Abstract

Background: Health care providers are required to demonstrate evidence of ongoing competence or performance. This is especially crucial for nurse practitioners working in critical care arenas, like the Neonatal Intensive Care Unit (NICU). Neonatal nurse practitioners (NNP) working in these settings must competently perform multiple high risk procedures, like the percutaneous insertion of central catheters (PICC), yet performance for these providers and outcomes for these procedures are often not visible. In addition few frameworks exist that adequately measure them.

Purpose: The main purpose of the project was to determine if an evidence based electronic PICC line note could be utilized as a tool to evaluate NNP PICC line performance or outcomes in a Neonatal Intensive Care Nursery Setting. The objectives of the project were as follows:
1.) Determine what tools if any, are utilized by Baltimore-Washington area NICU's to evaluate NNP PICC line insertion performance or competence
2.) Evaluate the perception of eight commonly used performance measurement tools.
3.) Build and implement an evidence based electronic PICC line note embedded within the electronic health record, for NNP providers to use in the NICU at Mercy Medical Center.
4.) Using data analysis software, analyze the PICC line note elements to determine the usability of the note as a tool to measure NNP PICC line performance.
5.) Evaluate the note implementation process and NNP satisfaction with the updated PICC line note format.

Methods: Baltimore Washington area NICU's were surveyed to determine what tools they use to measure NNP PICC line performance, and what their perceptions were of those tools as measures of NNP PICC line performance outcomes. Using GE Centricity Perinatal Software, an evidence based electronic NNP PICC line procedure note was developed and implemented. A post implementation survey was conducted using the Clinical Information Systems Evaluation Scale. SPSS was used to analyze both survey results as well as the outcomes of the PICC line note.

Results: Out of 14 NICU's surveyed, 78.6% (N=11) do not measure NNP PICC line outcomes or performance. Of the 21.4 % (N=3) that do measure NP PICC line performance, two used the electronic health record to do so, but felt that it was less than adequate to measure NNP PICC line performance ($M = 1.7$, $SD = 0.6$). Eighty one percent of note fields were completed in the insertion section of the note, 85% of fields were completed for the adjustment part of the note and 88% of the removal note fields were completed. The implementation was viewed as moderately to highly successful with a CISIES total score of 3.2.

Conclusions: NNP PICC line performance is not routinely measured in local Baltimore Washington area NICU's. The successful implementation of a clinical information system, in this case an evidence based electronic NNP PICC line procedure note, demonstrates the potential power of the electronic health record to serve as a tool in the evaluation of NNP performance, outcomes and competence.

Running head: USE OF THE ELECTRONIC HEALTH RECORD

Building the Evidence - Use of the Electronic Health Record in the Measurement of Nurse Practitioner Performance

By

Janice Wilson

Capstone Project Submitted to the Faculty of the School of Nursing
of the University of Maryland, Baltimore
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Dedication

This project is dedicated to the Neonatal Nurse Practitioners at Mercy Medical Center

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Preface

Despite the redundancy, percutaneously inserted central catheters (PICC) are commonly referred to as PICC lines by a variety of neonatal care providers. Following the current vernacular, this terminology will be used throughout this paper.

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Background

In the 1970's, as a means to address the reduction in hours of pediatric house staff in Neonatal Intensive Care Units (NICU), the role of the neonatal nurse practitioner (NNP) was first developed (Johnson, Jung & Boros, 1979). The legitimacy of the role was established by early research that found NNP staff to be safe, competent and cost effective care providers, (Beal et al, 1999; Bissinger et al 1997; Johnson et al., 1979; Mitchell-Dicenso, Guyatt, & Marrin, 1996; Schultz, Liptak, & Fioravanti, 1994; Trotter & Danaher, 1994). In the context of these studies, competence was demonstrated by equivalent or better mortality, morbidity, and cost outcomes when compared to resident staff. Individual NNP competence or performance, beyond educational preparation and length of experience was not addressed.

While critical, morbidity, mortality and cost outcomes are in reality a reflection of provider competence. They do not directly measure competence. In other words, the processes necessary to achieve good outcomes are not visible.

Competence is a complex and multifaceted construct. It is an intricate interrelationship between cognitive, psychomotor, critical thinking and decision making skills (Robb, Fleming & Dietert, 2002). It has been defined as "the ability to perform a specific task in a manner that yields desirable outcomes" (Kak, Burkhalter, & Cooper, 2001, p. 3). It is acquired over time (Benner, 1984), is context dependent, and composed of an individual's knowledge, abilities, traits and skills (Kak, Burkhalter & Cooper, 2001). These attributes, in combination with social, motivational and organizational factors, contribute to provider performance and subsequent health care outcomes (Kak, Burkhalter & Cooper, 2001). But how is competence or performance best measured?

The year 2009 will mark the thirtieth anniversary of the first description of the NNP role by Johnson and colleagues (1979). Since that time, establishing and identifying the performance outcomes of advanced practice nurses (APN) has been driven primarily by the regulatory processes of licensure, certification and credentialing. These processes help define basic requirements for competent practice, but they do not provide or recommend frameworks to measure ongoing provider competence and performance in the clinical setting.

Current patient safety initiatives and core measures for neonates primarily evaluate neonatal morbidity and mortality outcomes. While NNP performance contributes to overall patient, system and provider outcomes, the specific contributions that the NNP makes to these outcomes in this population of patients has been difficult to measure.

The Joint Commission on Accreditation of Hospitals (Joint Commission Resources, 2007), APN licensure agencies, APN certifying bodies as well as public citizens (Citizen Advocacy Center, 2004), demand ongoing demonstration of provider competence, performance and outcomes. This is particularly crucial for APN's in critical care practices performing multiple high risk procedures as is evidenced by those individuals providing acute care in the neonatal setting.

The Institute of Medicine (IOM) in its Bridge to Quality Report (2003) has recommended the incorporation of five core competencies in the patient care practices of all health care professionals. With an interdisciplinary approach, health care professionals must apply quality improvement principles, utilize informatics, and employ evidence based practice in order to provide patient centered care (The National Academy of Science, 2003). Congruent with the Pew Commission report (1998), recommendations were also made for licensing and certifying bodies to require that providers periodically demonstrate, through competence measures, their ability to deliver quality patient care (Health Professions Education: A Bridge to Quality, 2003). The recommendations do not include a framework to achieve these goals.

Problem Statement

The sweeping changes of health care reform in the twenty first century include mandates from health care organizations and regulatory agencies to ensure that health care providers demonstrate competence throughout their careers (DeVries, 1999).

The IOM's five core competencies, in addition to discipline specific competencies, must be transparent and incorporated into the daily process of patient care (Bingham, 2005). Yet there is a paucity of competency measurement research and a very small segment of that addresses APN competency issues. None is specific to the evaluation of ongoing NNP competence. Many of the tools available for use have not demonstrated that they indeed measure what they were designed to measure and they are not universally applicable. Additionally, single competence measurement methods lack the ability to adequately evaluate the breadth and depth of provider competence (Kak et al., 2001)

Neonatal nurse practitioners are required to make complex patient management decisions for seriously ill neonates. Critical management decisions often involve the performance of numerous high risk procedures and tasks. One of the more challenging and technically difficult of these is the percutaneous insertion of central catheters (PICC). The small size of the patient, accessible veins of adequate diameter, and the caliber of the catheters themselves can make successful insertion problematic (Paulson & Miller, 2008). In addition, the risks are not insignificant and can be potentially life threatening. Overall complication rates, according to the literature, range from 0% to 33.6% (Pettit, 2003). Commonly seen complications are occlusion, infection and dislodgement. Complications related to inappropriately placed catheters can result in permanent disability or death.

It is clear that the demonstration of procedural competence is fundamental to the prevention of or reduction in PICC line adverse events (Paulson & Miller, 2008; Pettit, 2002; Pettit 2003a; Pettit, 2003b) and in the maintenance of safe reliable vascular access for a vulnerable patient population (Pettit & Wyckoff, 2007). A significant component of the demonstration of PICC line competence is the documentation of provider and patient PICC line outcomes (Linck et al., 2007; McMahon, 2002; Pettit, 2002; Pettit & Wyckoff, 2007).

These types of procedural skills can be described as key competencies that are crucial for safe, effective provider performance (Kak, et al., 2001). Creating a system or tool that can adequately measure these critical skills is the challenge.

A literature review regarding competency (Appendix A) did not identify a single systematic and sensitive tool that could be used in real time to identify or measure NNP performance. While the IOM recommends the use of informatics to assist in the safe and patient centric delivery of high quality care (The National Academy of Sciences, 2003), none of the tools reviewed included an informatics approach.

In 1991 the IOM recommended the transition from a paper based record system to an electronic format known as the electronic health record or EHR (Institute of Medicine Committee on Data Standards of Patient Safety, 2003). One of the critical core EHR functions identified by the IOM is the ability of the EHR to generate electronic reports regarding quality (Institute of Medicine Committee on Data Standards of Patient Safety, 2003).

Informatics infrastructures also have the capacity to obtain information from electronic databases to report on quality of care, in addition to the generation of patient and population specific evidence (Cimino et al., 2005). Electronic patient record systems, through the "collection of standardized data elements" (Rubin et al., 2001) can assist in the assessment of the quality of care. In addition to the generation of evidence, the embedding of clinical guidelines in the electronic record can reduce the variability of patient care delivery (Bakken, 2001; Johnson & Ventura, 2004; Tierney, 2001).

Information technology can be used to provide real time feedback that can assist providers in evaluating the processes by which they deliver care (Johnson & Ventura, 2004; Safran et al, 2007). Finally, the use of the EHR to measure provider performance and patient outcomes has the potential to reduce health care costs (Safran et al., 2007; Tierney, 2001).

Project Significance

If successful, this project has the potential to contribute to reportable advanced practice nursing specific outcomes. The use of the electronic health record to measure APN performance could also serve as a template for the measurement of other advanced practice outcomes as well as a template to evaluate other healthcare provider outcomes. Reports generated from the data analysis of the electronic note could provide a link to the organizational quality assurance and quality improvement measures. This would have particular significance for patient safety initiatives as well as the patient, provider and organizational costs incurred from potential procedural complications. The electronic data analysis could not only serve as a benchmarking tool for APN providers, but could also be incorporated into personal portfolios demonstrating ongoing provider competence to the organization, the provider, the community and to licensure and certifying agencies.

