began to identify which practices were evidence-based and served to provide optimal care to these patients. It was then realized that even though evidence-based practices were published in guidelines and recommendations, a gap remained between the evidence and practices occurring at the bedside.

Along with being a direct care nurse, the author was also enrolled in a Clinical Nurse Specialist Master's program. Within this program, she conducted a Master's theses regarding nursing assessments and interventions for subarachnoid hemorrhage patients (Wuchner, Bakas, Adams, Buelow, & Cohn, 2012). This study influenced her thinking as a Clinical Nurse Specialist by identifying opportunities around implementation of subarachnoid hemorrhage guidelines. As she moved into a Clinical Nurse Specialist position, she had greater influence and more opportunities to improve implementation of these

guidelines. Initiatives to implement these practices were undertaken; however, not all were successfully sustained. Not only was this frustrating to the author, it was also challenging to nursing leadership, direct care nurses, and ultimately had the potential to affect patient outcomes.

Introduction

Implementing evidence-based practice has long been understood to improve patient outcomes by decreasing variations among practices. Yet, it has been cited that it takes some 17 years from the time new knowledge is identified until it reaches practice (Morris, Wooding, & Grant, 2011). Due to this research-practice gap, patients are failing to benefit from optimal therapy, with up to 25% of patients receiving unnecessary or even harmful care (Grimshaw et al., 2012; Grol, 2001). The Institute of Medicine recognizes these deficiencies and recently prioritized the dissemination and implementation of research into practice (Powell et al., 2012).

Successful implementation of evidence-based practices requires evidence-based processes (van Achterberg, Schoonhoven, & Grol, 2008). Implementation science has made great strides over the last several years, yet as the field expands there are noted issues. Use of inconsistent terminology and inadequate descriptions of strategies make it difficult to understand and advance the field (Baker et al., 2015; Ista et al., 2014; Nielsen & Randall, 2013). Further, there is a dearth of literature concerning implementation processes specific to nursing, one of the largest healthcare disciplines (Wuchner, 2014). The purpose of this dissertation is to add to the growing body of knowledge regarding

evidence-based implementation processes, with a narrowing focus on the neurocritical care nurse caring for stroke and spinal cord injury patients.

Background

Prevalence of nursing practice variation

Nurses play an integral role in caring for hospitalized patients, as this discipline spends the most time in direct patient care. Results from several studies suggest that 30% to 40% of patients do not receive care per evidence (Grol & Wensing, 2013; Grol, 2001). Weng et al. (2013) noted that among various groups of healthcare professionals (physicians, nurses, pharmacists, and allied healthcare professionals), nurses reported implementing evidence-based practices the least. Improving nursing knowledge of and adherence to evidence-based practices is one of the first steps to closing the nursing research-practice gap. Improved patient outcomes and decreased healthcare costs can ultimately be obtained by decreasing nursing practice variations through successful implementation of evidence-based practice.

Importance of implementation science

With the emergence of implementation science, efforts have been undertaken to study how to speed the process of implementation and use of evidence-based practices. Prioritization has been focused on implementation *strategies,* defined as “methods or techniques used to enhance the adoption, implementation, and sustainability of a clinical program or practice” (Proctor, Powell, & McMillen, 2013, p.2). However, due to a lack of conceptual clarity and insufficient, complex reporting of strategies, the acquisition and interpretation of

this science is complicated. Furthermore, these shortcomings "limit replication in both research and practice and ultimately stymie the translation and application of empirical studies that could inform implementation processes" (Powell et al., 2015).

Traditional strategies, such as passive dissemination, have not shown to be successful in sustaining translation of evidence into practice (Powell et al., 2015; Bernhardsson et al., 2014). Passive dissemination includes those strategies that are unplanned, untargeted, and uncontrolled, such as mass mailings and untargeted presentations (Rabin & Brownson, 2013). Tailored, multi-faceted strategies linked to identified determinants (i.e. barriers and facilitators) are believed to be more effective (Squires, Sullivan, Eccles, Worswick, & Grimshaw, 2014). Yet there is a lack of understanding of how strategies are linked to determinants and exactly how tailoring is accomplished (Emond et al., 2015; Gagliardi & Alhabib, 2015; Trogrlic et al., 2015). Further, it is unknown as to which grouping of multiple strategies is most effective (Powell et al., 2015; Bernhardsson et al., 2014).

It has been noted that many studies analyzing the effectiveness of implementation strategies include those that are inconsistently labeled, lack operational definitions and detailed descriptions, and are often not theoretically supported (Proctor et al., 2013). Proctor et al. (2013) state that "implementation strategies need to be fully and precisely described, in detail sufficient to enable measurement and 'reproducibility' of their components" (p. 1). The authors go on to offer recommendations for adequate reporting of strategies to enable this

reproducibility (Proctor et al., 2013). The Effective Practice and Organization of Care Group, a Cochrane Review Group, has conducted several reviews to offer conceptual definitions and detailed descriptions of common strategies in an effort to improve consistency among implementation researchers (Baker et al., 2015; Flodgren et al., 2011; Giguere et al., 2012; O'Brien et al., 2007).

These gaps in literature need to be mitigated with future research to identify which strategies are most effective to implement evidence-based practices. Further studies are warranted that include theoretical justification and detailed descriptions of how strategies were selected, tailored, and operationalized. Strategies should be consistently labeled and described as defined by the Effective Practice and Organization of Care Group. Further, focus on a particular population will be helpful in order to understand the processes among a narrow scope prior to studying the impact among other populations.

Prevalence of vulnerable neuroscience patients

The acute neuroscience population, including stroke and spinal cord injury patients, are at an increased risk of adverse events due to their disease process (Donnellan, Sweetman, & Shelley, 2013; Grossman et al., 2012). These patients are at risk for a variety of complications, including aspiration pneumonia, inadequate nutrition, urinary tract infections, venous thromboembolism, depression, falls, and hospital readmissions, among others (Donnellan et al., 2013; Grossman et al., 2012). Additionally, these neuroscience patients can incur high healthcare costs. For instance, stroke is one of the leading causes of

serious, long-term disability in the United States, with an approximate 30 day hospital readmission rate of 12.7% (Mozaffarian et al., 2015).

Likewise, spinal cord injury patients are susceptible to numerous long-term complications such as respiratory, urological, and musculoskeletal issues. Approximately one-third of all spinal cord injury patients are re-hospitalized each year for these secondary complications (DeJong et al., 2013; Munce et al., 2013). Length of hospital stay for spinal cord injury patients is nearly 3.3 days longer compared to general medical patients, accounting for increased healthcare costs (DeJong et al., 2013; Munce et al., 2013).

Despite these issues, there are numerous guidelines available to direct nursing care for these vulnerable patients (Marsolais et al., 2008; Miller et al., 2010; Summers et al., 2009). Many of these adverse events and complications can be reduced or even prevented by appropriate evidence-based nursing care per guideline recommendations (Duncan et al., 2005; Hubbard et al., 2012). Attention to these patient populations merit focused attention to improve evidence-based care provision. As such, efforts must be undertaken to understand the implementation process to expedite the translation of these practices to the bedside.

Problem Statement

Specific Aims

Although nurses need to provide evidence-based care per guideline recommendations to improve patient outcomes, evidence-based practices are not reliably provided to hospitalized patients. Vulnerable neuroscience patients

in particular are at an increased risk for complications that can be mitigated by evidence-based nursing care. Implementation science seeks to enhance the translation of evidence-based care into practice, yet opportunities to better understand and improve these processes require further study.

The purpose of this dissertation is to further the body of knowledge regarding implementation processes by applying a specific group or "bundle" of strategies during a Stroke Competency Program and further replicated during a Spinal Cord Injury Competency Program. Overall, this dissertation in its entirety aims to:

a) Provide a synthesis of current literature focused on implementation strategies to improve nursing adherence to evidence-based practices (Paper #1).
b) To explore implementation of theoretically-based processes to improve knowledge of and adherence to stroke guidelines among neurocritical care nurses (Paper #2).
c) To replicate implementation of these same theoretically-based processes to improve knowledge of and adherence to spinal cord injury guidelines among neurocritical care nurses (Paper #3).
d) To evaluate and explore the neurocritical care nurse's perceptions of the Stroke and Spinal Cord Injury Competency Programs using a mixed methods approach, with findings used for further program improvement (Discussion).

Theoretical Underpinnings

Grol and Wensing's (2013) Model of Implementation incorporates a comprehensive overview of several behavioral change theories and provides a stepwise approach to guide overall implementation processes (see Figure 1). The steps within this model include:

1. Develop a proposal for change
2. Analyze actual performance (baseline data) and identify targets for change (outcomes)
3. Analyze the target group and setting (identify determinants)
4. Selection of implementation strategies
5. Develop, test, and execute the implementation plan
6. Integrate the changes into routine practice
7. Evaluate and readjust the implementation plan

For this dissertation, much emphasis was placed on selection of implementation strategies, the fourth step of the model (Grol & Wensing, 2013). Within this step, Grol and Wensing (2013) provided potential implementation strategies based on identified determinants and took into consideration the different phases of change. This tailoring process allowed strategies to be selected based on the local context, helping to prevent inappropriate solutions (van Achterberg et al., 2008; Grol & Wensing, 2013).

In accordance with the model, measures were taken to first understand determinants to consistently implement evidence-based practices found in stroke and spinal cord injury guidelines (Grol & Wensing, 2013). Local discussions with

neurocritical care nurses, as well as through a quantitative survey question, yielded several determinants that have also been identified in the literature. The nurses noted that the guidelines were complex and the current educational materials were not easily accessible or helpful. Further, nurses perceived a lack of knowledge, motivation, time, and importance with using the guidelines.

Because of insufficient information regarding which strategies are most effective, this dissertation sought to identify a tailored bundle of strategies to mitigate the identified determinants within one neurocritical care unit. This bundle included the three implementation strategies: (a) local opinion leaders, (b) printed educational materials developed at the local level, and (c) educational outreach. Based on recommendations from Proctor et al. (2013), detailed descriptions of these implementation strategies and how they were used in this dissertation can be found in Table 1.

Conceptual Definitions

Implementation science

Implementation science has been defined as the "study of methods to promote the integration of research findings and evidence into healthcare policy and practice" (National Institutes of Health, 2010, p. 1). This relatively new term has previously been described as innovation diffusion, dissemination, knowledge translation, research utilization, and knowledge utilization, among others (Chaudoir, Dugan, & Barr, 2013; Eccles et al., 2009).

Implementation strategies

Within the study of implementation processes, the specific implementation strategies used to bridge the research-practice gap are defined as "methods or techniques used to enhance the adoption, implementation, and sustainability of a clinical program or practice" (Proctor et al., 2013, p.2). For this dissertation, programs were developed using the implementation strategies of local opinion leaders, printed educational materials, and educational outreach to improve neurocritical care nurses' knowledge of and adherence to stroke and spinal cord injury guidelines. As such, the term *program* throughout this dissertation refers to the bundle of these three implementation strategies.

Local opinion leaders

From the integrative review findings (Wuchner, 2014), as well as through a literature search, the three implementation strategies of local opinion leaders, printed educational materials, and educational outreach were identified and utilized for the manuscripts found in Chapters Three and Four. Local opinion leaders are "individuals perceived as 'credible,' 'likeable' and 'trustworthy.' Opinion leadership is the degree to which an individual is able to influence other individuals' attitudes or overt behavior… and in improving the behavior/practice of healthcare professionals and/or patient outcomes" (Flodgren et al., 2011, pp. 3, 5).

Printed educational materials

Printed educational materials are the "distribution of published or printed recommendations for clinical care, including clinical practice guidelines,

monographs, and publications in peer-reviewed journals, delivered personally or through mass mailings" (Giguere et al., 2012, p. 4). Furthermore, per recommendations within the implementation science literature, the printed educational materials used in this dissertation were developed at the local level to decrease complexity and promote understanding and adherence (Giguere et al., 2012).

Educational outreach

Lastly, the educational outreach strategy was used in this dissertation. Educational outreach includes the "use of a trained person …who meets with healthcare professionals in their practice setting to provide information with the intent of changing their performance" (O'Brien et al., 2007, p. 3).

Successful implementation

The three implementation strategies of local opinion leaders, printed educational materials, and educational outreach all seek to successfully implement stroke and spinal cord injury guidelines into practice to reduce the research-practice gap. Outcomes of successful implementation include the achievement and sustainability of the identified evidence-based practice, as well as patient and organizational goals (Helfrich et al., 2010). Whereas there is a lack of consensus regarding the conceptual definition of "successful implementation," Rycroft-Malone et al. (2013) defined this concept as "an orchestrated (active, planned) effort to make evidence-based changes by organizations, teams, and individuals that result in sustained improvements to care, patient outcomes, and service delivery, which are driven by and embedded

in organizational strategy. This definition includes the need to pay attention to the planning, process, and evaluation of the implementation activity in an iterative rather than staged approach" (p.10).

Adherence versus compliance

The terms adherence and compliance are very similar and have been used interchangeably in the implementation science literature. The integrative review in Chapter Two used the terminology of compliance, and provided discussion of nursing compliance with various evidence-based practice initiatives (Wuchner, 2014). Missing from this integrative review was a conceptual definition of compliance. Compliance means to follow, or literally to comply with, recommendations set forth by providers. This terminology implies a paternalistic role of the healthcare provider and a passive role of the patient (Aronson, 2007). Studies included in the integrative review used various terms interchangeably. For example, one study used *adherence* in the title of the article; however, discussed both *adherence* and *compliance* throughout the article (Huis et al., 2013).

Similar to compliance is the use of the term *adherence*, which has been defined as the extent to which behavior matches agreed recommendations and denotes an active role on both the part of the provider and patient (DiMatteo, 2004). Whereas these two terms share similar conceptual definitions, *adherence* is currently more widely accepted, as *compliance* has a perceived negative connotation. Adherence is felt to better reflect patients' changing needs; as such, it is now the recognized terminology (Aronson, 2007). To coincide with

current literature, the term *adherence* was adopted in the context of nurses' implementation of guidelines. While *compliance* was used in the integrative review in Chapter Two, the terminology was changed to *adherence* for Chapters Three and Four.

Organization of dissertation

Implementation science is a promising field of study to assist in understanding how to close the research-practice gap (Grol & Wensing, 2013). Identification of optimal implementation strategies can help to ensure patients are receiving the best known care. To begin, nurse's knowledge of and adherence to these guidelines must first improve. This dissertation has added to this growing body of knowledge of implementation processes. The remainder of the dissertation is organized into Chapter Two (Paper #1), Chapter Three (Paper #2), Chapter Four (Paper #3), with the 4th aim (qualitative evaluation in Chapter Five) to enhance the discussion.

Chapter Two. Paper #1: Integrative review of implementation strategies for translation of research-based evidence by nurses

Chapter Two, containing the first manuscript, is an integrative review evaluating eight studies that sought to identify effective implementation strategies to improve nursing adherence/compliance to evidence-based practices. However, due to the complexity of implementation strategies, there was difficulty in comparisons among studies. Also, strategies were not reported in a detailed enough way to allow reproducibility. As such, there was inconclusive evidence as to which multi-faceted bundle of implementation strategies was most effective

among studies included in the review. Implications suggested a need for more theoretically justified studies with detailed implementation strategies. Future research is needed to understand and identify which strategies are most effective for improving nurses' knowledge of and adherence to evidence-based practice (Wuchner, 2014).

Chapter Three. Paper #2: Impact of a tailored, multi-faceted stroke competency program to improve critical care nurses' knowledge of and adherence to stroke guidelines

Based on the results of the integrative review, a pre- and posttest study was designed to identify a bundle of implementation strategies to improve neurocritical care nurses' knowledge of and adherence to stroke guidelines. Guided by Grol and Wensing's (2013) Model of Implementation, the tailored, multi-faceted strategies of local opinion leaders, printed educational material, and educational outreach were used during the Stroke Competency Program. Improvements in nursing knowledge were statistically significant, based on an author-developed knowledge assessment tool, $F(2, 111) = 10.457$, $p = 0.000$. Documentation audits, including appropriate documentation frequencies of the National Institute of Health Stroke Scale and other assessments, patient and family education, and dysphagia screening, were conducted to measure nurses' adherence. There were improvements noted in adherence via these audits; however, these were not statistically significant (Reynolds, Murray, McLennon, & Bakas, in press).

Chapter Three contributed to the body of knowledge regarding successful, detailed, theory-driven implementation strategies. However, there was still a recognized need to replicate these strategies with other neuroscience specific guidelines (Reynolds et al., in press). Replication is necessary to note whether the implementation strategies are reproducible and yield similar, positive trends towards increased knowledge and adherence. As noted in the literature, findings and strategies from previous studies need replicated to understand reproducibility to understand which bundle of strategies are most effective (Grimshaw et al., 2012).

Chapter Four. Paper #3: Impact of a tailored, multi-faceted spinal cord injury competency program to improve critical care nurses' knowledge of and adherence to spinal cord injury guidelines

To determine reproducibility, Chapter Four replicated the implementation strategies of local opinion leader, printed educational materials, and educational outreach used in Chapter Three with content and procedures modified to correspond with spinal cord injury guidelines (Reynolds et al., in press; Reynolds, Murray, McLennon, Ebright, & Bakas, in review). An author-developed assessment was used to measure self-reported anticipatory adherence and nursing knowledge of the spinal cord injury guidelines. Statistically significant improvements were noted in both the total anticipatory adherence score, $F(2, 12) = 15.06$; $p = 0.001$, as well as the total knowledge score, $F(2, 10) = 3.57$; $p = 0.045$ (Reynolds et al., in review).