Finally, the data generated from the project could be presented in dashboard format to facilitate monitoring capabilities within the institution.

Setting and Target Population

The first phase of the project was undertaken to evaluate the use of common competency measurement tools used by local Baltimore-Washington Neonatal Intensive Care Nurseries. Phase two of the project, involved the building, implementation and evaluation of an evidence based electronic PICC line insertion note, to be utilized by the NNP staff in the NICU at Mercy Medical Center. The final phase of the project included NNP compliance in the use of the note, the perceived usefulness of the note and overall PICC line note outcome data.

Supporting Data for the Existence of the Problem

No single systematic and sensitive tool has been identified, as evidenced by the primary literature review (Appendix A), that can be used in real time to identify or measure NNP performance, particularly as it relates to the insertion of PICC lines. While the IOM recommends the use of informatics to assist in the safe and patient centric delivery of high quality care (The National Academy of Sciences, 2003), no tools have been identified that include an informatics approach to the measurement of NNP competence or performance as it relates to the insertion of PICC lines.

In the NICU, prior to this project, the NNP staff documented the insertion of PICC lines via an electronic documentation system (Meditech) in a "free text" format. The free text format does not provide a consistent documentation framework or language usage among providers or from patient to patient. It is also time consuming for providers to use, and does not lend itself to reliable or accurate analysis with currently available software. This process requires manual review of each PICC line note, causing delays and inconsistencies in reporting of PICC line outcome data and NNP PICC line performance.

Project Purpose

The overall purpose of the project was to determine if an evidence based electronic PICC line note could be built, implemented and successfully utilized as a tool to evaluate NNP PICC line performance or outcomes in a Neonatal Intensive Care Nursery Setting.

Objectives

1.) Determine what tools if any, are utilized by Baltimore-Washington area NICU's to evaluate NNP PICC line insertion performance or competence.

2.) Evaluate the perception of eight commonly used performance measurement tools (derived from the literature) as adequate tools to measure NNP PICC line competence.

3.) Build and implement an evidence based electronic PICC line note for NNP providers to use in the NICU at Mercy Medical Center.

4.) Using data analysis software, analyze the PICC line note elements to determine the usability of the note as a tool to measure NNP PICC line performance.

5.) Evaluate the note implementation process and NNP satisfaction with the updated PICC line note format.

Theoretical Framework

The Donabedian Quality Assurance Model of Structure, Process and Outcomes (Donabedian, 2003) provided the theoretical framework for the capstone project. Quality is the product that results from the combination of healthcare science and technology knowledge as it is applied in the patient care setting (Donabedian, 2003, p. 4). In addition, "the selection of valid, reliable feasible and usable" tools that accurately reflect provider performance and subsequent patient outcomes are critical building blocks for the culture of patient safety (Rubin, Pronovost & Diette, 2006).

Structure

In this theoretical model, from a global point of view, the setting in which health care takes place is a key construct of structure (Donabedian, 2003). Structure can also be defined as organizational factors and resources that influence the delivery of health care (Emmett, 1999). These factors include, but are not limited to, equipment, health care providers, education resources, program operations, as well as administrative structure (Donabedian, 2005; Emmett, 1999). The foundation of the structural framework for the theoretical model in this application includes the Neonatal Nurse Practitioner staff providing care in the Neonatal Intensive Care Nursery at Mercy Medical Center. They bring to the setting their expertise, knowledge and skills in performing the procedure for which outcomes were measured (the insertion of PICC lines).

A secondary critical element of structure in this application is the program operations of the intuitional healthcare information technology system. This includes the flexibility and adaptability of current existing EHR documentation systems as well as data mining and analysis capabilities. These capabilities helped to drive the development of the electronic note as well as the process measures of data mining and analysis. The dissemination of new technology by the IT staff is also a structural component.

The equipment currently utilized to insert PICC lines, as well as the interdisciplinary collaboration of NNP, physician, IT, quality assurance, infection control and nursing staff are also vital components of structure in the application of the model.

Process

Donabedian (2003) describes processes as those activities or actions that are involved in the delivery of health care. They include "interventions and interactions" between providers and patients (van Driel, 2005). Provider interventions or actions should be based in scientific evidence (Emmett, 1999; van Driel, 2005). Processes are also reflected in the technical proficiency and competence of providers (Donabedian, 2005). For the purpose of this project, process includes the building of the electronic note, data mining of the electronic procedure note, followed by data analysis and reporting mechanisms. The elements of the electronic note are rooted in evidence based practice guidelines for PICC line insertion (Pettit & Wyckoff, 2007) and also reflect provider performance and competence. These performance and competence processes, when analyzed, have the potential to aid in the evaluation of trends in provider performance as well as the evaluation of provider outcomes (Donaldson et al., 2005; Maas & Delaney, 2004).

A survey of local area NICU's assisted in the identification of the processes most commonly employed to measure provider performance and outcomes related to PICC line insertion by NNP staff.

Outcomes

Outcomes, according to Donabedian (2005, p. 694), "remain the ultimate validators of the effectiveness and quality of medial care". Processes or actions contribute to or result in outcomes (Emmett, 1999), which can be desirable as well as undesirable (Donabedian, 2003). Both structure and process contribute to outcomes (van Driel, 2005) and outcome measures must reflect provider performance (Donabedian, 2003). For the scope of this project, the data mining and analysis of the electronic PICC line procedure note facilitate the demonstration of provider as well as patient specific outcomes. Provider evaluation of the electronic note implementation process as well the evaluation of the note's utility and function, assist in the demonstration of provider satisfaction as an additional outcome measure.

Capstone Structure, Process and Outcome Model

Donabedian's (2003) initial visual concept of the structure, process, outcomes model was linear in nature.

While in this view, structure leads to process which in turn leads to outcome; there may also be reciprocal interactions at each linear intersection. Structure may influence process as well as outcome. While processes are thought to have the greatest impact on outcomes (Donabedian, 2005; Emmett, 1999), process may also offer relevant feedback to structure mechanisms. In the outcome analysis phase of the project, recommendations for changes in both structure and process were generated in order to better identify and report provider performance and outcomes. Figure 1 (Appendix C) demonstrates the interrelationship between the framework elements.

Primary Literature Review

In an attempt to identify existing competency or performance measurement resources that would be applicable to neonatal nurse practitioners, a literature search was conducted. Using the PICO format, the following question was posed: What methods or combination of methods (C) are the most appropriate for use in the measurement (I) of advanced practice nursing (P) competence (O)?

Utilizing CINAHL, MEDLINE and the Cochrane Library, the following key words were entered singly and in combination: performance, measurement, evaluation, methods, tools, assessment, advanced practice nurses, nursing, professional, competence, and research. Additionally, specific requests were made for randomized clinical control trials, systematic reviews and meta-analysis reviews. A search for developing protocols was also conducted, using the Cochrane Effective Practice and Organization of Care Groups.

A total of eighty eight articles were retrieved for evaluation and grouped into the following eight categories: performance, outcome, quality, education, regulatory, role, informatics and competence. A subset of twenty eight articles was identified as the most useful for a detailed review. From review of both abstracts and individual articles, sixty were eliminated, as non contributory, or not useful The majority of these were related to educational competencies of advanced practice nurses or were articles discussing both physician and APN role differentiation Articles evaluating health care system outcomes were eliminated as well as articles that discussed APN scope of practice, certification or APN utilization. A subset of informatics technology (IT) related articles discussing decision support tools, data management systems, and IT system usability were not helpful to the identification of performance or outcome measures and therefore excluded. Literature that presented organizational policy statements were excluded as well (organizational policy statements can be found in greater detail in Appendix A). Articles describing clinical practice guideline applications were also eliminated.

To organize and facilitate the literature review, the twenty eight articles were divided into five groups; (a) qualitative and descriptive systematic reviews, (b) single quasi-experimental or descriptive studies, (c) single qualitative studies, (d) measurement/tool implementation reports, and (e) regulation or organizational standards and statements. No randomized control clinical trials or experimental studies were located. A table format of the literature review can be found in Appendix A.

Systematic reviews of qualitative and descriptive studies

Three systematic reviews of qualitative or descriptive competency measurement studies were appraised. The research studies evaluated in each review were either qualitative, descriptive or mixed qualitative/descriptive in design. Measurement tools were individually critiqued

(Meretoja & Leino-Kilpi, 2001; Robb, Fleming, & Dietert, 2002), or described in the context of the research in which they were used (Kak, Burkhalter, & Cooper, 2001).

The Meretoja and Leino-Kilpi (2001) review was the most rigorous. Search strategies and critique criteria were explicitly described. Twenty one articles were reviewed and nineteen distinct tools for measurement of nursing competence were identified. Psychometric properties for each individual tool, if available, were included in a clear concise table format. The majority of the tools proved to have significant issues with reliability and validity. While no tool specifically addressed APN competence, a variety of levels of nursing practice, from student to manager, were assessed. The dates of the research studies in the review ranged from 1965-2000. The Six-Dimension of Nurse Performance tool was regarded as having the greatest strength (Meretoja & Leino-Kilpi, 2001). It is a fifty two item scale that evaluates leadership, critical care, teaching/collaboration, planning/evaluation, interpersonal relationships, communication and professional development. According to the authors, it was used repeatedly and was well tested for reliability and validity (Meretoja & Leino-Kilpi, 2001).

Using a similar search strategy with much less critique process detail, Robb and colleagues (2002) located competence measurement research studies and tools. Most of the research evaluated nursing student competence. One non-nursing tool was included for its potential applicability to nursing. Instrument reliability and validity were not discussed. The instruments evaluated were used in studies from 1963-2000 (Robb, Fleming & Dietert, 2002). Four of the tools that were highlighted were also included in the Meretoja and Leino-Kilpi (2001) review. None of the tools were felt to have universal applicability (Rob, Fleming & Dietert, 2002).

Kak and associates (2001) included seventeen competence measurement studies from 1992-2000. The majority of the studies and instruments were used to evaluate medical students, residents and physicians. Only one study of nurse competence assessment was included. No mention was made of how the studies were chosen for inclusion in the review.