This study used the same implementation strategies as outlined in Chapter Three (Paper #2). Replicating these tailored, multi-faceted strategies to implement a spinal cord injury competency program add to the body of knowledge regarding effective strategies to improve neurocritical care nurses' knowledge of and adherence to neuroscience guidelines. This study supported the usefulness of the three implementation strategies employed for both studies (i.e. local opinion leaders, printed educational materials, and educational outreach). Further replication of these strategies among other, larger nursing populations is warranted to establish the breadth of their commutability (Reynolds et al., in review).

Chapter Five. Conclusion

The dissertation concluded with a final chapter to summarize the three papers, as well as to discuss the linkages among them. Preliminary findings from a program evaluation study, conducted to understand neurocritical care nurses' perceptions of the usefulness of the stroke and spinal cord injury competency programs, were briefly reviewed. Lastly, strengths and limitations of the dissertation, as well as theoretical, research, and practice implications were discussed.

Linkages Among Chapters Two, Three, and Four (Papers #1, #2, and #3)

From the above noted progression through Chapters Two, Three, and Four (containing Papers #1, #2, and #3, respectively), each manuscript built the science of implementation strategies used in neurocritical care nursing. Chapter Two provided the background and existing literature regarding implementation

strategies used to improve nursing adherence. Noted deficiencies found in this review lead to the research conducted in Chapters Three and Four. Chapter Three improved upon the literature by using theory to guide the selection and use of implementation strategies. These strategies included consistent conceptual definitions as identified by the Effective Practice and Organization of Care Group, along with improved detailed descriptions of strategies as recommended by Proctor et al. (2013).

Chapter Four sought to replicate the bundle of implementation strategies used in Chapter Three in efforts to provide reproducible methods and results; a noted need identified in the literature (Grimshaw et al., 2012; Proctor et al., 2013). To close this dissertation, Chapter Five provided an overall discussion of findings from the previous four chapters. Additionally, findings from a mixed-methods program evaluation of the neuroscience educational competency programs were reviewed in Chapter Five. Findings revealed strengths and weaknesses of the educational competency programs, as well as opportunities for improving future implementation of these programs.

Conclusion

Implementation science is needed to close the research-practice gap by identifying evidence-based strategies to improve translation of evidence into practice. Understanding the process of implementation and how to improve nursing knowledge of and adherence to neuroscience evidence-based guidelines is the first step toward closing this gap. Findings from this dissertation added to the body of literature regarding how evidence-based guidelines can best be

implemented among nurses. Successfully implementing guidelines will help to ensure that best care is provided to vulnerable neuroscience patients.

FIGURE 1. Adaptation of Grol & Wensing's (2013) Model of Implementation.

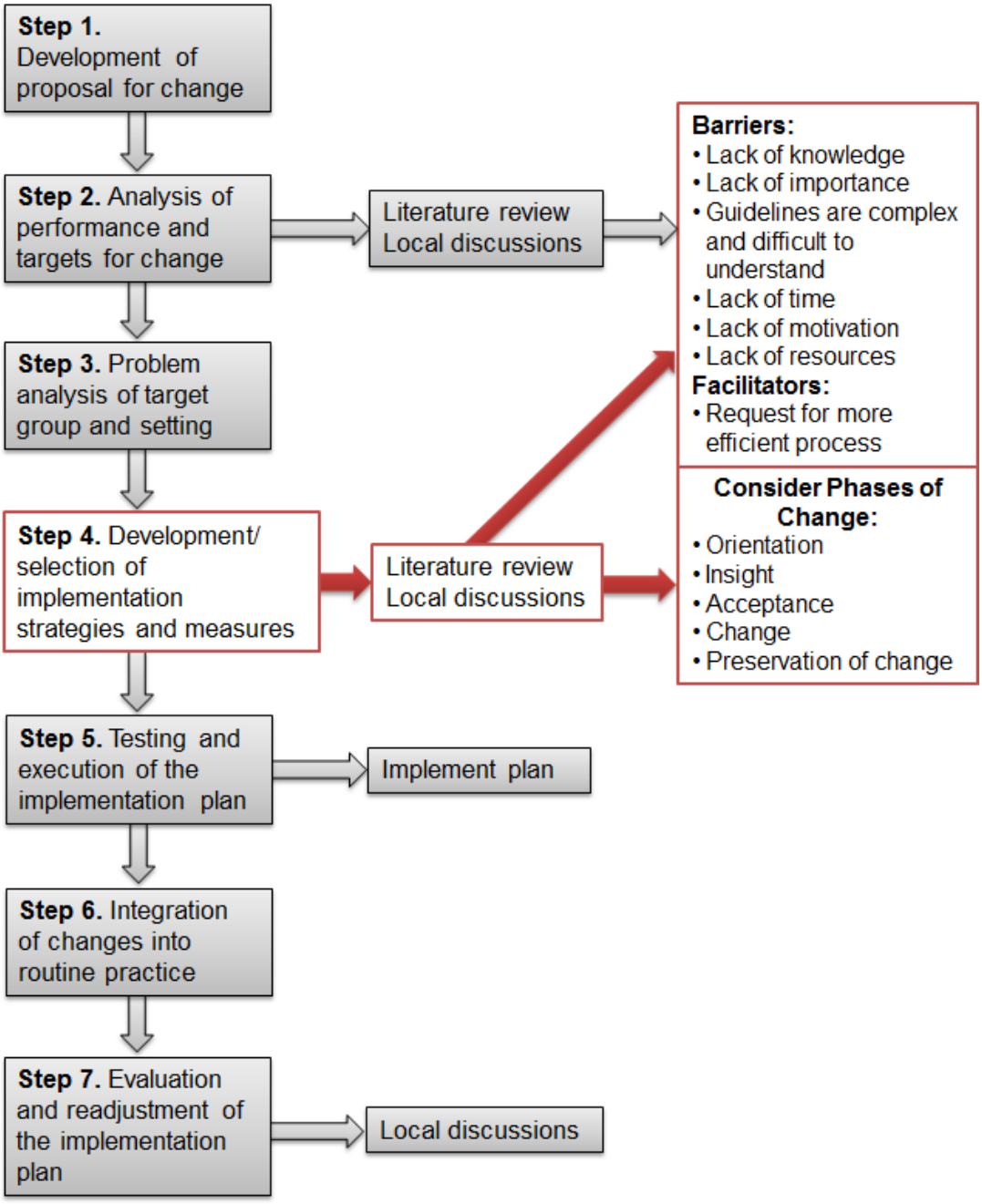

TABLE 1. Proctor et al. (2013) recommendations for specifying and reporting implementation strategies.

1. Name it:	***Local Opinion Leaders***	***Printed Educational Materials***	***Educational Outreach***
2. Define it:	Local opinion leaders are "individuals perceived as 'credible,' …and 'trustworthy.' Opinion leadership is the degree to which an individual is able to influence other individuals' attitudes or overt behavior… and in improving the behavior/practice of healthcare professionals and/or patient outcomes" (Flodgren, 2011, pp. 3, 5)	The "distribution of published or printed recommendations for clinical care, including clinical practice guidelines, monographs, and publications in peer-reviewed journals, delivered personally or through mass mailings" (Giguere et al., 2012, p. 4)	The "use of a trained person …who meets with healthcare professionals in their practice setting to provide information with the intent of changing their performance." (O'Brien et al., 2007, p. 3)
3. Operationalize it:			
a. *The actor*: a "stakeholder who actually delivers the … strategy"(Proctor et al., 2013, p. 5)	Direct care nurses who are informal leaders, deemed credible and trustworthy by their peers	The implementation team: • Local opinion leaders • Clinical Nurse Specialist • Clinical Educator	The implementation team
b. *The action*: "the actions, steps or processes, and sequences of behavior" (Proctor et al., 2013, p. 5)	Local opinion leaders, as a part of the implementation team, assisted with development of the printed educational materials and educational outreach sessions	Printed educational materials developed at the local level by the implementation team. Feedback and revisions were sought from direct care nurses. Printed education materials reviewed during educational outreach sessions, and placed in each patients' room for easier accessibility	Face-to-face, one-to-one educational outreach sessions with each nurse on the neurocritical care unit by a member of the implementation team. Sessions were scripted to ensure consistent messaging. Nurses were asked to demonstrate appropriate documentation of activities, printed educational materials were reviewed, and nurses were encouraged to ask clarifying questions

	Local Opinion Leaders	***Printed Educational Materials***	***Educational Outreach***
c. *Action Target:* "where [strategies] are directed or the conceptual 'targets' they attempt to impact" (Proctor et al., 2013, p. 5)	Opinion leaders provided social influences/optimism that the program would improve care of the neuroscience patient	Printed educational materials impacted knowledge and accessibility of resources improved	Educational outreach sessions improved nurses' knowledge of guideline recommendations and the skills necessary to document these activities
d. *Temporality*: "the order or sequence of strategy use" (Proctor et al., 2013, p. 6)	Not applicable The educational competency programs did not follow/ precede any further training	Not applicable	Not applicable
e. *Dose*	Local opinion leaders were involved with development/ implementation of the program, and were available after completion of the program	Printed educational materials reviewed during educational outreach sessions and were available in each patients' room after the program	Educational outreach sessions occurred one time during a one-to-one, face-to-face interaction, lasting approximately 5-10 minutes
f. *Implementation Outcomes Affected*	Adoption of guideline recommendations and sustainability in practice (Proctor et al., 2013)	Adoption of guideline recommendations per knowledge assessment; penetration and sustainability in practice per documentation audits/ adherence assessments (Proctor et al., 2013)	Adoption of guideline recommendations per knowledge assessment; penetration and sustainability in practice per electronic documentation audits/ adherence assessments (Proctor et al., 2013)
g. *Justification:* "justification or rationale for the strategies that they use to implement a given intervention" (Proctor et al., 2013, p. 7)	Local opinion leaders assist in reducing barriers regarding a lack of: knowledge, motivation, importance, and resources (Grol et al., 2007)	Printed educational materials is a strategy aimed at decreasing guideline complexity/difficulty, and a lack of: knowledge, time, and resources (Grol et al., 2007)	Educational outreach is a strategy to combat specific barriers related to guideline complexity/difficulty, and a lack of knowledge and motivations (Grol et al., 2007)

CHAPTER TWO: INTEGRATIVE REVIEW OF IMPLEMENTATION STRATEGIES FOR TRANSLATION OF RESEARCH-BASED EVIDENCE BY NURSES

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Dr. Murray contributed to this publication by providing substantive and critical advice for this study.

Abstract

Objectives: The purpose of this review was to synthesize and critique experimental and/or quasi-experimental research that has evaluated implementation strategies for translation of research-based evidence into nursing practice.

Background: Successfully implementing evidence-based research can improve patient outcomes. Identifying successful implementation strategies is imperative to move research-based evidence into practice.

Rationale: As implementation science gains popularity, it is imperative to understand the strategies that most effectively translate research-based evidence into practice.

Description: The review used the CINAHL and MEDLINE (Ovid) databases. Articles were included if they were experimental and/or quasi-experimental research designs, were written in English, and measured nursing compliance to translation of research-based evidence. An independent review was performed to select and critique the included articles.

Outcome: A wide array of interventions were completed, including visual cues, audit and feedback, educational meetings and materials, reminders, outreach, and leadership involvement. Because of the complex multimodal nature of the interventions and the variety of research topics, comparison across interventions was difficult.

Conclusion: Many difficulties exist in determining what implementation strategies are most effective for translation of research-based evidence into practice by nurses.

Implications: With these limited findings, further research is warranted to determine which implementation strategies most successfully translate research-based evidence into practice.

Introduction

Healthcare workers are responsible for providing the best possible care to their patients. However, patients are not consistently receiving safe and effective evidence-based care, leading to complications and increased healthcare costs (Grol & Grimshaw, 2003; Grol, 2001). Up to 40% of patients do not receive healthcare according to current scientific evidence and some patients receive unnecessary or harmful care (Davies, Edwards, Ploeg, & Virani, 2008).

Successfully implementing research-based evidence can improve patient outcomes (Hubbard et al., 2012; Duncan et al., 2005). Implementation science, the "study of methods to promote the integration of research findings and evidence into healthcare policy and practice" (National Institute of Health, 2010, p. 1) has recently gained notoriety in the literature. Research has demonstrated that passive dissemination of evidence-based knowledge is an ineffective strategy to integrate research into practice (Grimshaw et al., 2001; Bero et al., 1998; Davis, Thomson, Oxman, & Haynes, 1995; Oxman, Thomson, Davis, & Haynes, 1995). Several studies have noted that using multi-modal implementation strategies that are tailored towards identified barriers and facilitators are more effective than single implementation strategies (Edwards, Davies, Ploeg, Virani, & Skelly, 2007; Eccles, Grimshaw, & Walker, 2005; Grimshaw et al., 2004; Rycroft-Malone et al., 2004; Grol & Grimshaw, 2003, O'Boyle, Henly, & Larson, 2001). To improve patient outcomes, decrease variability in practice, and decrease adverse patient events, there is a need to

determine the most effective strategies for implementing research-based evidence into practice.

Several studies and reviews have been completed assessing the effectiveness of different interventions strategies (Colquhoun et al., 2013; Shojania et al., 2010; Baker et al., 2010; Grimshaw et al., 2001). These studies, however, have primarily focused on how the implementation strategy affects practices of physicians and/or healthcare professionals in general. There have been few studies that have specifically assessed how different implementation strategies affect nursing practice specific to the nurse's compliance in translation of research-based evidence to the bedside. Implementation literature in nursing has focused instead on theoretical frameworks and barriers to/facilitators of implementing research-based care (Helfrich et al., 2010; Carlson & Plonczynski, 2008; Van Achterberg, Schoonhoven, & Grol, 2008). To the author's knowledge, no integrative review of implementation strategies for translation of research-based evidence specific to nursing has been completed.

According to Weng et al. (2013), among six different groups of healthcare professionals, physicians reported implementing evidence-based practice the most ($p<0.001$) with nurses implementing evidence-based practice the least. Positive attitudes towards and beliefs in evidence-based practice were also significantly lower among nurses ($p<0.001$) than in the other five groups (Weng et al., 2013). Nurses comprise the majority of healthcare workers and warrant focused attention on how to increase their utilization of best practices found in research (Scott & Pollock, 2008). The purpose of this review is to synthesize and

critique experimental and/or quasi-experimental research that has evaluated implementation strategies for translation of research-based evidence into nursing practice in order to identify successful approaches for future use.

Methods

A systematic approach was used to identify articles examining implementation strategies aimed at translating research-based evidence into practice. Articles were included if they were experimental and/or quasi-experimental research designs and written in English. Furthermore, the intervention needed to be focused on implementation strategies to improve compliance of integration of research-based evidence into practice in order to be included in the review. Articles were excluded if the main outcome measured how the intervention affected only the patient, physician, and/or other healthcare members. Only those articles that specifically measured nursing compliance were included. There was no limit set on the year of publication for this review. The search was performed using both the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and MEDLINE (Ovid) databases.

Several key words were searched including: guideline adherence, implementation, program implementation, nurses, randomized controlled trial, and intervention study. Other key words included: practice guidelines, evidence-based nursing, nursing evaluation research, practice facilitation, intervention strategies, implementation strategies, and diffusion of innovation.

One rater independently reviewed and critiqued the full text articles using the Transparent Reporting of Evaluations with Non-Randomized Designs

(TREND) Statement, as well as the Consolidated Standards of Reporting Trials (CONSORT) Statement to evaluate the quality of the included studies (Schulz, Altman, & Moher, 2010; Des Jarlais, Lyles, & Crepaz, 2004). Detailed information from each article pertaining to the study's aim, implementation strategy, control group interventions, outcome measures, and success of the intervention based on compliance of translation by nurses were abstracted into Table 2a. The reviewer evaluated and labeled each study's implementation strategy as either "not successful," "partially successful," or "successful" based on the nurse's compliance of translating research-based evidence into practice. "Not successful" strategies included those that did not show a statistically significant improvement in nurse compliance (*n* = 1), whereas those labeled as "partially successful" showed statistically significant improvements in at least one implementation strategy and/or compliance with at least one outcome (i.e. some studies measured compliance with several different research-based recommendations) (*n* = 3). "Successful" implementation strategies showed statistically significant improvement in compliance from at least one intervention group (*n* = 4).

Results

A total of 435 articles were included in the initial screening process, with 307 titles excluded, as they were either not focused on improving translation of research-based evidence, were non-intervention studies, or were duplicates. Abstracts of the remaining 128 articles were then screened with 120 excluded. The excluded articles did not have interventions aimed at implementation

strategies and/or did not measure nursing compliance. Full text of the remaining eight articles were critiqued and included in this review.

Due to the numerous amounts of interventions and variety of topics studied, it was difficult to compare the effectiveness across each implementation strategy and study. Comparison was also difficult because each study operationalized their strategies in a myriad of different ways. Furthermore, the specific details of the interventions were not provided in many studies. Even when details of how the intervention was operationalized were included in the study's methods, the precise content of the strategy was not presented. Due to these limitations, an integrative review was deemed more appropriate than a meta-analysis. According to Torraco (2005), an integrative review is "a form of research that reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated" (p. 356). Guidelines for conducting integrative reviews were used to guide this synthesis (Cooper, 1982).