The authors fail to evaluate or critique individual studies, but rather, present a variety of provider competence measurement methods. The competence measurement method least congruent with provider performance is the written test while the most congruent method is the observation of real time clinical situations (Kak et al., 2001). Objective structured clinical examination (OSCE) tools were used successfully in six of the seventeen competency measurement research studies reviewed by the authors. The OSCE is a combination of both written tests and clinical scenarios presented at stations and can evaluate knowledge, critical thinking and psychomotor skills. It is a multidimensional test that facilitates competency measurement at a variety of levels.

The criteria recommended by the authors for choosing any measurement method include affirmation of instrument reliability and validity, critical resource appraisal, and the ability of the method to test a broad spectrum of competence.

Several themes were identified by each of the preceding systematic reviews. The first is the difficulty in and the variation of the definition of competence. Most of the studies used the performance and competence terms interchangeably. Additionally, many of the tools utilized in competency measurement lack reliability and validity. Finally, one single method of measurement may not adequately measure the breadth and depth of provider competence. Of note, none of the tools described were designed to evaluate APN competence or performance.

Single quasi-experimental or descriptive research

Azzarello (2007) and Mason, et al (2005) employed a single group pre-test, post-test design to evaluate structural knowledge of students, and performance of emergency nurse practitioners (ENP) respectively. Competency measurement tools were used in both studies.

While student post-test scores were higher after the completion of a community health course, the pathfinder computer program used to analyze structural knowledge was noted to be time consuming and complicated, with limited documented use outside of the classroom (Azzarello, 2007). Reliability and validity for the pathfinder program are context dependent, and in this instance deemed to be adequate.

An objective structured clinical examination or OSCE tool was used to evaluate test scores of seventeen ENP before and after an educational intervention (Mason et al., 2005). In this pilot study, the OSCE post-test scores were higher overall. Statistical significance was reached for the written test component of the OSCE, but not for the clinical station component. Inter-rater reliability between the written test and the clinical stations for both pre and post-test results was high. No other evaluation of reliability or validity was presented.

Descriptive studies were used to evaluate nurse practitioner (NP) peer chart review (Sheahan, Simpson & Rayens, 2001), differences in NP and clinical nurse specialist (CNS) practice (Becker et al, 2006), and to identify competencies of community mental health nurses (Kudless & White, 2007). While no specific tools were used in these studies, Sheahan and colleagues (2007) utilized NP peer chart review as a measure of NP competence. The peer review process was found to be labor intensive with poor inter-rater reliability among reviewers.

Becker and associates (2006) used the eight nursing competencies of the Synergy Model of Practice (Hardin & Kaplow, 2005) to describe practice differences between NP's and CNS's.

Kudless and White (2007) found that all levels of nurses in a single community mental health setting used skills and competencies congruent with their scope and standards of practice. These studies employed competencies to define APN roles. They did not evaluate advanced practice nursing competence.

Single qualitative studies

Five single qualitative studies were evaluated. By means of observational techniques and interviews, a competency framework was developed for dementia nurse specialists (Dewing & Traynor, 2005), and nursing competencies were noted to be well situated within practice domains for critical care nurses (Benner, 1984; Dunn et al., 2000).

Benner (1984) used “critical incidents” to define competencies and relate them to five levels of proficiency. The critical incident technique or tool was used to evaluate perception differences between novice and expert nurses regarding a specific patient care scenario.

Keating and associates (2003) used the California Differentiation Model (CBDRM) to evaluate levels of practice between student nurses and graduate nurses. Students were most often rated at the novice level, while new graduates functioned at the competent level. No details about the tool were included, and its applicability may be limited to evaluation of students and novice nursing staff.

Patricia Allen and associates (2008) invited a group of twenty five nurse leaders to discuss issues relevant to the evaluation of professional nurse competency. The group identified three critical themes: (a) components that comprise evaluation of competence, (b) barriers and challenges to competence evaluation and (c) competency evaluation recommendations. The conference attendees agreed that the evaluation of practice specific career competency expertise is a key component of competency evaluation and must be reflective of all levels of abilities, from novices to experts. They also concluded that achieving a competency evaluation standard is difficult if not impossible given the variety and diversity of nursing roles (Allen et al., 2008).

Competency measurement framework or tool implementation reports

Seven practice reports involving the implementation of competency measurement frameworks or tools were included for this review.

The Accreditation Council of Graduate Medical Education (ACGME) Healthcare Matrix tool was presented by Bingham and associates (2005). The tool combines the ACGME six core competencies with the IOM's six dimensions of quality care; (a) safe, (b) effective, (c) timely, (d) efficient, (e) equitable, and (f) patient centered. The matrix is a conceptual framework designed to assist in medical resident education, and is currently being piloted in a number of settings to ascertain its validity (Bingham et al., 2005). The ACGME core competencies have been adopted by the American Board of Medical Subspecialties as standards for initial certification as well as certification renewal. In this situation, the intent is to use the matrix to link competencies to outcomes (Bingham et al., 2005).

Johnson and colleagues (2000) and Arcand and Neumann (2005), give detailed descriptions of competency framework implementation projects. Similar to the OSCE, both used a combination of written tests, skill stations, demonstration models and case scenarios to evaluate and score nursing competence within the context of the framework. The description of the framework implemented by Arcand and Neumann (2005) was applied across nursing disciplines, including nurse practitioners. Either framework could be adapted for use in large institutions.

Kleinpell and Gawlinski (2005) discussed the use of quality indicators as a method to assist in the assessment of advanced practice nursing outcomes. Outcomes are "results of interventions based on the use of clinical judgment, scientific knowledge, skills and experience" (Klienpell &

Gawlinski, 2005, p. 43). They provide recommendations for the identification of quality indicators, identification of outcome measures as well as the planning, assessment, implementation and evaluation processes required to assist in the measurement of APN outcomes.

Melander, Kleinpell and Mclauglin (2007) provide an expert opinion on the necessity of ensuring clinical competency for acute care nurse practitioners. In addition to following scope of practice guidelines, the authors recommend implementation of clinical skills and procedure logs as well as credentialing and privileging for specific skill sets.

Organizational statements or recommendations

Nursing organizations were searched for practice standards, practice statements and competency recommendations. The American Nurses Association (ANA), the National Association of Neonatal Nurses (NANN), the American Association of Critical Care Nurses (AACN) and the Health Resources and Services Administration (HRSA), have all clearly defined educational core competencies as well as entry level competencies for nurse practitioners. None include recommendations for ongoing competency measurement. The ANA does, however recommend APN peer review as part of the credentialing and privileging process (ANA position statement, 2006).

The National Certification Corporation (NCC) has recently piloted a study to evaluate the competence of women's health nurse practitioners. Self report and written tests will be compared as measures of competence. If successful, this may change how nurse practitioners are certified as well as recertified. The results as of March 2009 were not available.

Finally the Citizens Advocacy Center in its 2004 Road Map to Continuing Competency Assurance (www.cacenter.org/cac/continuing_competence_requirement, accessed May 4, 2008) and its more recent publication, “Implementing Continuing Competency Requirements for Health Care Practitioners (Swankin, LeBuhn & Morrison, 2006), describe the process and elements necessary to demonstrate ongoing health care provider continuing competence. Critical elements of performance measurement are discussed, but no frameworks are suggested.

As highlighted by this literature review, there is a paucity of quality effective NNP specific performance measurement tools. The EHR is a potentially rich source of heretofore untapped data that may aid in the identification of outcome measures that better reflect NNP performance. In building a framework for the measurement of NNP PICC line performance, it is critical to identify appropriate outcome measures. A secondary literature review was conducted to identify PICC outcomes that could be incorporated into an EHR format. This format could be then be utilized for the documentation of NNP PICC line procedural performance.

Secondary Literature Review

Percutaneously Inserted Central Catheters

In order to identify evidence based outcome measures for the insertion of PICC lines, a secondary literature search was conducted. Using CINAHL, Medline and the Cochrane Library, the following key words were entered singly and in combination: percutaneously inserted central catheters, neonates, complications, outcomes, guidelines, assessment, and catheter related blood stream infections. Limits were set for neonates and a time span of five years. Twenty four articles provided contributory evidence that was useful for the creation of the PICC line electronic procedure note (Appendix B includes the literature review in table format).

Six themes were identified: (a) complications, (b) assessment, (c) placement, (d) management, (e) documentation, and (f) clinical guidelines.

The majority of the literature addressed complications related to PICC line use in the neonatal population. The most commonly addressed complication was that of catheter related blood stream infection (CRBSI).

CRBSI rates vary widely among institutions and have been reported to be as low as zero percent and as high as forty six percent (Cartwright, 2004). The majority of the literature links the use of PICC lines with increases in neonatal infection risks, particularly in the very low birth weight groups (Chien et al., 2002), (Garland et al., 2008; Graham et al 2006; Perlman et al, 2007). To reduce the incidence of CRBSI, some researchers recommend limiting the use of PICC lines in this population (Perlman et al., 2007) or limiting the length of time the lines are left in place (Graham et al., 2006).

Smith and associates (2008) found no increased incidence of CRBSI with prolonged PICC line dwell time, and in a Cochrane review (Ainsworth, Clerihew, & McGuire, 2008), no increased risk of untoward events was found when PICC lines were compared with standard peripheral intravenous (IV) catheters.

The incidence of CRBSI, as well as the occurrence of other complications, may be reduced when stringent PICC line insertion and management guidelines are followed (Aly et al, 2005; (Camara, 2001; Golombeck et al 2002; Link et al., 2007; Pettit, 2007).

Placement complications occur less often than catheter related infections, but are potentially more life threatening. The caliber and size of the lines makes them difficult to visualize radiographically even with the advent of digital imaging (Webster et al., 2004). Several case reports describe significant complications and death when PICC lines are inserted in the lower extremities, particularly the left saphenous vein. Chedid and colleagues (2005), Chen and associates (2001), as well as a report from an Australian NICU (Clarke et al., 2002), all document incidents of misplacement of PICC lines into the lumbar vein or paraspinal venous plexus. Due to infant decline, lumbar punctures were performed in all of the reported cases. Total parenteral nutrition and lipid solution was discovered in each of the infant's cerebral spinal fluid. In each case report, the site of insertion for the PICC line was the left saphenous vein. On the other hand, a study conducted at the University of California at Irvine (Hoang et al., 2007) found that catheters inserted via the upper extremity route had more complications than those placed in lower extremities.

The placement, migration or dislodgement of PICC lines within the heart have resulted in incidents of cardiac tamponade and neonatal death (Nadroo et al., 2000). Pettit (2003) notes that pericardial effusion and cardiac tamponade can account for up to 0.7% of PICC related complications. While extremely rare, these complications are difficult to diagnose and treat. The catheter and or the infusate can erode through and into the pericardial space (Pettit, 2003) causing an accumulation of fluid and subsequent tamponade.

According to Pettit (2002), the most common PICC line complication is occlusion, followed by infection, dislodgement and catheter leakage. The more rare complications, in descending order, are phlebitis, catheter breakage, malposition, pleural effusion, catheter migration, catheter retention, thrombosis and pericardial effusion (Pettit, 2002; Pettit, 2003).

A "focused assessment" is crucial to the avoidance and identification of neonatal PICC line complications (Paulson & Miller, 2008; Pettit, 2007). Understanding venous anatomy and physiology, identification of appropriate IV solutions for use with PICC lines, and strict PICC line insertion and management protocols also assist in the prevention and reduction of PICC line adverse events (Paulson & Miller, 2008; Pettit, 2002; Pettit, 2003a; Pettit, 2003b). Pettit (2002, 2003a & 2003b) as well as Paulson and Miller (2008), give in depth and excellent primers on the assessment required for infants with PICC lines. Their assessment recommendations are complication specific, and include suggestions for addressing difficulties when they arise.

Documentation is crucial to the monitoring of PICC line insertion and management (Linck et al., 2007; McMahon, 2002; Pettit, 2002; Pettit & Wyckoff, 2007). McMahon (2002) provides examples of PICC line outcome tracking measures that include success rates, complication rates, dwell times as well as methods of insertion and reasons for removal. Outcome data collection assists in the generation of evidence that can drive quality improvement initiatives critical for enhancing patient care (Linck et al., 2007; McMahon, 2002; Pettit & Wyckoff, 2007).

The competence and experience of staff inserting, managing, and trouble shooting peripherally inserted central catheters, also impacts the morbidity associated with neonatal PICC lines (Paulson & Miller, 2008). Pettit and Wyckoff (2007) include in their guidelines for practice handbook, a comprehensive review of what needs to be included in a PICC line placement curriculum. While they note that each institution is responsible for assuring provider competence in PICC line insertion, they do not prescribe a specific method or framework to demonstrate competence.

The National Association of Neonatal Nurses (NANN) Practice Guidelines for the Insertion of Peripherally Inserted Catheters (Pettit & Wyckoff, 2007) is the PICC line resource most commonly used by neonatal nursing staff, including advanced practice nursing staff. It is a compendium of information based on the best evidence found in the literature and corroborates the literature discussed in this review. As a result, the NANN PICC guideline handbook was used for the development of the electronic PICC line procedure note.

Economic Considerations

No institutional or organizational costs were incurred during any phase of the project implementation. The GE documentation software was already in place and the incorporation of the NNP staff into the electronic documentation roll out for the NICU was part of the strategic plan for the Maternal Child Health (MCH) division at Mercy. As part of the strategic plan, the time investment by the IT staff to complete this project, was built-in, and was not above what was expected by the organization.

“MindJet” ™ mapping software, purchased and used to support Doctorate of Nursing Practice (DNP) course work was utilized to create the organizational impact diagram.

The implementation of the project has the potential to generate cost benefits for the institution. As noted previously, while complications of PICC line insertions are rare, they may result in life threatening adverse events. Adverse events have been noted to increase length of stay in the pediatric population which in turn increases the overall cost of care (Kronman et al, 2007). By tracking NNP PICC line performance and outcomes, trends in complications can be identified; patient safety initiatives implemented thereby improving patient outcomes and reducing costs.

The embedding of evidence based data in the electronic patient record may facilitate real time feedback regarding processes of care. Improving processes of care has been shown to reduce costs (Johnson & Ventura, 2004; Pronovost, et al, 2006).

System Analysis

This project was conducted at a 300 bed inner city hospital in its 26 bed NICU (level IIIB – See Appendix D for definitions of NICU levels). The focus of the project was the implementation of an electronic PICC line procedure note for use by the NNP staff in the NICU.

The NNP staff is under the department of Pediatrics in the division of Medicine. The hospital organizational structure is traditional and hierarchical in nature, with a strong physician presence. The Chief Nursing Officer (CNO) has no direct input into nurse practitioner practice within the institution, but does sit on the Medical Executive Board that makes credentialing and privileging decisions for those providers.

The CNO is currently spearheading the move towards Magnet Certification. As a result of the groundwork done for this project, the advanced practice nurses, including all hospital nurse practitioner staff, have been invited to participate in the Magnet Journey. This has created a strong collaborative working relationship between the nursing and advanced practice nursing staff within the institution that did not exist before.

There is a Nursing Informatics Technology staff that functions under the direction of the CNO. They interfaced directly with the NNP staff to help determine the feasibility of creating and implementing an electronic NNP PICC line procedure note within the existing GE Centricity Perinatal Software system that is currently in use in the MCH division. NICU Nursing documentation has been in place through the GE system for approximately one year. Part of the long term MCH strategic plan was to incorporate the NNP staff in the GE documentation framework. The creation of the PICC line procedure note was to be a test case of the documentation process for this subset of providers.

Since outcomes from the analysis of the three part electronic PICC line procedure note have potential impact on the Division of Pediatrics, Division of Neonatology, Quality Assurance and Infection Control, representatives from each of these areas were asked for collaborative input regarding the project. Using MindJet ™ mapping software, a flow diagram of the actual and potential impact of this project on the system was created and can be found in Appendix E.

Methodology

Survey

In the initial phase of the project a telephone survey was conducted to determine the most commonly used measures to evaluate NNP PICC line procedural performance in Baltimore-Washington area Neonatal Intensive Care Units. Using a Likert scale, participants were asked their perception of each tool as an adequate measure of NNP PICC line procedural performance. The measurement methods included procedure checklists, peer review, paper chart review, physical models or simulations, real time observations, written examinations, and computer generated examinations. These are examples of methods frequently used to evaluate and demonstrate provider performance taken from the primary literature review. Through the inclusion of the use of the EHR as a measurement tool, it was hoped that the survey would corroborate the use, or lack of use, of the EHR as a tool to measure PICC line procedural competence.

Depending on each unit's organizational structure, contacts consisted of NNP staff, NNP managerial staff, NNP directors, nursing unit directors or physician unit directors. These names were accessed from a known list of contacts for each NICU. Names of respondents were not included in the data collection and each NICU was assigned an identifying number which was coded on the survey data collection sheet. A codebook with hospital identifiers was kept in a locked file cabinet in the office of the principal investigator (PI) at the University Of Maryland School Of Nursing. Only the PI and the graduate student conducting the survey had access to the codebook and the survey data. Participants were informed that agreement to participate in the phone survey conveyed consent. IRB approval was obtained prior to conducting the survey

(CICERO HP 0040438). The survey and data collection format and tool definitions can be found in Appendix D.

Building of the Electronic Procedure Note

An electronic PICC line procedure note was developed using the GE Centricity Perinatal electronic documentation software in place in the NICU at Mercy Medical Center. Due to the quantity of data that needed to be included, the note was separated into three separate entities; (a) the insertion note, (b) the adjustment note, and (c) the removal note. Evidence based PICC line insertion and management guidelines (Pettit & Wyckoff, 2007) were used to build the elements of the note (Appendix F includes “screen shots” of each note as viewed by the NNP provider). Examples of elements incorporated into the insertion section of the three part note included the following provider specific outcome data; success (yes or no), number of attempts, length of procedure in minutes, starting and ending temperature, use of pain medication, placement location, use of contrast for placement identification, auxiliary aids for insertion (transillumination or ultrasound) as well as any complications as a result of the insertion.

The provider outcome data incorporated in part two of the note included the reason for line adjustment, radiographic confirmation of placement at the time of adjustment, use of contrast, skin integrity assessment at the time of adjustment and any identified complications as a result of the adjustment.

The final part of the note, or the removal section, required the provider to document the reason for removal, line complications requiring removal and complications resulting from line removal.

The complications incorporated into each note section can be found in Table 1. They are directly derived from the secondary literature review, and can be seen embedded into the electronic note format in Appendix F.

Table 1

PICC Line Complications			
Patient Related		**Line Equipment Related**	**Placement Related**
Air Embolism	Infiltration	Catheter Break	Inappropriate Placement
Apnea	Laceration	Catheter Embolism	Line Migration Inward
Arrhythmias	Nerve Damage	Catheter Knot	Line Migration Outward
Bleeding	Pericardial Effusion	Catheter Leak	
Bradycardia	Phlebitis	Catheter Perforation	
Cardiac Arrest	Respiratory Arrest	Catheter Retention	
Cardiac Tamponade	Sepsis	Catheter Tear	
Desaturation	Suspected Sepsis	Equipment Malfunction	
Death	Thrombosis	Occlusion	
Hematoma	Vasospasm		
Hypoxia	Vena Cava Syndrome		

Patient specific data was also incorporated into the three part note. The information was loaded into part one of the note (insertion) and was able to flow electronically into the second and third sections of the note (adjustment and removal). This data include gestational age at birth, date of birth, age in days at the time of insertion, birth weight, and insertion weight. The weight at the time of adjustment or removal was also included.

Electronic Note Implementation

The implementation phase consisted of two parts. During phase one, the electronic note template was made available to the NNP staff for review via the “training/test” mode of the GE Centricity Perinatal electronic documentation system. The NNP staff had access to the test mode for one week prior to implementation of the electronic note system. During this phase the IT staff was available by phone to answer any questions regarding the use or format of the note.

Phase two, the "go live" phase, immediately followed the training phase. IT staff remained available on site and by phone for support. During the "go live" phase, the NNP staff documented all PICC line insertions, adjustments and removals using the three part electronic note.