Three of the retrieved articles were published in nursing journals (Huis et al., 2013; Sutherland-Fraser, McInnes, Maher, & Middleton, 2012; Beeckman et al., 2008), whereas the other five articles were published in medical journals (Fuller et al., 2012; Martin-Madrazo et al., 2012; Nevo et al., 2010; Cheater et al., 2006; Murtaugh, Pezzin, McDonald, Feldman, & Peng, 2005). All of the articles were published within the last seven years, with most of them (*n* = 7) published since 2010. The majority of the interventions (*n* = 5) were implemented between 2006 and 2010 (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012;

Beeckman et al., 2008); one intervention was implemented between June 2000 and November 2001 (Murtaugh et al., 2005). The remaining two articles did not include dates of implementation (Nevo et al., 2010; Cheater et al., 2006). The duration of the interventions ranged from 4 to 36 months (including baseline and follow-up), with an average of 16.4 months (mode of 14 months) (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012; Sutherland-Fraser et al., 2012; Beeckman et al., 2008; Murtaugh et al., 2005).

Design

As shown in Table 2a, half of the articles (*n* = 4) implemented interventions aimed at increasing hand hygiene compliance (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012; Nevo et al., 2010). Beeckman et al. (2008) and Sutherland-Fraser et al. (2012) focused on implementing pressure ulcer prevention practices. The remaining two articles evaluated interventions for heart failure and urinary incontinence (Cheater et al., 2006; Murtaugh et al., 2005).

Most of the articles were randomized controlled trials (*n* = 7); five studies randomized participants at the ward or hospital level (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012; Beeckman et al., 2008; Murtaugh et al., 2005), whereas the two other studies randomized at the individual clinician level (Martin-Madrazo et al., 2012; Sutherland-Fraser et al., 2012). One study was a pre-post intervention study that did not include randomization (Sutherland-Fraser et al., 2012). An intention-to-treat analysis was used in three of the hand hygiene

compliance studies (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012).

Sample

Two thirds (*n* = 5) of the studies were conducted in Europe (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012; Beeckman et al., 2008; Cheater et al., 2006). Two studies were completed in the United States and one in Australia (Sutherland-Fraser et al., 2012; Nevo et al., 2010; Cheater et al., 2006).

Five of the interventions were implemented within hospital settings (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012; Sutherland-Fraser et al., 2012; Nevo et al., 2010) and one study was conducted with nursing home healthcare workers (Beeckman et al., 2008). Of the studies that were conducted in hospitals, a variety of wards were included, ranging from intensive care units, medical-surgical floors, pediatric wards, to peri-operative areas. The remaining two studies were conducted with community or home health care nurses (Cheater et al., 2006; Murtaugh et al., 2005).

Per inclusion criteria of this review, nurses participated in all studies. Other healthcare professionals in addition to nursing (i.e. physicians, occupational therapists, etc.) were included in four studies (Fuller et al., 2012; Martin-Madrazo et al., 2012; Nevo et al., 2010; Beeckman et al., 2008). Across all eight articles, there were a total of 3,134 participating nurses with 70% (*n* = 2,733) of these nurses coming from a single study (Huis et al., 2013). There were a total of 273 non-nurse participants. In one article, the precise number of

healthcare workers was not provided, only stating that 60 wards were included (Fuller et al., 2012).

Interventions

Throughout the eight studies, several implementation strategies were utilized (see Table 2a). Six of the articles utilized more than one implementation strategy and were multi-modal (Huis et al., 2013; Martin-Madrazo et al., 2012; Sutherland-Fraser et al., 2012; Beeckman et al., 2008; Cheater et al., 2006; Murtaugh et al., 2005). Three of these six articles mentioned the importance of tailoring intervention strategies to incorporate barriers and facilitators; however, only two designed tailored, multi-modal interventions (Huis et al., 2013; Beeckman et al., 2008; Cheater et al., 2006).

A framework was utilized to guide the development of the interventions in four studies, including Grol and Wensing's model for effective implementation (Beeckman et al., 2008), the Medical Research Council's framework for complex interventions coupled with the Operant Learning Theory (Fuller et al., 2012), the Health Belief Model (Nevo et al., 2010), and the Precede-Proceed Model (Murtaugh et al., 2005). However, whether or not the study included a guiding framework did not have any effect on the success of the intervention.

Whereas it was difficult to compare interventions and outcomes across all eight articles due to the complexity of differing strategies and topics, there were seven main overall intervention themes that emerged (see Table 2b): (a) visual cues, (b) audit and feedback, (c) educational meetings, (d) educational materials, (e) reminders, (f) outreach, and (g) leadership involvement. Both visual cues

(Nevo et al., 2010) and leadership involvement (Huis et al., 2013) were only used once. Educational meetings and reminders were the most frequently used strategies, with both utilized in four of the studies (Huis et al., 2013; Martin-Madrazo et al., 2012; Sutherland-Fraser et al., 2012; Beeckman et al., 2008; Murtaugh et al., 2005).

Even within these broad overall themes, however, each study operationalized the strategies differently. Nevo et al. (2010) implemented a variety of visual cues to increase hand hygiene compliance. Leadership involvement was described by Huis et al. (2013) as gaining active commitment of management, modeling good behavior by informal leaders, and setting norms and targets within the team. Educational meetings varied between small group sessions (Beeckman et al., 2008) and audio-visual presentations (Huis et al., 2013; Martin-Madrazo et al., 2012; Sutherland-Frasher et al., 2012). Reminders came in the forms of posters (Martin-Madrazo et al., 2012; Sutherland-Fraser et al., 2012; Beeckman et al., 2008) and e-mails (Murtaugh et al., 2005). Huis et al. (2013) and Fuller et al. (2012) implemented simple audit and feedback interventions to improve hand hygiene compliance. Cheater et al.'s (2006) audit and feedback intervention involved mailing individual nurses feedback on their performance regarding urinary incontinence management, highlighting the nurses' good practices, opportunities for improvement, and suggestions on how to achieve change. Beeckman et al. (2008) also utilized an audit and feedback method, along with various other methods; however, the authors did not provide detail on how the audit and feedback process was operationalized. Educational

materials included a variety of resources, including CD Roms, pocket cards, website links, and resource folders (Sutherland-Fraser et al., 2012; Beeckman et al., 2008; Murtaugh et al., 2005); however, detailed information about the content of these educational materials was not provided. Outreach strategies included in-person visits (Cheater et al., 2006) as well as e-mail outreach (Murtaugh et al., 2005). One study utilizing an outreach method did not provide detail as to how this was completed (Beeckman et al., 2008). Each study implemented these strategies in a variety of ways. Due to this, along with the multi-modal nature of the interventions and array of topics, many articles lacked the detail required for replication of the intervention strategies.

Outcomes

Several interventions were used across the eight studies. Please refer to Table 2b for an overview of the articles' interventions and success of compliance. As previously mentioned, success of the intervention was based on the compliance of translation by nurses. The interventions were listed as "not successful," "partially successful," or "successful." Whereas some studies also included patient-related outcomes, only nursing compliance to translation of research-based evidence were included in this review. Compliance to research-based practices was the main outcome measured in the studies. Beeckman et al. (2008) assessed compliance to guideline-based care recommendations for pressure ulcer prevention with an algorithm based on a previous pilot study. Self-reported improvement in practice as measured by a researcher-developed 48-item questionnaire was used to measure compliance by Sutherland-Fraser et

al. (2012). Cheater et al. (2006) and Murtaugh et al. (2005) both assessed compliance of nurse performance by completing chart audits on the nurses' documentation against evidence-based review criteria for the assessment of urinary incontinence and heart failure management, respectively. Reviewers from these studies pulled information from patients' charts to identify nurse's compliance with appropriate documentation of assessment, management, and patient education. Compliance was measured by observation in the four studies whose strategies focused on increasing hand hygiene compliance. Of these four studies, three provided information on the training the observer completed, which ranged from a 1.5 hour to a 2 day training course (Huis et al., 2013; Fuller et al., 2012; Martin-Madrazo et al., 2012). Fuller et al. (2012) utilized a reliable Hand Hygiene Observation Tool, whereas the other studies relied on observation alone.

Discussion

Translating research-based evidence into practice has been shown to improve patient outcomes. Many evidence-based guidelines have been created; however, there remains a gap between research and practice (Davies et al., 2008; Grimshaw et al., 2001; Grol, 2001). To bridge this gap, intervention studies aimed at effective implementation strategies are gaining notoriety in the literature. There is currently a lack of research that links the effects of the implementation intervention back to compliance of the healthcare provider. Since nurses comprise the majority of healthcare workers and have the most direct contact with patients, it is important to identify research that specifically

addresses this population (Scott & Pollock, 2008). The purpose of this review was to critique research on implementation strategies for translation of research-based evidence to the bedside by nurses.

The two most common topics examined in this review was hand hygiene compliance and pressure ulcer prevention. Hand hygiene is noted to be the most effective way to decrease the potential for infection; however, nurses, along with other healthcare providers, have very poor hand hygiene compliance (Erasmus et al., 2010; Kilpatrick, 2009; World Health Organization, 2009, Gould, Chudleigh, Moralego, & Drey, 2007). Since hand hygiene is so important, it is no surprise that half of the reviewed articles focused on improvement of hand hygiene compliance.

Two articles primarily examined compliance to pressure ulcer prevention guidelines. Pressure ulcers have been rated within the top five adverse events in western countries and can decrease quality of life (Gorecki et al., 2009; Ayello & Lyder, 2008; Spilsbury et al., 2007). This harm is considered to be largely preventable and is a priority for most institutions (Gorecki et al., 2009; Ayello & Lyder, 2008; Spilsbury et al., 2007). The other topics studied, urinary incontinence and heart failure, were considered a high priority to the participating institutions. Each of these studies noted adverse events associated with these preventable issues, and designed interventions aimed to decrease poor outcomes (Murtaugh et al., 2005; Abrams, Cardozo, Khoury, & Wein, 2002; Thomas et al., 2000).

Literature suggests that the most successful implementation strategies are multi-modal and tailored towards identified barriers and facilitators to implementation (Edwards et al., 2007; Eccles et al., 2005; Grimshaw et al., 2004; Rycroft-Malone et al., 2004; Grol & Grimshaw, 2003; O'Boyle et al., 2001). All but two articles utilized multi-modal intervention strategies; however, many of these strategies were cumbersome and did not include the detail warranted for translation.

Furthermore, four studies mentioned the importance of tailoring interventions based on barriers and facilitators; however, only three of these studies incorporated this knowledge in the design and development of the intervention. The success of the multi-modal, tailored interventions that these three articles utilized varied greatly. One study's outcomes were not successful, one partially successful, and the final study demonstrated successful outcomes. These findings may challenge the notion set forth in previous literature as to the importance of multi-modal tailored strategies; however, this finding should be evaluated with caution, as only a small number of articles narrowly focused on nursing compliance were included in this review. Other literature focused on patients and/or non-nursing outcomes may have yielded different results.

Leadership has also been noted in the literature as being a driving force behind effective implementation strategies (Cummings, Hutchinson, Scott, Norton, & Estabrooks, 2010; McCormack, McCarthy, Wright, Slater, & Coffey, 2009; Cummings, Estabrooks, Midodzi, Wallin, & Hayduk, 2007; Wallin, Estabrooks, Midodzi, & Cummings, 2006). Interestingly, only one article, focused

on hand hygiene compliance, utilized an intervention strategy that purposefully included leadership involvement. This article found statistically significant improvements in nursing compliance, and the intervention regarded as "successful" (Huis et al., 2013). Whereas leadership involvement is supported in previous research, three other articles that had "successful" outcomes did not include leadership involvement as part of the intervention strategy. This finding may question the importance of leadership involvement; however, this should also be evaluated with caution.

Several different implementation interventions were utilized including visual cues, audit and feedback, educational meetings and materials, reminders, outreach, and leadership involvement. Increasing the number of different strategies implemented did not necessarily equate to more successful outcomes. All implementation strategies were utilized at least once in those studies that yielded "successful" outcomes; however, the majority of these strategies were also utilized in studies which outcomes were deemed "partially successful" and "not successful."

Nurses' compliance to research-based practice recommendations was the main outcome for this review. One study measured nurses' compliance to pressure ulcer prevention recommendations with an algorithm based on a previous pilot study; however, reliability and validity data on this algorithm was not included. In another study, nurses were asked to complete a research-developed questionnaire to measure self-reported practice improvements. This tool was reviewed for face validity only and no reliability data was provided. Also,

using self-reported data has limitations. Self-reported data can rarely be independently verified, as well as the nurses could have exaggerated their improvements in research-based practice recommendations (Adams, Soumerai, Lomas, & Ross-Degnan, 1999). Two studies measured compliance by reviewing nursing documentation to assess for an increased compliance with guideline recommendations. However, the implementation strategy sought to improve the nurses' compliance to recommended assessment, management, and patient education skills, not their documentation skills. Also documentation may not adequately reflect nurses' practice (Murtaugh et al., 2005). Finally, hand hygiene observations may produce the Hawthorne effect in nurses, and any increase in hand hygiene compliance may have been due to the nurses knowing they were being observed. Additionally, three of the four interventions that were deemed "successful" were focused on hand hygiene compliance. These designs may have seen a greater improvement due to the relatively simple nature of hand hygiene observation. Also, even though the majority of these studies required observers to attend training courses, hand hygiene compliance is a somewhat subjective measure, which could skew the data depending on the observer (Boscart, Lee, Marquez-Chin, Tsang, & Fernie, 2011).

There are several limitations to this review. Within this review, a thorough literature search was conducted; however, only one reviewer identified the selected articles and there may have been an incomplete retrieval of articles that met the inclusion criteria. This critique had a narrow scope and only sought to review those studies that evaluated how implementation strategies affected

nursing compliance, yielding a small selection of only eight articles. Other studies involving patient and other healthcare providers may have reached different conclusions about the success of various strategies.

Conclusion

Translating research-based evidence into practice is of utmost important to improve patient outcomes. Research aimed at how to implement these research recommendations within nursing is relatively scant. This review sought to critique the existing research on implementation strategies in order to pinpoint the most beneficial strategies. Further research is warranted to better understand which strategies should be utilized to best implement research-based evidence to nursing. Identifying these strategies will help to increase compliance and adherence to evidence-based standards, ultimately improving patient outcomes and decreasing variance in care and adverse events.

TABLE 2a. Overview of the articles' objectives/aims, interventions, control groups, outcome measures, and success of the intervention based on compliance of translation by nurses.

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Beeckman et al. (2013)	To determine if a multi-faceted strategy to implement an electronic clinical decision support system would improve adherence to pressure ulcer (PU) prevention recommendations	• Appointment of key nurse • Diagnostic interview • Multidisciplinary team • Creation of best practice guidelines • Theoretical training about PU prevention • Interactive small group sessions with Clinical Decision Support education • CD rom distribution • Website links about PU classification • Small group case discussions • Monthly audit and feedback • Reminders • Posters • Flyers • Daily reminders during shift change • Pocket card • Review of PU prevention material • Organizational support on delivery of PU prevention materials	• Standard protocol developed and passive dissemination • 30 minute lecture presented	• Risk assessment • Skin observation • Prevention (surface, repositioning frequency, offloading of heels) • PU prevalence	Partially successful • Statistically significant improvement in PU prevention when resident seated in a chair (p=0.003) • Statistically significant lower proportion of residents receiving no prevention while seated in chair or in bed (p=0.001) • No statistically significant improvement in PU prevention when resident in bed (p=0.3)

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Cheater et al. (2006)	To evaluate the effectiveness of four different interventions in prompting improvements in community nursing practice and patient outcomes for those patients diagnosed with urinary incontinence (UI)	Audit and Feedback (AF) group: • Mailed personal feedback on nurses' performance from baseline audit • Aggregated feedback on other study nurses' performance • Resource pack with printed educational materials on bladder function, types of UI, advice on therapy; did not contain evidence-based recommendations on best practice Educational Outreach (EO) group: • Mailed personal feedback on nurses' self-reported barriers to providing optimum UI care • Aggregated feedback on other study nurses' reported barriers • Outreach visits by a trained "link nurse" • Follow up phone calls from "link nurse" AF and EO combined group: • Combination of above interventions	• Received educational resource packet	• Nurse performance as measured by nursing documentation of assessment and management of UI	Not successful • No statistically significant difference between four arms for nurse performance

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Fuller et al. (2012)	To determine if a behaviorally designed feedback intervention would improve hand hygiene compliance (HHC) compared to routine practice	• Weeks 1 and 2: 20 minute observations followed with immediate feedback and formation of an action plan for non-compliant individuals; individuals praised if they were compliant • Week 3: 20 minute observation and group compliance recorded (no feedback given) • Week 4: 20 minute observation and group compliance recorded with feedback and action plans formulated at a ward meeting	• Usual care	• HHC (expressed as percentages) measured by direct observation using the Hand Hygiene Observation tool	Partially successful • Statistically significant improvement in HHC in intensive care units ($p<0.001$) but not general medicals wards ($p=0.5$)