Building the Electronic Analysis Framework

Data analysis of the three part note was completed using Excel spreadsheet software. The data from the note elements were downloaded from GE Centricity Perinatal into the spreadsheet, which were then loaded into SPSS and subsequently analyzed. The analysis included provider and patient specific outcome data. Table 2 includes examples of the outcome measures included in the data analysis of the three part note (Appendices F includes the note format with required fields).

Table 2

Electronic Outcome Measure Reporting Data

Provider Data (Group & Individual)	Patient Data
Number of lines inserted , adjusted or removed	Summary of start and end temperatures
Summary of # of attempts per line placement	Summary of reasons for insertion
Complication type	Summary of reasons for adjustment
Use of contrast per line	Summary of reasons for removal
Summary of use of auxiliary equipment for placement	Skin Integrity Score
Summary of pain medication use	Complications
Summary of line placement documentation	

Pilot of the Electronic Note and Note Analysis

The implementation of the electronic note was piloted over a three month period from December 2008 to March 2009. At the end of that period, the information generated from the data mining and analysis of the note was evaluated. Providers were assigned letters by Mercy IT staff and provider identities were not known at the time of analysis. Patients were assigned numbers prior to data analysis and were not identifiable at the time of data analysis. A request for project approval was submitted to the IRB at Mercy Medical Center on September 26, 2008 (Proposal MMC2008-97) and was approved as a quality improvement project and therefore not under IRB oversight. The IRB at the University of Maryland, via an expedited review, approved this protocol (HP 00040438) on January 25, 2009

Electronic Note Usability and Functionality Evaluation

Provider satisfaction with the implementation, usability and functionality of the electronic note was evaluated through of the use of the Clinical Information System Implementation Effectiveness Scale (CISIES). The CISIES tool was administered to the NNP staff in computerized format via Survey Monkey. The CISIES tool is accessible on the AHRQ health information technology web page (http://healthit.ahrq.gov/portal/server.pt?open=512&objID=653&&PageID=12713&mode=2&in_y8_userid=3882&cached=true).

The CISIES is a modification of two previous clinical information evaluation scales (Gugerty, Wooldridge & Brennan, 2000; Gugerty et al, 2004). The CISIES tool used in this pilot was an amended version of the previous evaluation tool which had an alpha reliability of 0.97 for the total scale and sub dimension alpha's from 0.70 and 0.97 (Gugerty, Maranda & Rook, 2006). An expert panel reviewed the updated tool, amended changes were minimal, and the new version was finalized in January 2005 (Gugerty, Maranda & Rook, 2006).

Computerized completion and return of the questionnaires signified permission to participate. No participants were identifiable at any time during the survey. Survey results were automatically downloaded into SPSS and analyzed. See Appendix G for a copy of the CISIES tool.

Results

Hospital NICU Survey

In order to ascertain what tools, if any are used to assess NP PICC line insertion performance, a total of seventeen hospitals with NICU's in the Baltimore Washington metropolitan area were chosen to complete a telephone survey. Out of the seventeen, two institutions no longer employ NNP staff in the NICU and were subsequently excluded. Of the remaining fifteen, fourteen were willing to participate in the survey, while the NNP staff at one single institution remained unavailable, yielding an overall response rate of 93% (N = 14).

Four of the hospital NICU's surveyed (28.5%) were level IIIA, five (35.7%) were level IIIB and five (35.7%) were level IIIC (See Appendix D for NICU level definitions). In all but one institution, NNP staff inserted PICC lines. Three of the fourteen NICU's measured NNP PICC line performance (21.4%). Two of these NICU's were level IIIC institutions and the third was designated as a level IIIB. Two of these NICU's used NNP staff to evaluate NNP PICC line performance and one used Infection Control Staff to assist in NNP PICC line performance evaluation.

The three NICU's that measured NNP PICC line insertion performance used multiple tools to evaluate that performance. The tools most commonly used to accomplish this, were procedure checklists (14.3 %, N = 2), paper chart review of NNP PICC line procedure notes (7.1%, N = 1), review of electronically documented NNP PICC line procedure notes (14.3%, N = 2) within the EHR, and the use of physical or simulation models (14.3%, N = 2). Of those NICU's that evaluated PICC line performance, none utilized peer review, real time observations, written tests or computer generated tests. One NICU used what was designated as a Central Line

Management Form, which by description appeared to be in a checklist format. Of the NICU's surveyed, 78.6% did not measure NNP PICC line competence or performance (N = 11).

Using a five point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree), all participants whether they measured NNP PICC line performance or not were additionally surveyed regarding their perception of these eight tools as adequate measures of PICC line performance. The tool with the highest overall mean score was Real Time Observation (M = 3.9, SD = 1.1, N = 14). Table 3 includes a summary of these results. Of those who used the EHR to measure NNP PICC line performance and outcomes, their perception of that tool as an adequate measure was low. Results for those who utilized procedure checklists and paper chart review tools had slightly higher means. The use of the physical model tool was perceived as a more adequate measure of performance in the group of participants that measured NNP PICC line performance.

Table 3 - Perception of Performance Evaluation Tools

Tool	Tool Use Group (N = 3)	Non Tool Use Group (N = 11)	Both Groups (N = 14)
EHR Chart Review	Mean = 1.7 SD = 0.6 †	Mean = 3.1 SD = 1.6	Mean = 2.8 SD = 1.5
Real Time Observations	Mean = 3.3 SD = 2.1 *	Mean = 4.0 SD = 0.8	Mean = 3.9 SD = 1.1
Physical Models	Mean = 3.7 SD = 1.5 †	Mean = 3.6 SD = 1.3	Mean = 3.6 SD = 1.3
Procedure Checklists	Mean = 2.7 SD = 2.1 †	Mean = 3.6 SD = 1.1	Mean = 3.4 SD = 1.3
Peer Review	Mean = 2.7 SD = 2.1 *	Mean = 3.3 SD = 1.1	Mean = 3.1 SD = 1.4
Paper Chart Review	Mean = 2.7 SD = 2.1 ‡	Mean = 2.5 SD = 1.2	Mean = 2.5 SD = 1.3
Written Tests	Mean = 4.0 SD = 0.0 *	Mean = 3.4 SD = 0.9	Mean = 3.5 SD = 0.9
Computer Generated Tests	Mean = 4.0 SD = 0.0 *	Mean = 3.5 SD = 0.8	Mean = 3.6 SD = 0.8

†Used by 14.3% of participants
‡Used by 7.1% of participants
*Not used by those who measured NNP PICC line performance

PICC Line Note Analysis – Part I, Insertion

A total of 368 fields out of 456 were completed for an overall completion rate of 81%. Seven providers documented PICC line insertions. Individual NNP provider completion rates for the insertion section of the electronic note ranged from 67% (32 out of 48 fields completed), to 93% (67 out of 72 fields completed).

Fields in the insertion note that were the most inconsistently completed were beginning temperatures (7 out of 19 fields completed, 36.8%, N = 19), ending temperature (6 out of 19 fields completed, 31.6%), and the completion of the insertion complications field (9 out of 19 fields completed, 47.4%, N = 19). While the completion rate of the pain medication administration field was 68.4% (13 out of 19 fields completed, N = 19), it fell to 54.5% (6 of 11 fields completed, N= 11) in the last month of the pilot project.

The mean time for insertion was 44.5 minutes (SD = 22.7, N = 18), with a minimum insertion time of 25 minutes and a maximum insertion time of 95 minutes. The mean number of attempts per insertion was 2.2 (SD = 1.2, N = 19) with a minimum number of attempts being one and the maximum number of attempts being five, per provider.

The most common method of pain control was the use of Sweetease™ (31.6%, N = 6), followed by containment and pacifier use (31.6%, N = 6). In six notes (31.6%, N = 6), no pain control method was documented. Finally, for all 19 PICC line insertions, 17 were successful while 2 were not (89.5%, N = 19).

PICC Line Note Analysis – Part II, Adjustment Note

During the pilot implementation period, only three adjustment notes were documented. The field completion rate for all providers was 85% (23 out of 27 fields completed,). The most common reason for adjustment was malposition (N = 2), followed by a line that was found to be non-central (N = 1).

The mean skin score at the time of line adjustment was 3.3 (SD = 0.6, N = 3). The skin scale scoring system (Lund et al., 2001) ranges from a low of 3 which denotes intact skin, to a total of 9 which indicates poor skin integrity.

PICC Line Note Analysis – Part III, Removal Note

Seventy four out of eighty four items were completed (88%, N = 14). Four NNP providers documented line removal. The lowest completion rate was 79% (19 out 24 fields completed,). Two providers completed 100% of the removal note fields.

For each removal, the NNP was asked to document which line insertion number the line removal matched. The completion rate for this field was 46.2% (6 out of 13 fields completed, N = 13). The most common reasons for line removal were completion of therapy, occlusion, phlebitis and sepsis (21.4% for all N = 14), followed by infiltration (14.3%,, N = 14).

Clinical Information Systems Implementation Evaluation Scale (CISIES) Survey

The CISIES survey tool (Appendix G) administered via Survey Monkey was used to determine the success of the electronic note implementation process, as well as the perception of its usability and function by NNP staff. All NNP providers in the NICU at Mercy Medical Center, eligible to insert PICC lines, were included in the survey. Eight surveys were electronically sent, completed and returned for a response rate of 100%.

The survey is comprised of 37 items that are scored on a six point Likert scale. The scale ranges from Strongly Disagree to Strongly Agree, with no neutral point. Table 4 demonstrates a summary of the highest and lowest scoring items in the survey.

Table 4

Highest and Lowest CISIES Survey Scores

Survey Question	Results
Question #1 - Overall I prefer using the system than the old way of doing things.	M = 5.6, SD = 0.4, N = 8
Question #5 - Adequate resources were available when I was learning to use the system.	M = 5.6, SD = 0.5, N = 8
Question #8 - The system is more efficient than the old way of doing things.	M = 5.6, SD = 0.7, N = 8
Question #21 - I am committed to the successful use of the system.	M = 5.6, SD = 0.5, N = 8
Question #22 - People who use the system should have had more to say about the design of the system.	M = 1.9, SD = 0.8, N = 8
Question #32 – Members of other disciplines should receive more training regarding how their entry of information affects my use of the system.	M = 3.5, SD = 0.9, N = 8

Using the CISIES recommended scoring system (Gugerty, Miranda & Rook, 2006), a total scale score for the survey was calculated using an Excel spreadsheet. Positively worded items were given -5, -3, -1, +1, +3, and +5 scores for Strongly Disagree, Disagree, Somewhat Disagree, Somewhat Agree, Agree, and Strongly Agree, respectively. Reverse scores were given for negatively worded items. The CISIES total scale score for the three part electronic PICC line note implementation was 3.2. Scores of 2 to 3.99 "indicate a moderate to high degree of satisfaction with system implementation and a low likelihood of problems with implementation" (Gugerty, Miranda & Rook, 2006).

Recommendations and Discussion

NICU Survey

The tools perceived as most able (participants agreed or strongly agreed) to measure performance or competence were Real Time Observations (71.5%), Physical Models (64.3%), Procedure Checklists (57.1%), Written Tests (57.1%), Computer Generated Tests (57.1%) and

Peer Review (50%). While a significant percentage of participants agreed that the Real Time Observation Model would be an adequate tool to measure competence or performance, none of the hospitals who measured PICC line performance utilized it.

The tools perceived as least able (participants disagreed, or strongly disagreed) to measure performance or competence were the use of the Paper Chart to review NNP procedure notes (64.3%) and the use of the Electronic Health record to review NNP PICC line notes (57.1%).

Of those NICU's that utilized the EHR to assist in the measurement of NNP PICC line performance, it was perceived as an inadequate measurement tool. The paper chart review process as a tool was rated marginally higher by those who collect NNP PICC line performance information. In actuality providers may feel that tools employed to evaluate their performance are inadequate to assess the complex construct of performance or competence.

Fifty seven percent of all survey respondents felt that the review of the EHR is not an adequate method to measure performance or competence. Sixty four percent felt that the use of a paper chart review is inadequate to the measure NNP PICC line performance. Chart review is considered the "gold standard" for the gathering of outcome data (Johnson et al., 2005). Both electronic chart reviews and paper chart reviews can be labor intensive processes. The information gathered is usually retrospective and may be less than accurate (Johnson et al., 2005; Johnson & Ventura, 2004). During the survey many respondents commented on the time consuming task of chart review, and this factor may have influenced the perception of it as an adequate method to assess competence.

Significant variation exists between electronic health record frameworks. This survey did not gather information regarding the specific EHR frameworks that were used by providers to evaluate NNP PICC line performance. It is also important to note that dissatisfaction with the

EHR as a measurement tool may in truth been a reflection of provider dissatisfaction with a specific EHR system or framework.

Participant perceptions seem to mirror the competency measurement literature, in that the competence measurement method most congruent with provider performance is the observation of real time clinical situations (Kak et al., 2001). While in the literature, written tests are found to be the least congruent with provider performance measures (Kak et al., 2001), the participants in this sampling felt that written tests (along with computer generated tests) are adequate methods to employ in the evaluation of performance. Of the small group of local participants that measure NNP PICC performance, most utilized more than one tool in combination. Tools used in combination are more likely to capture multiple aspects of provider performance (Kak et al, 2001).

Caution must be used when interpreting the results of this small pilot sample. This has particular importance when evaluating the small number of NICU's that actually measured NNP PICC line performance (N = 3). This survey is also a reflection of a single geographic location. Repeating the survey across a nation wide sampling of NICU's and NNP staff would provide a broader perspective of NNP PICC line performance measurement practices and perceptions.

PICC Line Note Analysis

The insertion part of the three part electronic note system had the lowest compliance in terms of completion of required fields (81%) when compared to the adjustment (85%) and the removal note segments (88%). In order to determine why there was a 4-7% difference in the insertion note field completion, it was subsequently reviewed after the pilot ended for elements that might have made the completion more challenging for the NNP providers. It was clear from the outset that this note was considerably larger than the other two notes. The field compliance was highest at the beginning of the note and tended to drop off near the end of the note. Modification of the note will be recommended to make sure that critical elements are placed in such a way that they will not be missed by providers. Deletion of some fields may be necessary to make the form more succinct and user friendly.

All three notes were two pages in length, with the complication elements placed on the second page. The providers are required to "click" on yes or no for complications, and if no is clicked, then the note is finished. If yes is clicked then the provider must itemize which complication(s) has (have) occurred. Completion of this complication field was the most problematic for the insertion note with only a 47.4% rate of completion. Moving forward, recommendations will be made to move this complication "yes no" field to the first page of the note to maximize completion and data collection. Highlighting this field in a contrasting color to make is it more visible on the computer screen may also assist in a higher rate of provider field completion. It will be invaluable to also include the NNP staff in the critique of the three part note. This may result in changes in note format that better meet end user needs and facilitate continued success of the electronic PICC line documentation process.

The draping of patients as required by PICC line insertion guidelines has the potential to disrupt thermoregulation and temperature control, particularly in the smallest of infants. Beginning and ending temperatures were included in the note format to assist in the evaluation of temperature stability during insertion. Completion of these note fields was 37% and 32% respectively. A key part of the PICC line procedure, as the note continues to evolve, will be the collaborative effort between nursing and NNP staff to include temperature documentation in the GE nursing flow sheet at the beginning and ending of the procedure. This will make temperature information more readily available for documentation in the NNP insertion note.

During the pilot note implementation, pain management was also inconsistently documented (6 of 19 notes had no pain control documented). This has particular significance in terms of the American Academy of Pediatrics (AAP) revised pain management recommendation for neonates. In it's 2006 policy statement, the AAP recommends; (a) the use of multidimensional neonatal appropriate pain tools be used to assess pain, (b) the reduction of pain from common daily procedures, and (c) that neonates be provided with appropriate pharmacologic and non-pharmacologic pain relief (AAP Committee on Fetus and Newborn, Section on Surgery, and Section on Anesthesiology and Pain Medicine, 2007). As a result of this pilot project, the NNP practice in the NICU at Mercy will now evaluate its pain management practices in relationship to the insertion of PICC lines.

Neonatal catheter related blood stream infection (CRBSI) incidence prior to the implementation of the electronic note format was followed by the hospital infection control department. The incidence was determined by the evaluation of positive blood cultures of infants with lines in place. Line removals for sepsis, or suspected sepsis were difficult to track accurately. In addition, other critical reasons for removal were not known. By recording reasons for removal, complications like phlebitis and line occlusion incidence can be followed and monitored for developing trends. During the pilot project, fourteen line removals were documented, but only three were removed due to the completion of therapy. All others were removed due to sepsis issues (3), phlebitis (3), occlusion (3) and infiltration (2). This is information that would have otherwise been unavailable and will now be accessible to support and implement quality improvement initiatives.

During the pilot implementation of the three part note, no complications as a direct result of insertion, adjustment or removal were found. As part of on going quality improvement initiatives at MMC, chart reviews of text based computer generated PICC line notes for the previous year yielded a single documented complication. In that year one PICC line required removal due to inadvertent arterial placement. This process confirms that PICC line insertion complication outcomes in the NICU remain low. The new PICC line procedure note documentation also provides a higher level of detail regarding complications than was previously possible.

Best practices and evidence based guidelines were used to build each section of the three part NNP electronic PICC line procedure note. The most critical of these included the patient and provider data elements recommended in the National Association of Neonatal Nurses (NANN) PICC line Practice Guidelines (Pettit & Wyckoff 2007). The Neonatal Skin Scoring Guidelines jointly supported by NANN and the Association of Women's Health Obstetric and Neonatal Nurses, or AWHONN (Lund et al., 2001) were embedded in the adjustment note.

"Yes, no" fields, (did you follow them or not) embedded to document the use of the Joint Commission's Universal Protocol Guidelines (wrong patient, wrong procedure) (http://www.jointcommision.org/PatientSafety/UniversalProtocol/) and the Center for Disease Control's Central Line Checklist (http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf), do not guarantee guideline use. They do however; serve as powerful reminders for NNP providers of their responsibility to reduce patient identification errors and the incidence of CRBSI.

Embedding clinical guidelines in the electronic record has the potential to reduce the variability of patient care delivery (Bakken, 2001; Johnson & Ventura, 2004; Tierney, 2001). In addition, the use of standardized data elements embedded within the electronic health record may provide more consistent and accurate data over time, thereby reducing the time and labor intensity required to conduct chart reviews (Rubin, Pronovost & Diette, 2001).

This project provided an opportunity to pilot an evidence based framework for the documentation of the procedural performance of NNP staff in a NICU setting that has not been previously reported. It has the potential to quantify meaningful performance outcomes that are provider, practice and patient specific. This in turn can assist an individual provider or practice in changing processes or performance that will ultimately reduce the variation in care delivery and improve outcomes (Johnson & Ventura, 2004; Rubin, Pronovost & Diette, 2001).

The data analysis of the three part PICC line procedure note was challenging and problematic during the pilot project. Due to institutional pressures of several ongoing IT projects, informatics staff was unable to implement data mining and note analysis through the use of the GE Advanced Reporting Software. As a result, the note data was transferred to Excel spreadsheets which were then copied into SPSS for final analysis. This process was time consuming and in fact required more time than the previous Meditech text based PICC line chart review used prior to the introduction of the updated documentation system. This complication made it difficult to track critical data such as catheter days per insertion.

The GE Centricity Perinatal documentation system was originally chosen to meet the general needs of the MCH division, in particular the Obstetrics documentation process. The NNP PICC line documentation process had to be "fit" into the existing system. According to Satzinger, Jackson and Burd (2009), when an organization is considering the purchase and implementation of a clinical information system, it is critical to plan for system upgrades that will improve and expand the capabilities of end users. As system upgrades become available, significant improvements in data mining, data analysis as well as real time access to data reporting will be essential to the timely appraisal of NNP provider outcomes.