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Huis et al. (2013)	To determine whether an innovative, theory based, team and leaders directed strategy would be more effective than a literature based state of the art strategy in increasing HHC rates among nurses	State of the art strategy: • Education for improving knowledge and skills • Reminders for supporting the actual performance of hand hygiene • Feedback • Adequate products and facilities Team and Leaders directed strategy: • State of the art strategy • Gaining active commitment and initiative of ward management • Modeling appropriate hand hygiene behavior by informal leaders at the ward level • Setting norms and targets within the team	• No control group (2 intervention groups)	• HHC expressed as percentages • Presence of jewelry, long sleeved clothes under uniforms, and compliance with specific types of hand hygiene opportunities	Successful • Statistically significant improvement in HHC for team and leaders directed strategy versus state of the art strategy ($p<0.001$) • Statistically significant improvement in team and leaders directed strategy over state of the art strategy for jewelry/long sleeve compliance ($p<0.001$)

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention

Martin-Madrazo et al. (2012)	To determine the effectiveness of a multi-modal intervention to improve hand hygiene compliance (HHC) in healthcare professionals in primary care	• Four sessions of 50 minutes each for healthcare center
		  ○ Video presentation
		  ○ Hand hygiene demonstrations
		  ○ Hydroalcoholic preparation tinted with fluorescent dye to determine visible disinfection on healthcare workers' fingertips
		• Hydroalcoholic solution placed in each healthcare centers' consultation offices
		• Reminder posters regarding infection control measures posted at key points
			• Usual care	• HHC expressed as percentages	Successful
					
					• Statistically significant improvement in HHC in primary healthcare workers compared with baseline data ($p<0.001$)

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Murtaugh et al. (2005)	To determine the effectiveness of two interventions designed to improve the adoption of heart failure evidence-based practices by home health nurses	Basic email: • Package of materials emailed to participants • Pocket card with medication management information • Prompter card to improve nurse's communication with physicians • Self-care guide for patients Augmented intervention: • Basic email including package of materials, pocket card, prompter card, and self-care guide • Outreach by an expert Clinical Nurse Specialist (CNS) o Standard email from CNS 1 week after basic email about patient's status, usefulness of heart failure self-care guide, and if the nurse or patient had any issues they would like to discuss	• Usual Care	•Nurse assessment practices as measured by nursing documentation • Nurse instructions/ education to patients as measured by nursing documentation of patient education	Successful with Augmented intervention • Nurses in both intervention groups showed a statistically significant improvement with the comprehensive assessment measure (Basic email p=0.006; Augmented intervention p<0.001) • Augmented group more likely to record assessment of medication side effects (p=0.03), instruct patients about when to contact the physician (p=0.014) and to give the self-care guide (p<0.001) • Greater number of statistically significant effects for the augmented group

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Nevo et al. (2010)	To assess the efficacy of various cues to improve hand hygiene compliance (HHC) upon entering (pre) and exiting (post) a simulated patient environment	• Baseline (Control group) • Baseline and Flicker: dispenser in baseline location and enhanced with flashing lights • Line of Sight: dispenser and poster moved to line of site on entering room • Line of Sight and Flicker: dispenser moved to line of sight and enhanced with flashing lights • Warning Sign: Same as baseline setting, only with a sign outside stating “Warning! This room is under electronic surveillance for hand hygiene compliance. Failure to perform hand hygiene within 10 seconds of entry will trigger an alarm. The violation will be reported!”	• Baseline data group served as control	• HHC expressed as percentages	Successful with Warning sign group; Partially successful in Line of Sight and Flicker group • Statistically significant improvement of HHC for pre-examination in Line of Sight and Flicker groups ($p=0.02$) • Statistically significant improvement of HHC for Warming Sign group both pre ($p<0.02$) and post examination ($p<0.001$)

Authors (Year)	Objective/Aim	Implementation Intervention	Control	Outcome measures	Success of Intervention
Sutherland-Fraser et al. (2012)	To determine if an educational intervention would improve peri-operative nurses' knowledge and practices regarding pressure ulcer (PU) assessment and prevention strategies	• 30 minute audio-visual presentation outlining pressure injury risks and prevention strategies • Resource folder of educational material, additional reference material, and policy documents with a companion CD rom • Reminder posters on key points from presentation	• No control group	• Self-reported knowledge and practice as measured by a researcher-developed 48 item questionnaire	Partially successful; Statistically significant improvement for the following outcomes: • Accurately describing PU stages (p=0.001) • Reassessment of a Stage 1 on patients' heels (p=0.05) • Decrease in number of nurses who would massage a Stage 1 or 2 (p=0.02) • Use of a PU risk assessment tool along with clinical judgment (p=0.0001)

TABLE 2b. Overview of intervention strategies used by authors and success of intervention based on compliance of translation by nurses.

Author/Year	Visual Cues	Audit & Feedback	Educational Meetings	Educational Materials	Reminders	Outreach	Leadership Involvement	Success of Outcome
Beeckman et al. (2013)		✓	✓	✓	✓	✓		Partially successful
Cheater et al. (2006)		✓				✓		Not successful
Fuller et al. (2012)		✓						Partially successful
Huis et al. (2013)		✓	✓		✓		✓	Successful
Martin-Madrazo et al. (2012)			✓		✓			Successful
Murtaugh et al. (2005)				✓	✓	✓		Successful
Nevo et al. (2010)	✓							Successful
Sutherland-Fraser et al. (2012)			✓	✓	✓			Partially successful

CHAPTER THREE: IMPLEMENTATION OF A STROKE COMPETENCY PROGRAM TO IMPROVE NURSES' KNOWLEDGE OF AND ADHERENCE TO STROKE GUIDELINES

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Abstract

Background: Nurses play an integral part in providing evidence-based care to stroke patients, yet some patients receive unnecessary or even harmful care. The literature supports the use of multi-faceted strategies to promote implementation of evidence-based practice; however, there is a gap in knowing which combinations of strategies are most successful.

Purpose: The purpose of this study was to determine if a tailored, multi-faceted Stroke Competency Program would improve nurses' knowledge of and adherence to evidence-based practices in the care of stroke patients. This program bundled implementation strategies of local opinion leaders, printed educational materials, and educational outreach.

Methods: This study used a pre/post-test program design. Nursing adherence was measured via documentation audits with knowledge measured by an author-developed assessment.

Findings: The majority of participating nurses had approximately 10 years of nursing experience and were Baccalaureate prepared; participation ranged from 32% to 58% (*n*=88). Overall, an improvement in nursing adherence was noted after the program, as well as significant improvements in nursing knowledge.

Conclusion: Although the Stroke Competency Program improved nursing knowledge of and adherence to stroke guidelines, future research should seek to extend these findings to identify which bundle of strategies are most effective for implementing evidence into nursing practice using psychometrically sound outcome measures.

Keywords: Nurse, stroke, implementation strategies, adherence

Background

Stroke continues to be a leading cause of serious long-term disability in the United States (Mozaffarian et al., 2015). Vulnerable stroke patients require tailored evidence-based nursing interventions to decrease practice variations and reduce further harm (Jauch et al., 2013; Wuchner, Bakas, Adams, Buelow, & Cohn, 2012). The American Heart Association and American Association of Neuroscience Nurses provide several guidelines to standardize nursing care of the stroke patient (Mozaffarian et al., 2015; Summers et al., 2009). Despite such guidelines, many patients do not receive evidence-based healthcare and some receive unnecessary or harmful care (Jauch et al., 2013).

Successful implementation of stroke guidelines can improve patient outcomes (Hubbard et al., 2012). Wuchner (2014) recently completed an integrative review to evaluate strategies aimed at improving nursing compliance with implementing evidence-based guidelines. Findings indicated limited research in this area, underscoring the need for more information regarding translation of guidelines for stroke care.

Single strategies, such as traditional didactic education and passive dissemination, have been shown to be less effective in translating guidelines into practice, whereas the use of multiple strategies have shown positive results (Powell et al., 2015). However, it is difficult to assess which multiple strategies are most beneficial (Powell et al., 2015). According to Proctor, Powell, and McMillen (2013) this is due to variable methodological qualities and use of

strategies that are “inconsistently labeled, poorly described, rarely justified theoretically, and lack operational definitions to guide their use” (p. 1).

Purpose

This study sought to identify a bundle of implementation strategies that would improve critical care nurses’ knowledge of and adherence to evidence-based stroke practices. Based on a needs assessment via local nursing discussions, direct care nurses reported areas of opportunity for improving care of the stroke patient. Per the direct care nurses, deficits were noted in knowledge of and adherence to completion of: (a) the National Institute of Health Stroke Screen (NIHSS) and detailed neurological and other assessments at specified frequencies, (b) patient and family stroke education, and (c) dysphagia screening. As such, we developed a tailored, multi-faceted Stroke Competency Program aimed at addressing these deficiencies and examined if this program improved nurses’ knowledge of and adherence to these recommendations (see Table 3a) (Jauch, 2013; Summers et al., 2009). Adherence was measured by electronic nursing documentation; knowledge was measured by an author-developed stroke knowledge assessment. Scores from the knowledge assessment were also correlated with nursing demographic factors, such as years of experience and certification. The exempt study was approved by the university’s institutional review board for the protection of human subjects.

Research Question. In neurocritical care nurses, does implementation of a Stroke Competency Program improve their knowledge of and adherence to stroke guideline recommendations?

Methods

A pre/ post-test design study was used to evaluate the effects of implementing the Stroke Competency Program, based on nursing knowledge and adherence. Adherence was measured via documentation audits. An experienced data collector performed these audits per Meaningful Use requirements from the Centers for Medicare and Medicaid Services (CMS; Centers for Medicare and Medicaid Services, 2010). All stroke patients were included in these audits (i.e., ischemic, hemorrhagic, and subarachnoid hemorrhage), as all stroke patients must be provided the same evidence-based care per CMS guidelines (CMS, 2010).

The stroke knowledge assessment was developed based on existing guideline recommendations (Summers et al., 2009), and checked for face validity by four content experts. The assessment consisted of 13 multiple-choice knowledge questions categorized into three subscales: (a) frequency of NIHSS/neurological and other assessments, (b) patient and family education, and (c) dysphagia screening. There were also five demographic questions and one question related to perceived barriers to implementing stroke guidelines. The nurses were asked to participate in the survey at three different time points: (a) prior to the start of the program (pre-program), (b) immediately after the program (post-program), and (c) three weeks after the program (follow-up). This survey, provided through Survey Monkey™, was anonymous and not linked to any identifiers. The survey link was sent via electronic mail; consent was implied once the Survey Monkey™ link was clicked. To promote participation in the

stroke knowledge assessment, nurses were offered one hour of continuing stroke education for completion of all three assessments.

Implementation Steps

Implementation steps identified by Grol and Wensing (2013) provided overall guidance for this study (see Figure 1). Barriers to implementation of these activities were identified during discussions with the direct care nurses, and included a lack of knowledge, motivation, time, and importance to the nurses, as well as reports that the guidelines were difficult to understand, complex, and not easily accessible. Implementation strategies were tailored based on these perceived barriers and included the bundle of local opinion leaders, printed educational materials, and educational outreach (Powell et al., 2015).

Local Opinion Leaders. To start, an implementation team was formed consisting of the unit's Clinical Nurse Specialist, clinical educator, stroke coordinator, and direct care nurses. These experienced direct care nurses served as local opinion leaders as they were experts in stroke and were noted by the staff and leadership to be informal leaders. When asked, direct care nurses stated that they went to these particular nurses often for questions regarding stroke care. Local opinion leaders involved in the implementation team were also certified in neuroscience nursing (CNRN). Through peer motivation, opinion leaders can influence others' attitudes and/or behaviors to improve their practice (Powell et al., 2015).

Printed Educational Materials: Previous printed educational materials were in a stroke resource binder and noted to be complex and not easily

accessible. The implementation team therefore created new printed educational materials developed from guideline recommendations (Powell et al., 2015; Summers et al., 2009). These materials sought to decrease complexity by streamlining the information into one resource packet. To facilitate accessibility, these packets were placed in each patient's room.

Educational Outreach. The educational outreach process consisted of one-to-one, face-to-face educational sessions by members of the implementation team with each nurse employed on the neurocritical care unit (Powell et al., 2015). A script was created to ensure consistent messaging among implementation team members.

Findings

Primary Outcome: Adherence

Electronic nursing documentation was audited for two months before and after the program to measure adherence. Prior to the program, adherence to documentation of NIHSS/neurological and other assessments at the appropriate frequencies were 88.6% (*n*=960); this improved to 90.5% (*n*=1855) following the program. However, this was not a statistically significant improvement per a chi-square test of independence, X^2 (1, N = 2815) = 2.41, p = 0.12. Patient and family education documentation adherence was measured by auditing documentation of the six necessary education components (see Table 3a). Both pre- and post-program adherence were high (98% [n = 40] and 92% [n = 48], respectively) and did not significant differ, X^2(1, N = 88) = 1.44, p = 0.2301. Dysphagia screening documentation improved from 71% (n = 100) pre-program

to 75% (n = 105) post-program; however, this difference was not statistically significant, $X^2(1, N = 205) = 0.49$, $p = 0.242$.

Secondary Outcome: Nursing Knowledge

A total of 88 nurses were employed on the neurocritical care unit. Attrition occurred between the three stroke knowledge assessments: Response rates were 58% pre-program, 43% post-program, and 33% at follow-up. On average, participating nurses had 10 years of nursing experience, with seven years' experience as a neurocritical care nurse. There was relatively equal participation between day and night shift nurses, with the majority holding a Bachelor's degree. Most nurses did not hold a national certification. Of those who were certified, most held certifications in critical care (CCRN) and neuroscience (CNRN).

Stroke Knowledge Assessment Questions

A one-way ANOVA was conducted to determine differences among the groups of nurses that were assessed at pre-program, post-program, and follow-up program time points. Because the assessments were anonymous in Survey Monkey™, a repeated-measure ANOVA could not be used for longitudinal analysis. Instead, the analysis was conducted using each time point as an independent group (see Table 3b), even though many of the same nurses participated at multiple time points. There was a significant improvement in knowledge of the appropriate frequencies for the NIHSS/neurological and other assessment subscale scores, $F(2,115) = 10.78$, $p = 0.000$, and in the overall total assessment scores, $F(2, 111) = 10.457$, $p = 0.000$.

Pearson correlations were calculated to identify associations between subscale and total assessment scores and the participants' nursing experience (see Table 3c). There were significant positive correlations between the follow-up knowledge of frequencies for NIHSS/neurological and other assessment subscale questions and months experience, both as a nurse (r = 0.407, n = 27, p = 0.035) and as a neurocritical care nurse (r = 0.481, n = 26, p = 0.013); thus, nurses with more experience scored higher on this subscale. Similarly, there were significant positive correlations between the follow-up assessment total score and months experience as a nurse (r = 0.418, n = 27, p = 0.030) and as a neurocritical care nurse (r = 0.471, n = 26, p = 0.015), indicating nurses with more experience scored higher on the follow-up assessment total score. Interestingly, correlations were only significant at follow-up.

A series of independent samples t-tests were used to calculate differences in knowledge scores based on certification within each group of nurses that were assessed at pre-test, post-test, and follow-up time points. Certification was collapsed into either having or not having certification. Nurses who held a certification scored significantly higher on both the pre-program NIHSS/neurological and other assessment frequencies subscale questions and the pre-program assessment total score (see Table 3d).

Open-ended Barriers Question

Nurses were asked to identify potential barriers to consistently providing stroke care based on guideline recommendations. In the initial pre-program assessment, 84% (n = 51) of the respondents reported a lack of knowledge of

the required activities as a barrier; this percentage decreased to 65% (*n*=29) during the follow-up assessment. Additionally, complexity/difficulty in understanding the requirements was reported by 49% (*n* = 51) during the pre-program assessment, which decreased to 34% (*n* = 29) in the follow-up assessment. These differences were not significant based on chi square tests of independence. Other barriers noted between all three assessments included lack of time (8%, *n* = 9), lack of motivation (26%, *n* = 31) and a perceived lack of importance (4%, *n* = 5).

Discussion

Implementation Strategies

The importance of using multi-faceted implementation strategies that are tailored to perceived barriers has been cited in the literature (Grol & Wensing, 2013). Grol and Wensing's (2013) implementation model was a useful guide for selection of strategies. Further exploration of educational theoretical models may enhance this type of work for future research. This study attempted to define which strategies could be bundled to improve nursing knowledge of and adherence to specific stroke care measures, and utilized the strategies of local opinion leaders, printed educational materials, and educational outreach. Wuchner (2014) identified different pairings of these strategies in a previously published integrative review. Likewise, previous studies documented improvements in adherence to evidence-based practices with the use of local opinion leaders (e.g., Huis et al., 2013). Beeckman et al. (2008) and Murtaugh, Pezzin, McDonald, Feldman, & Peng (2005) used educational materials and

outreach strategies and found improvements in nursing's adherence. Despite evidence supporting the adoption of the strategies used in the current study, there has been limited descriptions of how these strategies were operationalized, making it difficult for replication and comparison (Proctor et al., 2013; Wuchner, 2014).

Adherence Outcomes

The primary outcome for this study was adherence as measured by nursing documentation. Albeit documentation may not always adequately reflect nursing practice (Murtaugh et al., 2005), a component of our Stroke Competency Program sought to improve nursing documentation. That is, during the educational outreach sessions, nurses were asked to demonstrate appropriate documentation of these activities. Although an increase in adherence was observed post-program, this improvement was not statistically significant. This likely reflected, at least in part, relatively high pre-program adherence.

Wuchner's (2014) integrative review identified published studies in which nursing compliance of evidence-based practices was the primary outcome. Two of these studies evaluated compliance of various practices through nursing documentation audits which yielded mixed results. Murtaugh et al. (2005) utilized educational materials and outreach and found a significant increase in compliance with evidence-based heart failure practices. In contrast, Cheater et al. (2006) utilized audit and feedback and educational outreach strategies to address compliance with appropriate urinary incontinence practices but found no statistically significant difference in the documentation audit data.

The variations noted among findings can likely be attributed to procedural differences across studies. For example, the current and prior studies have varied in terms of which implementation strategies are bundled, making it difficult to identify which strategies may or may not foster adherence. Also, due to insufficient descriptions of strategies it remains possible that conflicting adherence outcomes reflect differences in how strategies were operationalized. Finally, this study sought to implement a stroke-specific program whereas prior studies have focused on other healthcare guidelines; this could have also contributed to the finding variations noted across investigations.

Knowledge Outcomes

A commonly noted barrier to implementing evidence-based practices is a lack of knowledge (Grol & Wensing, 2013), which was also identified by the nurses on the neurocritical care unit. To target this perceived barrier, the Stroke Competency Program included printed educational materials and educational outreach sessions to decrease the nurses' lack of knowledge and improve adherence to these necessary activities. Thus, a secondary outcome for this study was nursing knowledge measured by an author-developed stroke knowledge assessment.

A statistically significant improvement in nursing knowledge was noted for frequencies of the NIHSS/neurological and other assessment subscale score, as well as the total stroke knowledge assessment score. Although Wuchner's (2014) integrative review found several articles that also incorporated strategies to improve knowledge, only Sutherland-Fraser, McInnes, Maher, & Middleton

(2012) included knowledge as an outcome; Sutherland-Fraser and colleagues observed significant improvements in knowledge of pressure ulcer assessment and prevention strategies after a program comprised of educational meetings, educational materials, and reminder strategies.

In congruence with prior findings (Duffy et al., 2015), nurses in the current study with more experience had significantly higher scores on portions of the stroke knowledge assessment only at the follow-up time point. This may be due to attrition of less experienced nurses throughout the three assessments, which may have led to the significant correlations between more nursing experience and knowledge scores at follow-up. Nurses with more experience have had the opportunity to gain more knowledge through their years of practice (Duffy et al., 2015).

Likewise, nurses who held certifications scored significantly higher on components of the stroke knowledge assessment; however, only during the pre-program assessment. Not only has certification been shown to improve nurses' knowledge, but it also signifies that a nurse is up to date in his or her practice and enhances professional credibility (Duffy et al., 2015). Prior to the Stroke Competency Program, those who were certified may have been more knowledgeable of the guidelines recommendations. After receiving education from the stroke Competency Program, those not certified may have gained knowledge, thereby leading to no significant correlations between certification status and scores on the post-program and follow-up program assessments.

Limitations

The Stroke Competency Program evoked improvements in nurses' knowledge of and adherence to evidence-based activities for stroke patients. However, several limitations to this study exist. As stroke is considered a priority among Meaningful Use requirements (CMS, 2010), other coinciding quality improvement initiatives throughout the neuroscience service line may have contributed to improved documentation adherence rates. For example, an initiative to relay real-time deficiencies whereby stroke quality coordinators contacted nurses to inform them of missing activity requirements was instituted near the beginning of this program. Overlapping initiatives may have thus contributed to increased adherence to stroke activities. Additionally, documentation audits measuring adherence to these stroke activities occur throughout the whole hospital and not solely on the neurocritical care unit in which this initiative was implemented. Whereas the majority of stroke patients are cared for on the neurocritical care unit, any deficits in documentation noted could potentially be due to other units' non-adherence.

No statistically significant improvement in knowledge regarding patient and family education or dysphagia screening was found. This could have been attributed to a ceiling effect on the author-developed stroke knowledge assessment, which had limited psychometric testing. Indeed, post-hoc item analyses conducted to assess item difficulty and discrimination suggest some issues with the stroke knowledge assessment (see Table 3e) (Oermann & Gaberson, 2014). Internal consistency was calculated per the Kuder-Richardson

formula, and yielded a low Cronbach's alpha value (0.30). This assessment measured 3 separate subscales; these subscales, although all focused on care of the stroke patient, may have differed enough that the items were not interrelated, hence the low Cronbach's alpha. As this assessment only included 13 items, this could have contributed to its low internal consistency. Whereas adding additional items in the future may be an option, the assessment was created to be brief and foster participation. This assessment was voluntary; thus it remains possible that those taking the assessment may have been more knowledgeable on the subject and more motivated to take the exam.

Whereas an incentive (i.e., gaining one hour of stroke continuing education) was in place for the same nurses to complete the stroke knowledge assessment three times over the course of the study, there may have been variation among nurses who took the pre-program, post-program, and follow-up assessments. As previously noted, the assessments taken via Survey Monkey™ were anonymous and could not be linked to nurses via identifiers. Due to this, a one-way ANOVA was completed, versus a repeated-measure ANOVA, which may have yielded different results. Therefore, although as a group improvements in knowledge were noted following the program, we cannot determine whether given individual nurses increased and maintained knowledge over time. Future studies should consider matching pre- and post-program data to each individual participant.

Implications

According to Grimshaw, Eccles, Lavis, Hill, and Squires (2012), there is substantial, albeit incomplete evidence, to “guide choice of knowledge translation activities targeting healthcare professionals and consumers” (p. 14). It is documented that traditional didactic education is not an effective strategy to translate guidelines into practice (Baker et al., 2010). Multi-faceted techniques have been found to be beneficial; however, it is unknown which strategies are most effective and research is warranted to identify the best bundle of strategies (Powell et al., 2015).

Further, due to limitations unveiled during post-hoc item analyses of the Stroke Knowledge Assessment, future nursing research should take place to provide higher quality measures that have better evidence of reliability and validity. More rigorous testing of author-developed assessments is needed in clinical practice to measure implementation outcomes (Proctor et al., 2011). Without appropriate rigor, nurses may not be able to accurately determine if potential failure was due to strategies used or if the outcome assessment is simply not a quality measure.

This study added to the body of knowledge regarding which implementation strategies are most effective. By bundling the strategies of local opinion leader, printed educational materials, and educational outreach sessions, improvements in nursing knowledge and adherence to stroke guidelines were attained. Future studies should seek to replicate these strategies with similar guidelines to note whether the improvements found in this study are translatable.

Conclusion

Nurses are integral to the care of stroke patients and should utilize evidence-based practices. Guidelines must be successfully implemented into practice to ensure patients are receiving the best care. Tailored, multi-faceted implementation strategies have been shown to be effective; however, only a limited amount of literature has sought to identify which bundle of implementation strategies is most effective. Identified methodological issues need to be considered when conducting implementation research to enhance the reliability and validity of study outcomes. Improvements in nursing knowledge and adherence to the activities found in stroke care guidelines were noted in this study. These findings assist in closing the gap regarding which tailored, multi-faceted strategies should be used. Future studies should seek to replicate these findings to assist in growing the body of knowledge regarding the most effective implementation strategies for use in nursing practice.

TABLE 3a. Description of necessary nursing activities for the care of the stroke patient and the education directed towards these activities within the Stroke Competency Program.

Nursing Activities	Description	Education within the Stroke Competency Program
NIHSS/ Neurological & Other Assessment Frequencies	• Detailed, serial neurological assessments ○ Completed to prevent re-injury of brain tissue (Summers et al., 2009) • Post tPA assessments completed according to Activase Alteplase ® tPA recommendations (Genentech, 2013) • Other assessments warranted include vital signs and neurovascular checks	• Review of resource packet that included the NIHSS assessment and necessary documents/pictures that accompany the NIHSS • Tips on how to complete the NIHSS on intubated, comatose, and aphasic patients • Review of where to document the NISS, neurovascular checks, neurological checks, and vital signs in the electronic medical record • Review of the frequency of documentation of these assessments

Patient and Family Stroke Education	• Six educational components must be provided (The Joint Commission, 2008):
	  ○ Activation of emergency medical system
	  ○ Follow-up after discharge
	  ○ Medications prescribed at discharge
	  ○ Risk factors for stroke
	  ○ Warning signs and symptoms of stroke
	  ○ Documentation of written education provided.
		• Review of where to locate printed educational materials to provide to patients/families with the required information
		• Review of where to document this education in the electronic medical record

Dysphagia Screening	• Dysphagia screen must be completed prior to having any food, liquid, or medications by mouth (The Joint Commission, 2008)	• Review of how and why a dysphagia screen must be completed prior oral intake • Review of where to document dysphagia screens in the electronic medical record

TABLE 3b. Comparison of stroke knowledge assessment scores at each time point (pre-, post-, and follow-up).

Scale and subscales	Pre-Program Assessment	Post-Program Assessment	Follow up Assessment	F	p
	Mean (SD)	Mean (SD)	Mean (SD)		
NIHSS/ Neurological and Other Assessment Frequency Questions (Possible Range 0-6)	4.00 (1.06)	5.18 (1.88)	5.11 (0.74)	F(2,115)= 10.78	0.000***
Patient and Family Stroke Education (Possible Range 0-3)	2.86 (0.35)	2.95 (0.23)	2.93 (0.26)	F(2,113)= 1.07	0.347
Dysphagia Screening (Possible Range 0-4)	3.96 (0.20)	4.0 (0.0)	4.0 (0.0)	F(2,113)= 1.2389	0.254
Total Score (Possible Range 0-13)	10.85 (1.17)	12.11 (1.91)	12.04 (0.88)	F(2,111)= 10.457	0.000***

**p<.05; **p<.01; ***p<.001*

FIGURE 1. Adaptation of Grol & Wensing's (2013) Model of Implementation.

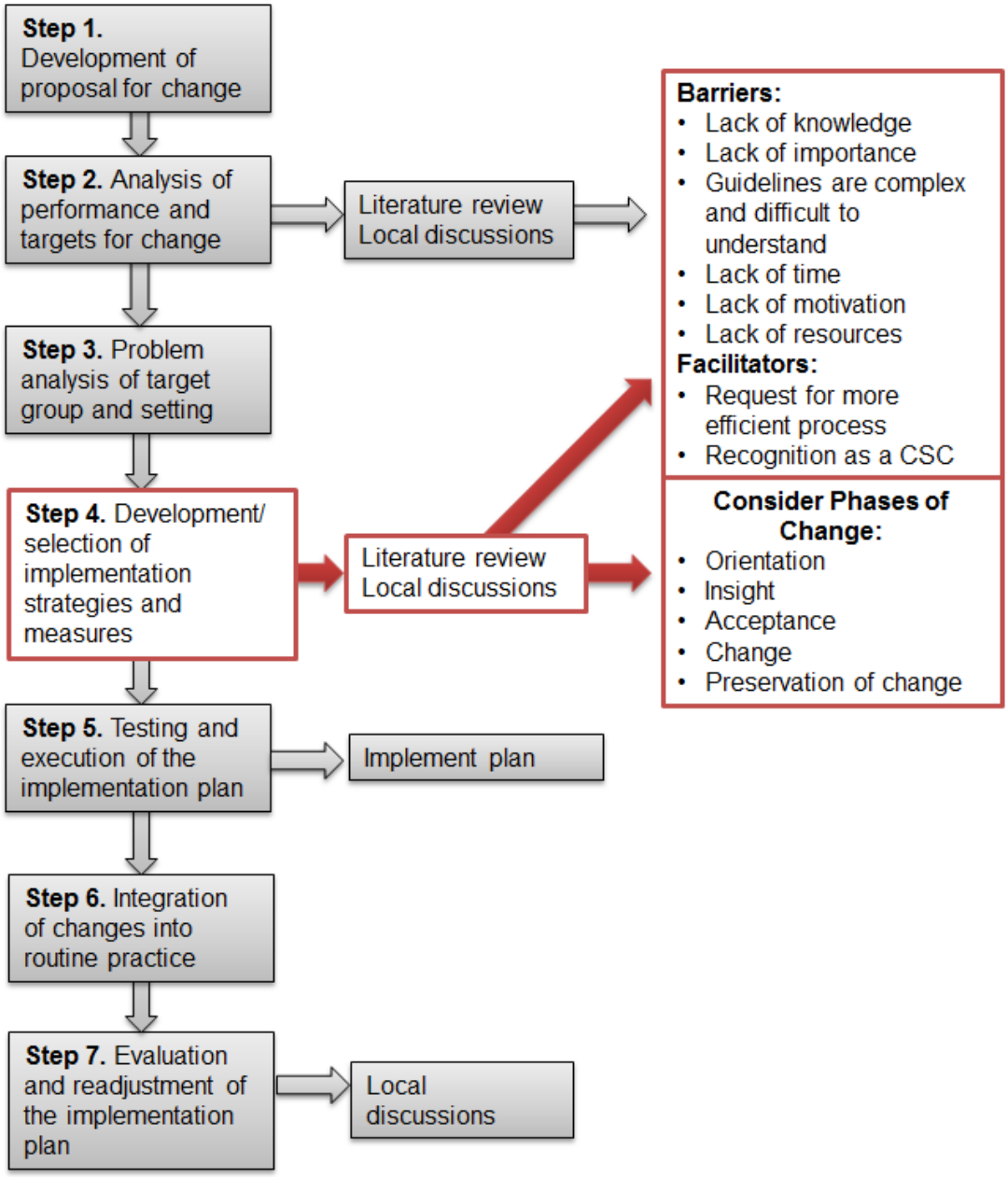

TABLE 3c. Pearson r correlation of Stroke Knowledge Assessment with nursing demographics.

	Experience as a Nurse r	**Experience as Neurocritical Care Nurse r**
Pre-Program Assessment: NIHSS/ Neurological and Other Assessment Frequency Questions	-0.130	0.045
Pre-Program Assessment: Patient and Family Stroke Education Questions	0.061	0.196
Pre-Program Assessment: Dysphagia Questions	0.096	0.137
Pre-Program Assessment: Total Score	-0.064	0.138
Post-Program Assessment: NIHSS/ Neurological and Other Assessment Frequency Questions	-0.053	0.114
Post-Program Assessment: Patient and Family Stroke Education Questions	-0.066	-0.234
Post-Program Assessment: Dysphagia Questions	---	---
Post-Program Assessment: Total Score	-0.050	0.096
Follow Up Assessment: NIHSS/ Neurological and Other Assessment Frequency Questions	0.407*	0.481*
Follow Up Assessment: Patient and Family Stroke Education Questions	0.261	0.247
Follow Up Assessment: Dysphagia Questions	---	---
Follow Up Assessment: Total Score	0.418*	0.471*

**p<.05; **p<.01; ***p<.001*

TABLE 3d. Differences in knowledge scores based on whether the nurse held a certification or not.

	Not Certified	Certified			
	Mean (SD)	Mean (SD)	*t*	df	p
Pre-Program Assessment: NIHSS/ Neurological and Other Assessment Frequency Questions	3.67 (1.11)	4.56 (0.88)	-2.178	34	0.036*
Pre-Program Assessment: Patient and Family Stroke Education Questions	2.81 (0.40)	3.0 (0.0)	-1.421	33	0.165
Pre-Program Assessment: Dysphagia Questions	3.92 (0.27)	4.0 (0.0)	-0.841	33	0.406
Pre-Program Assessment: Total Score	10.48 (1.33)	11.56 (0.88)	-2.248	32	0.032*
Post-Program Assessment: NIHSS/ Neurological and Other Assessment Frequency Questions	5.23 (2.39)	5.0 (1.15)	0.241	27	0.812
Post-Program Assessment: Patient and Family Stroke Education Questions	2.95 (0.22)	3.0 (0.0)	-0.570	26	0.574
Post-Program Assessment: Dysphagia Questions	4.0 (0.0)	4.0 (0.0)	--	--	--
Post-Program Assessment: Total Score	12.14 (2.48)	12.0 (1.15)	0.146	26	0.885
Follow Up Assessment: NIHSS/ Neurological and Other Assessment Frequency Questions	4.85 (0.69)	5.5 (0.55)	-2.037	17	0.058
Follow Up Assessment: Patient and Family Stroke Education Questions	2.85 (0.38)	3.0 (0.0)	-0.988	17	0.337
Follow Up Assessment: Dysphagia Questions	4.0 (0.0)	4.0 (0.0)	--	--	--
Follow Up Assessment: Total Score	11.69 (0.95)	12.5 (0.55)	-1.926	17	0.071

**p<.05; **p<.01; ***p<.001*

TABLE 3e. Item analysis report of Stroke Knowledge Assessment.

Item	Key	A	B	C	D	E	Difficulty Index*	Discrimination Index†
1	B	5	42	1	3	N/A	.82	.44
2	D	2	0	4	45	N/A	.88	.35
3	D	5	32	0	14	N/A	.27	.32
4	D	1	32	3	15	N/A	.29	.00
5	E	0	1	0	0	50	.98	.06
6	B	0	38	13	0	N/A	.74	.50
7	B	1	49	0	1	0	.96	.03
8	E	1	2	0	2	46	.91	.21
9	B	0	50	0	0	N/A	.98	.06
10	B	0	51	N/A	N/A	N/A	1.0	.00
11	D	0	0	0	51	N/A	1.0	.00
12	A	48	2	0	0	N/A	.94	.09
13	A	49	0	0	1	N/A	.96	.12

***Difficulty Index:** Measure of the difficulty of the assessment items, with a range from 0.00 to +1.00. Values of 0.80 and above are considered less difficult (i.e. the majority of participants provided the correct answer) and values of +0.20 or less are considered more difficult (i.e. few participants provided the correct answer).