Retrospective chart reviews in any format, require providers to react to outcome data that can be up to several months old. This delayed analysis makes it nearly impossible to understand the context in which care was delivered. The generation of reports in real time would provide more meaningful, timely and context specific outcome data. The GE Advanced Reporting System interfaces with Impromptu Cognos Report Writer, an IBM product, and has the potential to customize reports through data mining and analysis of the PICC line note elements. Moving forward, the goal is to generate monthly reports, preferably in dashboard format, that can be accessed by NNP providers, the Division of Neonatology, Quality Assurance, as well as Infection Control. This dashboard reporting of real time data will help track and benchmark performance as well as outcome trends that will be essential information as pay for performance initiatives expand into Neonatal Intensive Care settings (Profit et al, 2007). Real time reporting may also facilitate improvements in the delivery of care to a vulnerable population of patients.

CISIES Survey Results

The CISIES survey was conducted in the 45-60 day post implementation range recommended by the tool developers (Gugerty, Maranda & Rook, 2006). As the note is improved and upgraded, administration of a second survey, again as recommended by tool developers, will evaluate the effectiveness of the upgrades (Gugerty, Maranda & Rook, 2006). Overall providers were satisfied with the system and its implementation; however, they also felt that they should have had more input into the design of the system. Using a modified CISES scale, researchers now recommend a pre-implementation survey that may improve end-user involvement and buy-in, prior to the development and implementation of a new clinical information system (Wilson, Maranda & Gugerty, 2008). As a part of the pilot project, administration of a modified pre-implementation survey may have facilitated end user input satisfaction with the development of the final NNP PICC line documentation product.

Conclusions

Competence has been defined as “the ability to perform a specific task in a manner that yields desirable outcomes” (Kak, Burkhalter, & Cooper, 2001, p. 3). Outcomes measured from this pilot project, in and of themselves; do not convey provider competence. They do however provide a potentially powerful tool to generate real time information regarding provider performance and provider outcomes that is critical in the multifaceted, multifactorial assessment of competence. By making provider outcomes more visible and transparent, processes of care can be employed that will ensure the safe, effective, timely, and equitable delivery of quality patient care.

Attainment of Personal Leadership Goals

This project required collaboration with multiple stakeholders. Working partnerships with neonatal nurse practitioners, neonatologists, infection control staff, quality assurance staff and information technology staff was crucial to the development of the project. Outside of the institution, relationships with expert user groups as well as with data analysis and software company representatives were valuable pillars of support for plan development.

The proposal and project implementation required the synthesis of APN outcome measures and demonstration of PICC line procedural expertise congruent with current clinical guidelines. The project required the use of multiple evidence based practice guidelines as the pilot electronic note was developed.

This process also facilitated the acquisition of basic informatics competencies and skills that assisted in the building, implementation and evaluation of an electronic tool that enables the generation of outcomes and evidence that may improve practice and the delivery of patient care.

References

AARP, Swankin, D., Lebuhn, R. A., & Morrison, R. (2006, July). *Implementing continuing competency requirements for health care practitioners* (2006-16). Retrieved May 4, 2008 from http://www.aarp.org/ppi.

Agency for Healthcare Research and Quality. *Computer system usability questionnaire and the clinical information system implementation effectiveness scale*. Retrieved November 1, 2008, from AHRQ Healthcare Informatics Technology Knowledge Compendium Web Site: http://healthit.ahrq.gov/portal/server.pt?open=512&objID=653&&PageID=12713&mode=2&in_y8_userid=3882&cached=true

Agency for International Development by the Quality Assurance Project, Kak, N., Burkhalter, B., & Cooper, M. (2001). *Measuring the competence of healthcare providers*. Bethesda Maryland: The Quality Assurance Project.

Ainsworth, S. B., Clerihew, L., & McGuire, W. (2007). Percutaneous central venous catheters versus peripheral cannulae for delivery of parenteral nutrition in neonates. *Cochrane Database of Systematic Reviews,* Issue 3. Art. No: CD004219. DOI: 10.1002/14651858. CD004219.pub3.

Allen, P., Lauchner, K., Bridges, R. A., Francis-Johnson, P., McBride, S. G., & Olivarez, A. (2008). Evaluating continuing competency: a challenge for nursing. *The Journal of Continuing Education in Nursing, 39*(2), 81-85.

Aly, H., et al. (2005). Is bloodstream infection preventable among premature infants? A tale of two cities. *Pediatrics, 115*(6), 1513-1518.

American Academy of Pediatrics, Committee on Fetus and Newborn, Section on Surgery and Section on Anesthesiology and Pain Management, & Canadian Pediatric Society (2007). Policy statement: prevention and management of pain in the neonate, an update. *Advances in Neonatal Care, 7*(3), 151-160**.**

American Nurses Association (2006). Credentialing and privileging of advanced practice registered nurses. *ANA Board of Directors Position Statement,* 1-10.

American Nurses Association (2007, October 11). *Credentialing and privileging of advanced practice registered nurses*: Congress on Nursing Practice and Economics.

Arcand, L. L., & Neumann, J. A. (2005). Nursing competency assessment across the continuum of care. *Nursing Competency Assessment, 36*(6), 247-254.

Azzarello, J. (2007). Use of the pathfinder scaling algorithm to measure students' structural knowledge of community health nursing. *Journal of Nursing Education, 46*(7), 313-318.

Bakken, S. (2001). An informatics infrastructure is essential for evidence-based practice. *Journal of the American Medial Informatics Association, 8*(3), 199-201.

Becker, D., Kaplow, R., Muenzen, P. M., & Hartigan, C. (2006). Activities performed by acute and critical care advanced practice nurses: American Association of Critical-Care Nurses study of practice. *American Journal of Critical Care, 15*(2), 130-148.

Benner, P. (1984). *From novice to expert, excellence and power in clinical nursing practice*. Menlo Park, California: Addison-Wesley Publishing Company.

Bingham, J. W., Quinn, D. C., Richardson, M. G., Miles, P. V., & Gabbe, S. G. (2005). Using a healthcare matrix to assess patient care in terms of aims for improvement and core competencies. *Joint Commission Journal on Quality and Patient Safety, 31*(2), 98-105.

Bissinger, R. L., Allred, C. A., Arford, P. H., & Bellig, L. L. (1997). A cost-effectiveness analysis of neonatal nurse practitioners. *Nursing Economics, 15*(2), 92-99.

Camara, D. (2001). Minimizing risk associated with peripherally inserted central catheters in the NICU. *The American Journal of Maternal/Child Nursing, 26*(1), 17-22.

Cartwright, D. W. (2004). Central venous lines in neonates: a study of 2186 catheters. *Archives of Diseases in Children Fetal Neonatal Edition, 89,* 504-508.

Center for Disease Control. *Central line checklist*. Retrieved March 15, 2009, from Center for Disease Control Web Site: http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf.

Chedid, F., Abbas, A., & Morris, L. (2005). Radiographic inguinal curl may indicate paraspinal misplacement of percutaneously inserted central venous catheters: report of three cases. *Pediatric Radiology, 35,* 684-687.

Chen, C., Tsao, P., & Yau, K. T. (2001). Paraplegia: complication of percutaneous central venous line malposition. *Pediatric Neurology, 23*(5), 65-68.

Chien, L., Macnab, Y., Aziz, K., Andrews, W., McMillan, D. D., & Lee, S. K. (2002). Variations in central venous catheter-related infection risks among Canadian neonatal intensive care units. *The Pediatric Infectious Disease Journal, 21*(6), 505-511.

Cimino, J. J., Lee, N., & Bakken, S. (2005). Using patient data to retrieve health knowledge. *AMIA 2005 Symposium Proceedings,* 136-138.

The Citizen Advocacy Center (2004, April). *Maintaining and improving health professional competence: the Citizen Advocacy Center road map to continuing competency assurance*. Retrieved May 4, 2008 from http://www.cacenter.org/cac/continuing_competence_requirement

Clark, P., Wadhawan, R., Smyth, J., & Emmerson, A. J. (2003). Parenteral nutrition solution retrieved by lumbar puncture following left saphenous vein catheterization. *Journal of Paediatrics and Child Health, 39,* 386-389.

Dewing, J., & Traynor, V. (2005). Admiral nursing competency project: Practice development and action research. *Journal of Clinical Nursing, 14,* 695-703.

Donabedian, A. (2003). *An introduction to quality assurance in health care*. New York: Oxford University Press.

Donabedian, A. (2005). Evaluating the quality of medical care. *The Milbank Quarterly, 83*(4), 691-792.

Donaldson, N., Brown, D. S., & Aydin, C. E. (2005). Leveraging nurse-related dashboard benchmarks to expedite performance improvement and document excellence. *Journal of Nursing Administration, 35*(4), 163-172.

Dunn, S. V., et al. (2000). The development of competency standards for specialist critical care nurses. *Journal of Advanced Nursing, 31*(2), 339-346.

Emmett, M. (1999, August 23). *An agenda for quality*. Center for Health Services and Outcomes Research CAMCARE Institute.

Garland, J. S., et al. (2008). Cohort study of the pathogenesis and molecular epidemiology of catheter-related bloodstream infection in neonates with peripherally inserted central venous catheters. *Infection Control and Hospital Epidemiology, 29*(3), 243-249.

Golombeck, S. G., Roan, A. J., Parvez, B., Salice, A. L., & Lagamma, E. F. (2002). Proactive management of percutaneously inserted central catheters results in decreased incidence of infection in the elbw population. *Journal of Perinatology, 22,* 209-213.

Graham, P. L., Begg, M. D., Larson, E., Della-Latta, P., Allen, A., & Saiman, L. (2006). Risk factors for late onset gram-negative sepsis in low birth weight infants hospitalized in the neonatal intensive care unit. *The Pediatric Infectious Disease Journal, 25*(2), 113-117.

Gugerty, B., Maranda, M., & Rook, D. (2006). The clinical information system implementation evaluation scale. *Consumer-Centered Computer-Supported Care for Healthy People, ,* 621-625.

Hardin, S. R., & Kaplow, R. (2005). *Synergy for clinical excellence, the AACN synergy model for patient care*. Sudbury, Massachusetts: Jones and Bartlett Publishers.

Hoang, V., Sills, J., Chandler, M., Busalani, E., Clifton-Koeppel, R., & Modanlou, H. D. (2008). Percutaneously inserted central catheter for total parenteral nutrition in neonates: complications rates related to upper versus lower extremity insertion. *Pediatrics, 121*(5), 1151-1159.