†Discrimination Index: Indicator of test-item quality; measures how well the item discriminates between those participants who know the material and those who do not. Scores range from -1.00 to +1.00 with higher positive scores signaling better test items. Values of +0.20 or greater are desired (Oermann & Gaberson, 2014).

CHAPTER FOUR: IMPLEMENTATION OF A SPINAL CORD INJURY PROGRAM TO IMPROVE NURSING KNOWLEDGE AND ADHERENCE

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Abstract

Purpose: The purpose of this study was to evaluate a bundle of implementation strategies to increase neurocritical care nurses' knowledge of and adherence to spinal cord injury guidelines.

Design: A pre-program, post-program, and follow-up design was used to evaluate outcomes.

Methods: Adherence was measured via self-reported anticipatory adherence; knowledge was measured by an author-developed assessment. Implementation strategies included local opinion leaders, printed educational materials, and educational outreach sessions. Repeated-measures ANOVA was used for data analysis.

Findings: Improvements in nursing knowledge and adherence were found from pre-program to post-program to follow-up time points.

Conclusions: Outcomes noted in this study were consistent with previous research documenting the usefulness of the same bundle of implementation strategies used for a Stroke Competency program.

Clinical Relevance: Although future research is needed to refine implementation strategies, this study highlighted a systematic way of improving neurocritical care nurses' knowledge of and adherence to spinal cord injury guidelines.

Keywords: Nurses, spinal cord injury, evidence-based practice

Key Practice Points

1. This study replicated the implementation strategies used in a previous Stroke Competency Program to determine reproducibility of strategies.
2. This study sought to evaluate neurocritical care nurses' knowledge of and anticipated adherence to spinal cord injury guidelines before, immediately after, and three weeks after implementation of a Spinal Cord Injury Competency Program.
3. Correlations between nurses' knowledge and adherence scores and nursing demographic information were identified during data analysis.
4. Findings supported the use of three implementation strategies to develop and deliver a tailored, multi-faceted program to enhance neurocritical care nurses' knowledge of and adherence to spinal cord injury guidelines.

Background

Traumatic spinal cord injuries can have devastating effects on individuals. Secondary injury from psychosocial ramifications, complications, and other adverse events may contribute additional harm (DeJong et al., 2013; Munce et al., 2013). Spinal cord injured patients have an increased length of hospital stay, with an average of 3.3 more days spent in acute care (DeJong et al., 2013; Munce et al., 2013). Also, approximately one third of all spinal cord injury patients are re-hospitalized within 12 months due to various complications such as urological, respiratory, and musculoskeletal issues (Munce et al., 2013).

Nursing care within the acute phase of spinal cord injury, per evidence-based guideline recommendations, is imperative to promote optimal care and prevent secondary injury (Wuchner, Bakas, Adams, Buelow, & Cohn, 2012). Clinical practice guidelines for the care of the acute spinal cord injury patient, including activities specific to nursing, are available through the Consortium for Spinal Cord Medicine (endorsed by the American Association of Neuroscience Nurses) and *Journal of Spinal Cord Medicine* (Marsolais et al., 2008; Wing et al., 2008). It has been noted, however, that upwards of 50% of all medical patients do not receive healthcare based on scientific evidence, and approximately 25% of patients may receive unnecessary or even harmful care (Grol & Grimshaw, 2003). Nurses are in a unique position to provide evidence-based care to this vulnerable patient population, as nurses spend the most time in direct contact with patients.

Only a scant amount of literature exists regarding how to improve nursing adherence to neuroscience specific guidelines (Reynolds, Murray, McLennon, & Bakas, in press). The emerging field of implementation science is the study of processes and strategies used to successfully implement evidence into practice, thereby improving adherence to evidence-based guidelines (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012; Grol & Grimshaw, 2003). Multi-faceted strategies tailored to local determinants (i.e., barriers and facilitators) are noted to be most successful, yet there is still a gap regarding which bundle of implementation strategies is most effective (Grimshaw et al., 2012; Powell et al., 2015). In a previous study, the implementation strategies of local opinion leaders, printed educational materials, and educational outreach produced favorable outcomes when implementing stroke guidelines among neurocritical care nurses (Reynolds et al., in press). Further research is needed to understand if this bundle of strategies is translatable to other practice guidelines and yields similar, positive results. As such, this study seeks to replicate these strategies with spinal cord injury guidelines among the same group of neurocritical care nurses.

Purpose

The purpose of this study was to examine neurocritical care nurses' knowledge of and adherence to traumatic spinal cord injury guidelines following a tailored, multi-faceted competency program. A secondary purpose was to determine if neurocritical care nurses' knowledge of and adherence to traumatic spinal cord injury guidelines differed based on nursing participants' demographic characteristics. Based on a needs assessment per local nursing discussion and

through the NeuroTrauma Committee led by neurocritical care nurses, opportunities were noted for improving evidence-based care to the acute spinal cord injury patient. Deficiencies were noted in nursing's knowledge of and adherence to the following evidence-based activities: (a) frequency of spinal assessments, (b) integumentary/mobility/respiratory interventions, (c) bowel and bladder interventions, and (d) patient/family education and psychosocial support (see Table 4a). As such, implementation strategies used previously for the tailored, multi-faceted Stroke Competency Program were replicated with content and procedures modified to be commensurate with spinal cord injury guidelines. The Spinal Cord Injury Competency Program sought to address the identified deficiencies and improve nurses' knowledge of and adherence to the evidence-based guideline recommendations (see Table 4a).

The primary outcome was nursing adherence to spinal cord injury guidelines. Due to the low-volume of spinal cord injury patients at this facility, pre- and post-competency program documentation audits would not yield sufficient data to statistically measure adherence. Consequently, a self-reported anticipatory adherence assessment was utilized. Knowledge, the secondary outcome, was measured by an author-developed spinal cord injury knowledge assessment. This study was approved by the university Institution Review Board for the protection of human subjects.

Methods

Implementation Steps

Grol and Wensing's (2013) Model of Implementation was used to guide the overall implementation process (figure can be found in Reynolds et al., in press). First, determinants (i.e., barriers, facilitators) were identified via local nursing discussions. Barriers to consistently providing evidence-based care by nurses included a lack of knowledge, time, motivation, and perceived importance of the guidelines among nurses; these barriers have also been identified in the literature (Johnson & Bakas, 2010). Further barriers included the perception that the guidelines were complex and difficult to understand. Similar findings were noted by Reynolds et al. (in press) prior to beginning their Stroke Competency Program; as such, tailored implementation strategies of local opinion leaders, printed educational materials, and educational outreach were matched to these perceived determinants. After completion of the Stroke Competency Program, a positive trend towards improved knowledge of and adherence to evidence-based stroke practices was noted (Reynolds et al., in press). This bundle of implementation strategies was replicated for the current study regarding translation to spinal cord injury guidelines. Detailed descriptions of these implementation strategies can be found in Reynolds et al. (in press).

Outcomes

A pre-program, post-program, and follow-up design was used to evaluate the Spinal Cord Injury Competency Program. Outcomes included nursing knowledge of and adherence to spinal cord injury guidelines. Adherence was

measured via self-reported anticipatory adherence assessments, with knowledge measured by an author-developed assessment. Both assessments were provided to neurocritical care nurses prior to the start of the program (pre-program), immediately following (post-program), and three weeks after completion of the program (follow-up). Assessment item development was guided by evidence-based recommendations for spinal cord injury care and examined for face validity by two content experts (Marsolais et al., 2008; Wing et al., 2008).

All nurses employed on the neurocritical care unit were invited to participate in the assessments through a Survey Monkey™ link sent in an email; consent was implied by clicking on the survey link. Both assessments combined consisted of a total of 37 questions. The first question directed the nurses to create a personal 8-digit identification number. This number was known only by individual participants and used solely to match pre-program, post-program, and follow-up assessment scores. Ten demographic questions were included, followed by 16 questions assessing nurses' knowledge of the spinal cord injury guideline recommendations. The knowledge assessment was categorized into five subscales: (a) spinal assessments (3 questions; range 0-3), (b) integumentary/mobility/respiratory interventions (4 questions; range 0-4), (c) bowel and bladder interventions (3 questions; range 0-3), (d) patient/family education and psychosocial support (2 questions, range 0-2), and (e) neurogenic shock and autonomic dysreflexia knowledge (4 questions; range 0-4).

The final ten questions required the nurses to provide self-reported anticipatory adherence to certain spinal cord injury guideline recommendations. Nurses answered the questions as to *how they would care for a spinal cord injury patient.* A Likert-type scale included choices for anticipated frequency of adherence to activities with a range from 1 = Never to 7 = Every time. These questions were categorized into four subscales: (a) spinal assessments (1 question, range 1-7), (b) integumentary/mobility/respiratory interventions (4 questions, range 4-28), (c) bowel and bladder interventions (3 questions, range 3-21), and (d) patient/family education and psychosocial support (2 questions, range 2-14). To promote participation in the assessments, nurses were given a candy bar and entered into a raffle for one of two $25 gift cards for completion of all three assessments.

Findings

Nurse Demographics

Of the 75 nurses employed on the neurocritical care unit, 14 nurses completed all three Spinal Cord Injury Competency assessments. Of those 14, all were female with a mean age of 38.5 years. Years of nursing experience ranged from 3 to 35 years, with a mean of 13.6 years. On average these nurses had approximately 11 years of experience in neurocritical care nursing. There was a mixture of participants from each shift, with more participating from the day (n=9) than night shift (n=5); most worked full-time. Furthermore, all participants held Bachelor's Degrees. Seven (50%) of the participants held a certification with 3 others noting that they planned on becoming certified.

Primary Outcome: Self-Reported Anticipatory Adherence

The primary outcome was nurses' adherence to the spinal cord injury guidelines measured by a self-report of anticipatory adherence. There were 4 subscales on the self-reported adherence measure. A repeated measures ANOVA was conducted to determine changes over time in the pre-program, post-program, and follow-up adherence scores (see Table 4b). Improvements were found in the Integumentary/Mobility/Respiratory Interventions subscale scores, $F(2, 12) = 5.143$; $p = 0.013$, the Bowel and Bladder Interventions subscale scores, $F(2, 12) = 13.910$; $p = 0.001$, as well as the Patient/Family Education/Psychosocial Support subscale score, $F(2,12) = 5.571$; $p = 0.010$. Further, an improvement was noted for the total self-reported anticipatory adherence scores, $F(2, 12) = 15.06$; $p = 0.001$. Paired-samples *t*-tests were conducted to determine differences between post-program and follow-up program self-reported anticipatory adherence scores. No significant differences were noted, indicating short-term maintenance of improvements with anticipatory adherence.

Spearman rho correlations were calculated to identify associations between adherence scores at each time point and the participants' age, years of nursing experience, and years of neurocritical care nursing experience. The spearman rho test was used, as opposed to Pearson correlations, due to the small sample size and lack of a normal distribution (Gravetter & Wallnau, 2013). There was only one significant positive correlation, between experience as a neurocritical care nurse and the pre-program Spinal Assessment subscale, r_s =

0.543, $p < .05$, indicating nurses with more neurocritical care experience scored higher on this subscale.

A series of *t*-tests was used to calculate differences in self-reported anticipatory adherence scores based on certification (Certification or No Certification). There was a significant difference in self-reported anticipatory adherence between those who were (M=14.67, SD=1.86) versus were not certified (M=12.13, SD= 1.25) on the pre-program Bowel and Bladder Interventions subscale, $t(12)= -3.070$, $p = 0.010$. Those nurses holding a certification scored higher on this subscale than those not certified.

Secondary Outcome: Knowledge Assessment

A repeated measures ANOVA was used to identify differences over time in participants' knowledge scores (see Table 4c). Knowledge was measured with an author-developed spinal cord injury knowledge assessment with sixteen questions, including five subscales. There was an improvement in knowledge for the Integumentary/ Mobility/ Respiratory Interventions subscale, $F(2, 10) = 5.649$; $p = 0.026$, as well as the total knowledge assessment score, $F(2, 10) = 3.57$; $p = 0.045$. Paired samples *t*-tests were also conducted to determine differences between post-program and follow-up program knowledge scores. There were no differences, inferring that those improvements in knowledge were maintained over the three weeks in between the two assessments.

Spearman rho correlations were calculated to identify associations between knowledge scores at each time point and the participants' age, years of experience as a nurse, and years of neurocritical care nursing experience. There

were significant negative correlations between several post-program and follow-up assessments with these demographic variables (see Table 4d). Interestingly, these negative correlations indicated that the younger, less experienced nurses who participated had higher scores on the knowledge assessment for the post-program Spinal Assessment subscale and the follow-up Spinal Assessment and Bowel and Bladder subscales. A series of *t*-tests were also used to determine if there were any differences in knowledge scores between nurses who differed in terms of certification or shift worked. No significant differences were noted among these demographic variables and knowledge assessment scores.

Discussion

Implementation Strategies

The purpose of this study was to evaluate a multi-faceted program aimed at improving neurocritical care nurses' knowledge of and adherence to spinal cord injury guidelines. Our study found improvements in self-reported anticipatory adherence (i.e., Integumentary/ Mobility/ Respiratory, Bowel and Bladder, Patient/Family Education/Psychosocial Support, and total score) and nursing knowledge (i.e., Integumentary/Mobility/Respiratory and total score) over time. Use of multi-faceted strategies has been shown to be beneficial when implementing guidelines into practice. The bundle of implementation strategies used for this study (i.e., local opinion leaders, printed educational materials, and educational outreach) was replicated from a previous study that sought to implement stroke guidelines (Reynolds et al., in press). Other studies have used various pairings of these types of strategies (Wuchner, 2014); however,

insufficient details regarding how these strategies were operationalized has made comparisons across these studies difficult (Proctor, Powell, & McMillen, 2013; Wuchner, 2014).

Adherence Outcomes

Adherence was measured via self-reported anticipatory adherence assessments, given at three different time points. Whereas this measure of adherence is not commonly utilized, other studies have previously adopted this outcome measure and found similar, positive trends after educational initiatives (e.g., Brown, Aitken, Leggat, & Speare, 2010). Further, a systematic review conducted by Eccles et al. (2006) noted that there can be a predictable relationship between self-reported intentions of healthcare professionals and their subsequent behavior. Albeit self-reported adherence may incur social desirability bias, other measures of adherence (i.e., documentation audits, observation) were deemed unfeasible for this study (Krumpal, 2013).

There were improvements noted in self-reported anticipatory adherence in three of the four subscales (i.e., Integumentary/Mobility/Respiratory, Bowel and Bladder, Patient/Family Education/Psychosocial Support), as well as the total score. Improvements were identified in the subscale Integumentary/Mobility/Respiratory Interventions for both self-reported anticipatory adherence and knowledge scores. Nurses may have lacked knowledge of the guidelines surrounding these care activities prior to the program. Implementation of the program may have helped improve knowledge of these needed interventions, leading to both higher knowledge scores as well

as higher reported anticipatory adherence scores. These significant gains were also maintained from the post-program to follow-up assessment time frame. Understanding the sustainability of results is a noted need in implementation research (Chaudoir, Dugan, & Barr, 2013; Powell et al., 2015). Albeit short-term, these findings provide preliminary evidence of the sustainable effects of this type of implementation program.

Following the Spinal Cord Injury Competency Program, anticipatory adherence scores were also significantly higher for the Bowel and Bladder subscale; however, knowledge scores for this subscale did not improve significantly. Nurses may have had the knowledge regarding guideline recommendations for these activities, yet may have had a perception that such activities were not important or lacked motivation for completing them. Our program may have fostered understanding of the rationale behind these activities, leading to higher anticipatory adherence scores.

The Spinal Assessments subscale did not show significant improvements over time. These null findings could be due to relatively high pre-program assessment anticipatory adherence scores for this particular guideline recommended activity. The small number of participating nurses could have also confounded identifying significant changes.

Significant positive correlations between neurocritical care nursing experience and the Spinal Assessments subscale indicated that nurses with more neurocritical care experience tended to report higher anticipatory adherence to this guideline activity. Not surprisingly, these nurses may have felt

more confident and/or clinically able to complete these necessary recommendations for spinal cord injury patients, as experience has been noted as a facilitator of clinical guideline use (Abrahamson, Fox, & Doebbeling, 2012). After implementation of the program, less experienced nurses may have felt more confident with performing this guideline activity, lending to the lack of significant correlations at the post-program and follow-up program timeframes between experience and anticipatory adherence scores.

Independent *t*-tests were used to identify possible adherence score differences based on certification. It was found that nurses holding a certification self-reported higher anticipatory adherence compared to those with no certification for the pre-program Bowel and Bladder subscale. This finding mirrors results in Reynolds et al. (in press). Likewise, nurses holding certification have been shown to have higher levels of knowledge and skills within their profession (Duffy et al., 2015). This difference related to certification status, however, was only significant within the pre-program assessment. Whereas those holding certifications may have been more apt to report adherence to these guideline recommendations (i.e., Bowel and Bladder) before the program, the implementation program may have improved nurses' knowledge/ability, including those without certification, leading to non-significant findings in the post-program and follow-up anticipatory adherence scores.

Knowledge Outcomes

As noted during local nursing discussions, knowledge deficits in the evidence-based care of the spinal cord injury patient were present. In an effort to

tailor the program to the determinants of practice, printed educational materials were created to improve nurses' knowledge of the guidelines. These materials were reviewed during one-to-one educational outreach sessions to further enhance the nurses' knowledge. As such, knowledge was included as a secondary outcome for this study. Knowledge improved after the Spinal Cord Injury Competency Program for one knowledge subscale (i.e., Integumentary/Mobility/Respiratory) and the total score. Improvements in knowledge after implementation of educational programs have been cited in the literature (Reynolds et al., in press; Wuchner, 2014). Further, these improvements were sustained between the post-program and follow-up assessment, indicating short-term maintenance. This type of finding, although short-term, is needed to progress implementation research (Chaudoir et al., 2013; Powell et al., 2015). The lack of significant improvements in other knowledge subscales was likely related to high pre-program scores, as well as the small participant sample size.

Interestingly, Spearman rho correlations yielded significant negative associations between several post-program and follow-up knowledge scores and nurses' age, nursing experience and neurocritical care nursing experience. These findings indicated that younger, less experienced nurses scored higher on the knowledge assessment at these time points. Whereas such results are not common in the literature (e.g., Seliman et al., 2014), there are several possible explanations for this relationship pattern. Newer nurses participating in the assessments may have been more exposed to updated guideline

recommendations during their recent educational years. Also, many less experienced nurses stated that they were not confident in caring for spinal cord injury patients; this may have led them to being more interested and inquisitive during the educational outreach sessions. Whereas these results are intriguing, they should be acknowledged cautiously, as this study included a very small sample. Older, more experienced nurses may not have been as attentive during the educational outreach sessions, lending to a lack of significant improvements in knowledge over time.

Limitations

This study found improvements in self-reported anticipatory adherence and knowledge after implementation of the Spinal Cord Injury Competency Program; however, several limitations exist. To begin, there are limited ways to accurately measure adherence to evidence-based guideline recommendations. As this facility admits a low volume of spinal cord injury patients, it was felt that adherence could not adequately be measured by documentation audits, as previously used in prior implementation investigations (e.g., Reynolds et al., in press). As such, self-reported anticipatory adherence assessments were used to measure adherence. Due to social desirability bias, however, actual behavior by nurses may differ (Krumpal, 2013). Whereas other outcome measures such as documentation audits and observation also have limitations, these measures may have yielded different results.

There were improvements noted in nursing knowledge, yet the knowledge assessment was author-developed and did not undergo substantial psychometric

testing prior to dissemination. This lack of testing may have skewed the results or led to ceiling effects on the assessment. Item analyses, including difficulty and discrimination indices, were calculated for the knowledge assessment. Results from these analyses suggest further revisions of the assessment are warranted (see Table 4e) (Oermann & Gaberson, 2014). Internal consistency of the assessment was calculated per the Kuder-Richardson formula; in SPSS, this yielded a low Cronbach's alpha (0.33), signifying that this assessment should not be used without further revision. The low number of assessment items may have contributed to the low internal consistency for the knowledge measure. In the future, adding items may be an option; however, this shorter assessment was developed to minimize participation burden. Furthermore, this assessment measured five different subscales; although they were all geared towards care of the spinal cord injury patient, they may not have been deemed interrelated. This assessment was voluntary, and those taking the assessment may have been more knowledgeable on the subject and more motivated to take the exam. Lastly, short-term sustainability of results was noted for both the self-reported anticipatory adherence and knowledge scales. Whereas the maintenance of these findings is noteworthy, future research should seek to determine long-term sustainability of improvements (i.e., 6 months, 12 months).

It must be acknowledged that strong conclusions cannot be made from this study, as the sample size included a small number of nursing participants. Although not well powered with only fourteen participants, this study provides a blueprint for how this type of program may be implemented in the future

(Gravetter & Wallnau, 2013), and still identified several significant implementation program outcomes. Further, this study was conducted at one hospital in one neurocritical care unit, limiting generalizability of findings. It would be beneficial for future research to utilize these implementation strategies in other facilities with larger sample sizes of nurses.

Implications

Recent implementation studies have lacked detailed information regarding how strategies were operationalized, have used strategies that were not conceptually defined or theoretically justified, or both (Grol & Wensing, 2013; Proctor et al., 2013). Furthermore, multi-faceted strategies are proposed to be more useful than single passive strategies, such as didactic education; however, it is unknown which multiple strategies are most effective for translating knowledge into practice. This study sought to replicate a bundle of strategies used in a previous study aimed at translating evidence-based stroke practices (Reynolds et al., in press), and found similar positive trends regarding increased nursing knowledge and adherence. The strategies of local opinion leader, printed educational materials, and educational outreach sessions, when bundled together, may be beneficial to improve neurocritical care nurses' knowledge of and adherence to guideline recommendations in the acute care of stroke as well as spinal cord injury patients. Further replication of these strategies with other nursing populations is warranted to establish the breadth of their commutability.

Conclusion

Acute spinal cord injury patients require detailed, evidence-based nursing care to decrease and/or prevent secondary harm. Available nursing guidelines need to be translated into practice to assure patients receive optimum care. Tailored, multi-faceted strategies can be effective in closing this research-practice gap; however, few studies have sought to identify which multiple strategies are most beneficial. Findings from this study assist in closing this gap as to which strategies should be used. Future studies should consider replicating these strategies with larger participant samples to strengthen the literature in this needed area, as well as improve the reliability and validity of outcome measures.

TABLE 4a. Description of necessary nursing activities for the care of the spinal cord injury patient.

Nursing Activities	Description
Spinal Assessments	• Motor spinal assessments need to be completed upon admission and every hour until the patient is stable enough to go to surgery for fusion of spinal injury • Post operatively, motor spinal assessments need to be competed every hour for the first 24hours, then every 2hours for 24hours, then every 4hrs until transfer from the critical care unit • Sensory assessments need to be completed at least twice a day and with any neurological change
Integumentary/ Mobility/ Respiratory Interventions	• Thorough integumentary assessments need to be completed as spinal cord injury patients are at an increased risk for skin breakdown • Waffle cushions should be used when patients are seated • Cervical collar pads need to be changed daily and when soiled, with assistance from another healthcare provider to prevent secondary injury • Range of motion needs to be performed approximately three times daily • Aggressive pulmonary toileting (i.e., progressive mobility, oral care) should be instilled to prevent respiratory complications • Measures should be taken to prevent orthostatic hypotension when mobilizing patients (i.e. sitting patients up slowly)
Bowel and Bladder Interventions	• Routine intermittent catheterizations need to be instituted when the patient is medically stable to prevent urinary tract infections • Spinal cord injury patients need to follow a rigorous bowel management program, including daily rectal suppositories and digital stimulation
Patient/Family Education and Psychosocial Support	• Education needs to be provided to patients/families regarding spinal cord injury diagnosis, depression, skin assessments, etc. • Communication boards and development of daily schedules with input from the spinal cord injury patient can promote independence and decision making

TABLE 4b. Comparison of spinal cord injury self-report anticipatory adherence at each time point (pre- and post-program and follow-up).

Scale and subscales	Pre-Program Assessment Mean (SD)	Post-Program Assessment Mean (SD)	Follow-Up Assessment Mean (SD)	*F* (X,X) =	*p*
Spinal Assessment (Range 1-7)	5.93 (0.83)	6.14 (0.77)	6.14 (0.66)	0.432 (2, 12)	0.579
Integumentary/ Mobility/ Respiratory (Range 4-28)	20.86 (3.94)	23.64 (3.48)	23.86 (2.35)	5.143 (2, 12)	0.013*
Bowel and Bladder (Range 3-21)	13.21 (1.97)	17.36 (3.05)	17.42 (3.01)	13.910 (2, 12)	0.001***
Patient/ Family Education/ Psychosocial Support (Range 2-14)	9.14 (2.07)	10.93 (2.23)	10.57 (2.03)	5.571 (2, 12)	0.010**
Total Score (Range 10-70)	49.14 (6.06)	58.07 (7.80)	58.0 (5.70)	15.06 (2, 12)	0.001***

**p<.05; **p<.01; ***p<.001*

TABLE 4c. Comparison of spinal cord injury knowledge assessment scores at each time point (pre- and post-program and follow-up).

Scale and subscales	Pre-Program Assessment Mean (SD)	Post-Program Assessment Mean (SD)	Follow-Up Assessment Mean (SD)	F (X,X) =	p
Spinal Assessment (Range 0-3)	2.36 (0.84)	2.71 (0.61)	2.79 (0.58)	1.947 (2, 12)	0.163
Integumentary/ Mobility/ Respiratory (Range 0-4)	3.17 (0.83)	3.75 (0.45)	3.83 (0.39)	5.649 (2, 10)	0.026*
Bowel and Bladder (Range 0-3)	2.85 (0.38)	2.92 (0.28)	2.85 (0.38)	0.316 (2, 11)	0.732
Patient/ Family Education/ Psychosocial Support (Range 0-2)	1.57 (0.65)	1.57 (0.51)	1.36 (0.63)	1.315 (2, 12)	0.286
Neurogenic Shock/ Autonomic Dysreflexia (Range 0-4)	3.21 (0.80)	3.50 (0.65)	3.29 (0.61)	0.707 (2, 12)	0.502
Total Score (Range 0-16)	13.00 (2.22)	14.50 (1.00)	13.92 (1.24)	3.57 (2, 10)	0.045*

**p<.05; **p<.01; ***p<.001*

TABLE 4d. Spearman rho correlation of Spinal Cord Injury Knowledge Assessment with nursing demographics.

	Nurses' Age	**Experience as a Nurse** r_s	**Experience as Neurocritical care Nurse** r_s
Pre-Program Assessment: Spinal Assessment	-0.073	0.101	0.257
Pre-Program Assessment: Integumentary/ Mobility/ Respiratory	-0.422	-0.492	-0.320
Pre-Program Assessment: Bowel and Bladder	-0.216	-0.433	-0.455
Pre-Program Assessment: Patient/ Family Education/ Psychosocial Support	0.176	0.154	0.288
Pre-Program Assessment: Neurogenic Shock/ Autonomic Dysreflexia	-0.225	-0.074	-0.087
Pre-Program Assessment: Total Score	-0.172	-0.131	0.004
Post-Program Assessment: Spinal Assessment	-0.601*	-0.603*	-0.571*
Post-Program Assessment: Integumentary/ Mobility/ Respiratory	-0.259	-0.390	-0.303
Post-Program Assessment: Bowel and Bladder	-0.463	-0.387	-0.309
Post-Program Assessment: Patient/ Family Education/ Psychosocial Support	0.179	0.305	0.377
Post-Program Assessment: Neurogenic Shock/ Autonomic Dysreflexia	-0.312	-0.346	-0.250
Post-Program Assessment: Total Score	-0.708**	-0.684**	-0.491
Follow-Up Assessment: Spinal Assessment	-0.603*	-0.611*	-0.509
Follow-Up Assessment: Integumentary/ Mobility/ Respiratory	0.324	0.324	0.259
Follow-Up Assessment: Bowel and Bladder	-0.608*	-0.609*	-0.507
Follow-Up Assessment: Patient/ Family Education/ Psychosocial Support	0.138	0.223	0.352
Follow-Up Assessment: Neurogenic Shock/ Autonomic Dysreflexia	0.463	0.315	0.200
Follow-Up Assessment: Total Score	-0.022	-0.124	-0.011

**p<.05; **p<.01; ***p<.001*

TABLE 4e. Item analysis report of Spinal Cord Injury Knowledge Assessment.

Item	Key	A	B	C	D	E	F	G	Difficulty Index*	Discrimination Index†
1	C	0	0	12	1	1	--	--	.86	.04
2	B	0	10	4	0	--	--	--	.71	.67
3	D	3	0	0	11	--	--	--	.79	.21
4	D	0	0	0	14	--	--	--	1.00	.00
5	D	1	2	0	11	--	--	--	.79	.21
6	G	1	0	0	1	0	0	12	.86	.04
7	C	4	0	8	2	0	0	--	.57	.71
8	C	0	0	14	0	--	--	--	1.00	.00
9	B	0	14	--	--	--	--	--	1.00	.00
10	E	1	1	0	0	12	--	--	.86	.33
11	G	0	2	0	0	0	1	11	.79	.21
12	F	0	0	0	0	1	12	1	.86	.04
13	C	0	2	12	0	--	--	--	.86	.33
14	E	0	0	1	4	9	--	--	.64	-0.04
15	C	1	0	13	0	--	--	--	.93	.17
16	C	2	0	12	0	--	--	--	.86	.33

***Difficulty Index:** Measure of the test-item difficulty, with scores ranging from 0.00 to +1.00. Desirable values should be between 0.20 and 0.80.

†Discrimination Index: Indicator of test-item quality. Scores range from -1.00 to +1.00 with higher positive scores signaling better test items (Oermann & Gaberson, 2014).

CHAPTER FIVE: DISCUSSION AND IMPLICATIONS

Staci Sue Reynolds

Introduction

Successful implementation of guideline recommendations by nurses can improve patient outcomes (Hubbard et al., 2012), which hinges on the nurses' knowledge of and adherence to these guidelines. Evidence-based nursing care to vulnerable neuroscience patients (i.e., stroke and spinal cord injury) is imperative, as these patients are at an increased risk of adverse events due to their disease processes. Great strides have been made in implementation science, which is defined as the "study of methods to promote the integration of research findings and evidence into healthcare policy and practice" (National Institutes of Health, 2010, p.1). However, due to a lack of conceptual clarity, inconsistent terminology, and complex reporting of implementation strategies, further research is needed to understand which strategies are most effective for translating research-based evidence into nursing practice.

This dissertation began by evaluating literature regarding effective implementation strategies to translate evidence-based nursing practices to the bedside. Due to gaps identified, two pre- and posttest studies were conducted to identify the most helpful strategies for implementing stroke and spinal cord injury guidelines among neurocritical care nurses. The purpose of this chapter is to summarize the findings from the three papers that compose this dissertation, discuss the linkages among the three, and offer insight into program evaluations completed with the participating neurocritical care nurses. Finally, strengths and

limitations of the dissertation, as well as theoretical, research, and practice implications were discussed.

Summary of Findings from "Integrative Review of Implementation Strategies for Translation of Research-Based Evidence by Nurses"

First, an integrative review examining eight articles was conducted to identify effective implementation strategies to improve nurses' adherence to evidence-based practices (Chapter Two; Paper #1). Due to complex reporting and limited details of how the strategies were operationalized, comparison among studies was difficult. Further, many of the studies did not provide sufficient details regarding how the implementation strategies were operationalized to allow reproducibility. From this review, it was established that there was inconclusive evidence as to which implementation strategies were most effective for translating research-based evidence into nursing practice. Implications suggested a need for further research that included detailed descriptions of implementation strategies that were theoretically justified and that used terminology consistent with the implementation science literature. Future research to understand which strategies were most effective for improving nurses' adherence to guidelines was warranted (Wuchner, 2014).

Summary of Findings from "Implementation of a Stroke Competency Program to Improve Nurses' Knowledge of and Adherence to Stroke Guidelines"

Based on gaps found within the integrative review, a pre- and posttest study was designed to identify an effective bundle of implementation strategies to

improve neurocritical care nurses' knowledge of and adherence to stroke guidelines (Chapter Three; Paper #2). A tailored, multi-faceted stroke competency program, guided by Grol and Wensing's (2013) Model of Implementation, was developed. Implementation strategies used for the program included local opinion leaders, printed educational materials, and educational outreach. Improvements in nursing knowledge was noted, as measured by an author-developed assessment, $F(2, 111) = 10.457$, $p = 0.000$. Documentation audits were conducted to measuring nursing adherence, including appropriate documentation frequencies of the National Institute of Health Stroke Scale and other neurological assessments, patient and family education, and dysphagia screening. Improvements were noted in nursing adherence, yet they did not reach statistical significance (Reynolds, Murray, McLennon, & Bakas, in press).

This study contributed to the body of knowledge regarding detailed, theoretically justified implementation strategies. Those strategies led to improvements in nursing knowledge and adherence to stroke guidelines. However, there was a need to repeat these strategies to determine reproducibility of results. In conclusion, this study noted that future research should seek to replicate these findings to better understand the most effective implementation strategies to use when translating neuroscience nursing guidelines into practice (Reynolds et al., in press).

Summary of Findings from "Implementation of a Spinal Cord Injury Program to Improve Nursing Knowledge and Adherence"

To examine reproducibility of the implementation strategies employed during the stroke competency program, the program was replicated with content and procedures modified to correspond with spinal cord injury guidelines (Chapter Four; Paper #3). The spinal cord injury competency program was reproduced among the same neurocritical care nurses and again utilized the implementation strategies of local opinion leaders, printed educational materials, and educational outreach. Outcome measures included self-reported anticipatory adherence and nursing knowledge, both measured by an author-developed assessment. Significant improvements were found for both the total self-report anticipatory adherence score, $F(2, 12) = 15.06$; $p = 0.001$, as well as the total knowledge score, $F(2, 10) = 3.57$; $p = 0.045$ (Reynolds, Murray, McLennon, Ebright, & Bakas, in review).

Findings from this study supported the usefulness of these implementation strategies (i.e., local opinion leaders, printed educational materials, and educational outreach) and provided evidence that self-reported anticipatory adherence and nursing knowledge improved. The stroke and spinal cord injury programs both noted improvements in nursing knowledge of and adherence to these neuroscience nursing guidelines, suggesting these strategies are beneficial. This type of tailored, multi-faceted competency program should be reproduced with other, larger nursing populations to establish the breadth of their commutability (Reynolds et al., in review).

Program Evaluation of Stroke and Spinal Cord Injury Programs

Following completion of the stroke and spinal cord injury competency programs, a mixed-methods study was conducted to evaluate the programs' effectiveness via perceptions of the neurocritical care nurses. Implementation outcomes of acceptability, appropriateness, adoption, and sustainability were sought during data analysis (Proctor, Powell, & McMillen, 2013). Strengths and weaknesses of the competency programs were identified, along with recommendations for improvement for subsequent evidence-based programs. One-to-one interviews with ten neurocritical care nurses who participated in both the stroke and spinal cord injury competency programs were conducted. Nurses were requested to provide ratings on a Likert-type scale addressing effectiveness of the programs, which received high overall scores. Additionally, nurses were asked semi-structured interview questions. Specific data, such as participant quotes, will be forthcoming in a later manuscript.

The stroke and spinal cord injury programs, consisting of local opinion leaders, printed educational materials, and educational outreach, were deemed acceptable and appropriate by the neurocritical care nurses. Notably, all nurses commented on the usefulness of the educational outreach. Several nurses identified the time and labor intensive aspect of the programs as a potential area of concern. Many participants stated that they had no suggestions for improvement to the programs, indicating that the strategies used were sufficiently effective for this setting. Other nurses noted that having more local opinion leaders as part of the programs would have been beneficial.

The nurses also felt as though information from the programs were being adopted into practice, increasing both nursing knowledge of and adherence to the guidelines. Lastly, nurses were asked for ideas to sustain the improvements made during the stroke and spinal cord injury competency programs. Suggestions included ongoing education and reminders.

Findings from this study provided further support for the usefulness of the strategies employed during the stroke and spinal cord injury programs. Further evaluation studies of implementation research, measuring implementation outcomes as outlined by Proctor et al. (2013), are warranted to understand end-users' (i.e. those for whom the program was designed; ex. direct care nurses) perceptions of the utility of evidence-based programs.

Linkages Among Chapters Two, Three, and Four

Throughout this dissertation all three chapters (including Papers #1, #2, and #3) built upon each other. The integrative review conducted for Chapter Two provided the background and foundation of existing implementation science literature for translating research-based evidence into nursing practice. Several gaps regarding implementation strategies were noted in this review, including inconsistent use of terminology and complex strategies that were not theoretically justified. As such, comparison among studies, as well as the ability to replicate strategies, was difficult. Due to these deficiencies in the literature, the pre- and posttest studies conducted in Chapters Three and Four were developed.

Chapter Three improved upon the reviewed literature by using Grol and Wensing's (2013) Model of Implementation to identify implementation strategies

to use during the stroke competency program (i.e., local opinion leaders, printed educational materials, and educational outreach). These strategies were consistent with terminology found in the implementation science literature, as identified by the Effective Practice and Organization of Care Group (Flodgren, 2011; Giguere et al., 2012; O'Brien et al., 2007). Furthermore, detailed descriptions of how the strategies were operationalized were included (Proctor et al., 2013; Reynolds et al., in press; Reynolds et al., in review). This study found improvements in both nursing knowledge of and adherence to stroke guideline recommendations; however, replication of these strategies with other evidence-based neuroscience nursing guidelines was warranted to understand reproducibility of results.

Therefore, the stroke competency program was replicated with content modified to correspond with spinal cord injury guidelines, as noted in Chapter Four. As identified in the literature, there was a need for implementation strategies that could be replicated and produce similar positive trends in improving nursing knowledge of and adherence to evidence-based guidelines (Proctor et al., 2013). Similar to the stroke competency program, the spinal cord injury competency program found improvements in both nursing knowledge of and anticipatory adherence to the guideline recommendations.

All three chapters add to the body of knowledge regarding implementation of evidence-based practices among nurses. Procedures used in the two pre- and posttest studies attempted to mitigate gaps identified within the integrative review. Whereas further research is still warranted in this area, these chapters

assisted in closing the gap by providing a blueprint for identifying the most effective implementation strategies for translating research-based evidence into nursing practice. Descriptions of these strategies (i.e., local opinion leaders, printed educational materials, and educational outreach) can be found in Table 5.

Strengths and Limitations

Strengths

Whereas implementation science is a growing field, more research is warranted to understand the most effective implementation strategies to translate research-based evidence into practice, particularly among nurses. The integrative review (Chapter Two) is one of the first, if only, reviews that specifically analyzed implementation strategy effectiveness among nurses. As acknowledged in this integrative review, recent implementation studies report strategies that are inconsistently labeled, lack theoretical justification, and are not reported in a detailed way to allow for replication. As such, the subsequent pre- and posttest designs (Chapters Three and Four) sought to mitigate these gaps by using terminology consistent with the implementation science literature, selecting strategies that were theoretically justified (i.e., use of Grol and Wensing's [2013] Model of Implementation), and providing detailed descriptions of the strategies. Also, Chapter Four replicated the procedures used in Chapter Three to understand reproducibility of the strategies and results, which provided further support for the effectiveness of the implementation strategies.

Limitations

Whereas this dissertation adds to the body of knowledge and helps to strengthen the implementation science field, there are also several limitations to the papers. The integrative review had a narrow scope, yielding a small selection of eight articles. Although a thorough literature search was conducted, the articles were identified and assessed by only one reviewer, which may have led to incomplete retrieval of articles meeting the inclusion criteria for the integrative review. The stroke and spinal cord injury competency programs were completed within a single neurocritical care unit at one hospital, and included a small sample of nurses who took the assessments, which may limit generalizability of findings. Furthermore, the author-developed assessments used for both pre- and posttest studies did not undergo substantial psychometric testing. Post-hoc item analyses of both assessments suggested reliability issues and warrant further revisions. Although limitations to these studies exist, they provide a guide for how nursing programs may be implemented in the future.

Theoretical Implications

Grol and Wensing's (2013) Model of Implementation was used to guide the overall implementation of the stroke and spinal cord injury competency programs. This model incorporated a comprehensive overview of several behavioral change theories, and included the following steps:

1. Develop a proposal for change
2. Analyze actual performance (baseline data) and identify targets for change (outcomes)

3. Analyze the target group and setting (identify determinants)
4. Selection of implementation strategies
5. Develop, test, and execute the implementation plan
6. Integrate the changes into routine practice
7. Evaluate and readjust the implementation plan

The steps outlined in this model worked well to direct the implementation processes for the stroke and spinal cord injury competency programs. Deficits in nursing knowledge of and adherence to stroke and spinal cord injury guidelines were noted by neurocritical care nurses and a proposal for change was developed. Baseline data was collected and outcome measures were established (i.e., knowledge and adherence). Next, determinants were identified through local nursing discussions. Implementation strategies of local opinion leaders, printed educational materials, and educational outreach were selected and tailored based off of these determinants. The programs were executed and integrated into practice. Finally, program evaluations were completed, with suggestions provided to maintain the improvements made in knowledge of and adherence to the guidelines.

All components of this model were utilized during the implementation of the competency programs. Strategies that are theoretically justified, as those found in Chapters Three and Four, and tailored to the local context are warranted to ensure appropriateness of the processes. Subsequent implementation research should consider using this comprehensive guide to further strengthen and support the Grol and Wensing (2013) Model of Implementation.

Research Implications

The papers included in this dissertation furthers the field of implementation science regarding strategies that are most effective for improving nurses' knowledge of and adherence to neuroscience guidelines. Further replication of these implementation strategies with other, larger nursing populations is warranted. Furthermore, future nursing research should take place to provide higher quality outcome measures for nursing knowledge and adherence that have better evidence of reliability and validity. More rigorous testing of author-developed knowledge and adherence assessments is needed to appropriately measure clinical outcomes of implementation programs. Lastly, evaluation of implementation programs should be considered to explore end-users' perceptions of strengths, weaknesses, and opportunities related to the programs.

Practice Implications

The implementation process to translate research-based evidence into nursing practice is important to understand. Program implementation is optimized when guided by a comprehensive model (Grol & Wensing, 2013). Prior to implementing different evidence-based nursing programs, teams should consider the use of the Grol and Wensing (2013) Model of Implementation to ensure strategies and outcome measures are appropriate for the given context.

The stroke and spinal cord injury competency programs conducted for Chapters Three and Four provide evidence of the effectiveness of the implementation strategies of local opinion leaders, printed educational materials, and educational outreach to improve nursing knowledge of and adherence to

neuroscience guidelines. Further, program evaluation data analysis provides support of these strategies via perceptions of the neurocritical care nurses. This bundle of strategies shows promising outcomes and should be considered in future programs that aim to implement other evidence-based nursing guidelines.

Conclusion

Implementation science seeks to improve translation of research-based evidence into nursing practice. By examining the literature through the integrative review, deficiencies were identified that directed the development of the stroke and spinal cord injury competency programs. These programs, consisting of local opinion leaders, printed educational materials, and educational outreach, improved nursing knowledge of and adherence to stroke and spinal cord injury guidelines. Findings from this dissertation help to close the research-practice gap and add to the body of knowledge regarding how evidence-based guidelines can best be implemented among neurocritical care nurses. Successful implementation of these guidelines by nurses will help to ensure vulnerable neuroscience patients are receiving optimal care.

TABLE 5. Descriptions of implementation strategies used in this dissertation.

Implementation strategy	Definition	Details
Local opinion leader	Leaders who are "individuals perceived as 'credible,' 'likeable' and 'trustworthy.' Opinion leadership is the degree to which an individual is able to influence other individuals' attitudes or overt behavior… and in improving the behavior/practice of healthcare professionals and/or patient outcomes" (Flodgren, 2011, pp. 3, 5)	Local opinion leaders consisted of experienced direct care neurocritical care nurses who were noted by staff to be informal leaders.
Printed educational materials	The "distribution of published or printed recommendations for clinical care, including clinical practice guidelines, monographs, and publications in peer-reviewed journals, delivered personally or through mass mailings" (Giguere et al., 2012, p. 4)	New educational materials were developed from guideline recommendations by the local opinion leaders, Clinical Nurse Specialist, and clinical educator (i.e. the implementation team). To decrease complexity, these materials streamlined the information into one resource packet.
Educational outreach	The "use of a trained person …who meets with healthcare professionals in their practice setting to provide information with the intent of changing their performance" (O'Brien et al., 2007, p. 3)	The educational outreach process consisted of one-to-one, face-to-face educational sessions by members of the implementation team with each of the direct care neurocritical care nurses; a script was created to ensure consistent messaging between members of the implementation team.

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Wuchner, S.S. (2014). Integrative review of implementation strategies for translation of research-based evidence by nurses. *Clinical Nurse Specialist: The Journal for Advanced Nursing Practice, 28*(4), 214-223. doi:10.1097/NUR.0000000000000055

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CURRICULUM VITAE

Staci Sue Reynolds

EDUCATION:

GRADUATE

Indiana University	Doctor of Philosophy in Nursing Science	05/16
Indiana University	Master of Science in Nursing, Clinical Nurse Specialist	05/11

UNDERGRADUATE

Indiana University	Bachelor of Science in Nursing	05/08

APPOINTMENTS:

ACADEMIC

Duke University	Clinical Associate	Jan 2016-Present
Indiana University	Nurse R 505 Measurement and Data Analysis Teaching Assistant	May-Aug 2015 Aug-Dec 2012 May-Aug 2011
Indiana University	Clinical Nurse Specialist Preceptor	Aug-Dec 2014 Aug-Dec 2013

NON-ACADEMIC

Duke University	Neurocritical Care Clinical Nurse Specialist	2016-Present
Indiana University Health Methodist Hospital	Neurocritical Care Clinical Nurse Specialist	2012-2015
	Neuroscience Floor and Progressive Care Unit Clinical Nurse Specialist	2011-2013
	Critical Care Quality and Safety Coordinator	2010-2011
	Neurocritical Care Staff Nurse	2008-2010
	Neurocritical Care Student Nurse Extern	2006-2008

LICENSURE, CERTIFICATION, SPECIALTY BOARD STATUS:

Registered Nurse, North Carolina	2015-Present
Registered Nurse, Indiana	2008-Present
Stroke Certified Registered Nurse (SCRN)	2014-Present
Board Certified Adult Health Clinical Nurse Specialist (ACNS-BC)	2011-Present
Certified Neuroscience Registered Nurse (CNRN)	2010-Present
Critical Care Certified Registered Nurse (CCRN)	2010-Present

PROFESSIONAL ORGANIZATION MEMBERSHIPS:

American Association of Neuroscience Nurses	2009-Present
American Association of Critical Care Nurses	2009-Present
American Heart Association/American Stroke Association	2011-Present
Midwest Nursing Research Society	2011-2012
Sigma Theta Tau International Honor Society of Nursing	2010-2012

PROFESSIONAL AWARDS AND HONORS:

Certificant of the Year	American Board of Neuroscience Nurses	2015
Novice Writer's Award	American Board of Neuroscience Nurses	2013

GRANTS AND SCHOLARSHIPS:

Title	**Agency**	**Amount**	**Dates**
Irene and Nathaniel Aycock Scholarship	IUSON	$2,500	2015
Michelle A. White Scholarship	IUSON	$2,000	2015-2016
Graduate Student Nursing Research Grant	IUSON	$660	2010
Outstanding Freshman Scholar	IUPUI	$6,000	2004-2008
Academic Excellence Scholarship	IUPUI	$6,000	2004-2008
Plainfield Lion's Club Scholarship	Plainfield Lion's Club	$500	2008
Plainfield Kiwanis Club Scholarship	Plainfield Kiwanis	$500	2008
Tri Kappa Scholarship	Tri Kappa	$500	2008

PUBLICATIONS:

*Indicates maiden name

1. Bakas, T. & **Reynolds, S.S.** (in review). Stroke. In J.J. Fitzpatrick & M. Wallace (Eds.). *Encyclopedia of Nursing Research (ENR)* (4th ed.). New York: Springer.
2. **Reynolds, S.S.**, Murray, L., McLennon, S., Ebright, P., & Bakas, T. (submitted). Implementation of a spinal cord injury program to improve nursing knowledge and adherence. *Rehabilitation Nursing*
3. **Reynolds, S.S.**, Murray, L., McLennon, S., & Bakas, T. (in press). Implementation of a stroke competency program to improve nurses' knowledge of and adherence to stroke guidelines. *Journal of Neuroscience Nursing*
4. ***Wuchner, S.S.** (2014). Integrative review of implementation strategies for translation of research-based evidence by nurses. *Clinical Nurse Specialist: The Journal for Advaned Nursing Practice, 28*(4), 214-223.
5. Sitterding, M.C., Ebright, P., Broome, M.E., Patterson, E., & ***Wuchner, S.S.** (2014). Situation awareness and interruption handling during medication administration. *Western Journal of Nursing Research, 36*(7), 891-916.
6. ***Wuchner, S.S**., Bakas, T., Adams, G., Buelow, J., & Cohn, J. (2012). Nursing interventions and assessment for aneurysmal subarachnoid hemorrhage patients: Qualitative findings from practicing nurses. *Journal of Neuroscience Nursing, 44*(4), 177-185.
7. Bakas, T. & ***Wuchner, S.S.** (2011). Stroke. In J.J. Fitzpatrick & M. Wallace (Eds.). *Encyclopedia of Nursing Research (ENR)* (3rd ed.). New York: Springer.

PRESENTATIONS:

The Aftermath of Stroke	Indiana University Health Stroke Consortium	2014
Innovative Thinking and Resource Alignment Improve Evidence-Based Practice and Sustains Nursing Excellence	American Nurses Credentialing Center National Magnet Conference	2014
Evidence-Based Practice and Nursing Research	Indiana University Health Academic Health Center	2014
Using Evidence-Based Practice	IUSON	2014
The Neurologic System	Indiana University Health Methodist Hospital	2013
Traumatic Brain Injury and the Floor Patient	Indiana University Health Methodist Hospital	2012, 2013

Nursing Interventions and Assessment for Aneurysmal Subarachnoid Hemorrhage Patients: Qualitative Findings from Practicing Nurses	Indiana University Health Annual Research Conference	2012
Neuroanatomy	Neuroscience Certification Review Course	2012
Aneurysmal Subarachnoid Hemorrhages	Indiana University Health Methodist Hospital	2012
Nursing Interventions and Assessment for Aneurysmal Subarachnoid Hemorrhage Patients: Qualitative Findings from Practicing Nurses.	Midwest Nursing Research Society Annual Conference	2012
Nursing Interventions and Assessment for Aneurysmal Subarachnoid Hemorrhage Patients: Qualitative Findings from Practicing Nurses	Indiana University Health Methodist Hospital	2011
Nursing Interventions that Decrease Secondary Injury in the Traumatic Brain Injured Patient	Indiana University Health Methodist Hospital	2010

COMMUNITY SERVICE:

Stroke Screenings	American Heart Association Stroke Walk	2014
Stroke Screenings	Indiana Black Expo	2013
Stroke Screenings	Indiana University Health Neuroscience Center	2013

PROFESSIONAL SERVICE:

Critical Care Nursing	Journal Reviewer	2014-Present
Indiana University Methodist Hospital	Evidence-Based Practice and Nursing Research Navigator	2014-2015
	Transitions in Care Council Co-Leader	2014-2015
	Critical Care Quality Council Lead	2013-2015
	Evidence-Based Practice and Nursing Research Council Lead	2013-2015
	Evidence-Based Practice Steering Committee Member	2013-2015
	Neurocritical Care Leadership and Advancement Team Member	2012-2015
	Stroke Council Member	2010-2015
	Professional Practice Council Member	2010-2015