Institute Of Medicine Committee on Data Standards for Patient Safety (2003, July). *Key capabilities of an electronic health record system: letter report*. Retrieved November 20, 2007 from http://www.nap.edu/catgalog/10781.html

Johnson, C. E., Handberg, E., Dobalian, A., Gurol, N., & Pearson, V. (2005). Improving perinatal and neonatal patient safety, the AHRQ patient safety indicators. *Journal of Perinatal & Neonatal Nursing, 19*(1), 15-23.

Johnson, P. J., Jung, A. L., & Boros, S. J. (1979). Neonatal nurse practitioners: Part I. A new expanded nurse role. *Perinatology/Neonatology, 3,* 34-36.

Johnson, T., Opfer, K., Vancura, B. J., & Williams, L. (2000). A comprehensive interactive competency program part I: development and framework. *Medsurg Nursing, 9*(5), Johnson, T., & Ventura, R. (2004). Applied information for quality assessment and improvement. *Journal of Nursing Care Quality, 19*(2), 100-104.

Joint Commission on the Accreditation of Hospitals. . *Universal protocol guidelines*. Retrieved March 15, 2009, from Joint Commission Web Site: http://www.jointcommision.org/PatientSafety/UniversalProtocol/.

Joint Commission Resources (2007). *Credentialing and privileging your medical staff, examples for improving compliance*. Oakbrook Terrace, Illinois: The Joint Commission on Accreditation of Healthcare Organizations.

Kalb, K. B., et al. (2006). A competency-based approach to public health nursing performance appraisal. *Public Health Nursing, 23*(2), 115-138.

Keating, S. B., Rutledge, D. N., Sargent, A., & Walker, P. (2003). Testing the model for testing competency. *Patient Care Management, 19*(5), 7-11.

Kleinpell, R., & Gawlinski, A. (2005). Assessing outcomes in advanced practice nursing practice. *AACN Clinical Issues, 16*(1), 43-57.

Kronman, M. P., Hall, M., Slonim, A. D., & Shah, S. S. (2008). Charges and lengths of stay attributable to adverse patient care events using pediatric specific quality indicators: A multicenter study of freestanding children's hospitals. *Pediatrics, 121*(6), 1653-1659.

Kudless, M. W., & White, J. H. (2007). Competencies and roles of community mental health nurses. *Journal of Psychosocial Nursing, 45*(5), 36-44.

Linck, D. A., Donze, A., & Hamvas, A. (2007). Neonatal peripherally inserted central catheter team. *Advances in Neonatal Care, 7*(1), 22-29.

Maas, M. L., & Delaney, C. (2004). Nursing process outcome linkage research issues, current status and health policy implications. *Medical Care, 42*(2), II-40-II-48.

Mason, S., Fletcher, A., McCormick, S., Perrin, J., & Rigby, A. (2005). Developing assessment of emergency nurse practitioner competence - a pilot study. *Journal of Advanced Nursing, 50*(4), 425-432.

McMahon, D. D. (2002). Evaluating new technology to improve patient outcomes: a quality improvement approach. *Journal of Infusion Nursing, 25*(4), 250-255.

Melander, S., Kleinpell, R., & McLaughlin, R. (2007). Ensuring clinical competency for np's in acute care. *The Nurse Practitioner, 32*(4), 19-20.

Meretoja, R., & Leino-Kilpi, H. (2001). Instruments for evaluating nurse competence. *Journal of Nursing Administration, 31*(7/8), 346-352.

Mithchell-Dicenso, A. (1999). Responsibilities, roles and staffing patterns of nurse practitioners in the neonatal intensive care unit. *MCN, the American Journal of Maternal Child Nursing, 24*(4), 168-175.

Nadroo, A. M., Lin, J., Green, R. S., Magid, M. S., & Holzman, I. R. (2001). Death as a complication of peripherally inserted central catheters in neonates. *The Journal of Pediatrics, 138*(4), 599-601.

The National Academy of Sciences. (2003). *Health professions education: A Bridge to Quality*. Retrieved December 1, 2007, from The National Academy of Sciences Web Site: http://www.nap.edu/openbook/0309087236/html/l.html,copyright2003,2001

The National Association of Neonatal Nurses. (2002). Educational Standards for Neonatal Nurse Practitioner Programs. In *National association of neonatal nurses board of directors*. Retrieved October 2, 2007, from National Association of Neonatal Nurses Web Site: http://www.NANN.org

The National Association of Neonatal Nurses & American Nurses Association (2004). *Neonatal nursing scope and standards of practice*. Silver Spring, Maryland: Nursebooks.org.

The National Certification Corporation. In *Continuing Competency*. Retrieved October 2, 2007, from National Certification Corporation Web Site: http://www.nccnet.org/public/pages/index.cfm?pageid=434

The National Association of Neonatal Nurses, Pettit, J., & Wyckoff, M. W. (2007). *Peripherally inserted central catheters guidelines for practice* (2nd ed.). Glenview, IL: National Association of Neonatal Nurses

The National Organization of Nurse Practitioner Faculties and the American Association of Colleges of Nursing (2002, April). *Nurse practitioner primary care competencies in specialty areas: adult, family, gerontological, pediatric and women's health* (HRSA 00--0532(P)). Rockville, Maryland: Health Resources and Services Administration.

The National Panel for Acute Care Nurse Practitioner Competencies (2004). *Acute care nurse practitioner competencies*. Washington, DC: National Organization of Nurse Practitioner Faculties.

Nursing World/AJN, & Devries, C. M. (1999). Continued competence: assuring quality health care. In *Issues update*. Retrieved July 9, 2007, from http://www.needlestick.org/AJN/1999/OCT/Issu109f.htm

Paulson, P. R., & Miller, K. M. (2008). Neonatal peripherally inserted central catheters: recommendations for prevention of insertion and postinsertion complications. *Neonatal Network, 27*(4), 245-257.

Perlman, S. E., Saiman, L., & Larson, E. L. (2007). Risk factors for late-onset health care-associated bloodstream infections in patients in neonatal intensive care units. *American Journal of Infection Control, 35,* 177-182.

Petit, J. (2002). Assessment of infants with peripherally inserted central catheters: part I. detecting the most frequently occurring complications. *Advances in Neonatal Care, 2*(6), 304-315.

Pettit, J. (2003a). Assessment of infants with peripherally inserted catheters: part 2. detecting less frequently occurring complications. *Advances in Neonatal Care, 3*(1), 14-26.

Pettit, J. (2003b). Assessment of the infant with a peripheral intravenous device. *Advances in Neonatal Care, 3*(5), 230-240.

Pettit, J. (2007). Technological advances for PICC placement and management. *Advances in Neonatal Care, 7*(3), 122-131.

Profit, J., Zupancic, J. A., Gould, J. B., & Petersen, L. A. (2007). Implementing pay for performance in the neonatal intensive care unit. *Pediatrics, 119*(5), 975-980.

Pronovost, P., et al. (2006). How will we know patients are safer? An organization wide approach to measuring and improving safety. *Critical Care Medicine, 34*(7), 1988-1995.

Robb, Y., Fleming, V., & Dietert, C. (2002). Measurement of clinical performance of nurses: a literature review. *Nurse Education Today, 22,* 293-300.

Rubin, H. R., Pronovost, P., & Diette, G. B. (2001). The advantages and disadvantages of process-based measures of health care quality. *International Journal for Quality in Health Care, 13*(6), 469-474.

Safran, C., et al. (2007). Toward a national framework for the secondary use of health data: an American medical informatics association white paper. *Journal of the American Medical Informatics Association, 14*(1), 1-9.

Satzinger, J., Jackson, R., & Burd, S. (2009). *Systems analysis and design in a changing world* (5th ed.). Boston: Course Technology.

Schultz, J. M., Liptak, G. S., & Fioravanti, J. (1994). Nurse practitioners' effectiveness in NICU. *Nursing Management, 25*(10), 50-53.

Sheahan, S. L., Simpson, C., & Rayens, M. K. (2001). Nurse practitioner peer review: process and evaluation. *Journal of the American Academy of Nurse Practitioners, 13*(3), 140-145.

Smith, P. B. (2008). Is an increased dwell time of a peripherally inserted catheter associated with an increased risk of bloodstream infection in infants? *Infection Control and Hospital Epidemiology, 29*(8), 749-753.

Swider, S., et al. (2006). Matching a graduate curriculum in public/community health nursing to practice competencies: the rush university experience. *Public Health Nursing, 23*(2), 190-195.

Tierney, W. M. (2001). Improving clinical decisions and outcomes with information: a review. *International Journal of Medical Informatics, 62,* 1-9.

Trotter, C., & Danaher, R. (1994). Neonatal nurse practitioners: A descriptive evaluation of an advance practice role. *Neonatal Network, 13*(1), 39-47.

Van Driel, M. L., De Sutter, A. I., Christiaens, T. C., & Maeseneer, J. M. (2005). Quality of care: the need for medical, contextual and policy evidence in primary care. *Journal of Evaluation in Clinical Practice, 11*(5), 417-429.

Webster, N. J., Page, B., Kuschel, C. A., & Battin, M. R. (2005). Digital imaging does not improve localization of percutaneously inserted central lines in neonates. *Journal of Pediatrics and Child Health, 41,* 256-259.

Wilson, M. L., Maranda, M. J., & Gugerty, B. (2008, October). *Mitigating unintended consequences through the evaluation of clinical information system implementation effectiveness*. Paper presented at the meeting of the European Evaluation Society. Retrieved March 16, 2009 from http://www.europeanevaluation.ort/congressmedia

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Appendix A

Performance/Competence

Literature Review

Performance/Competence Measurement-Systematic Qualitative Reviews and Descriptive Research

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Kak, N, Burkhalter, B, & Cooper, M **2001**	**Level II-2**	Seventeen Healthcare Provider Competency Measurement Studies	Review of competency measure tools used in each study, including study target group, tools utilized, intervention description and outcomes description.	Multiple methods exist to evaluate competence. Existing tools have reliability and validity issues and no link to strong theoretical definition of competence. Indicators and levels of competence not well established.	No recommendations given of best competence measure. Only one study involving nurses was included and they were not advanced practice nurses.	**A** - Excellent description of competence concepts and influencing variables plus description of criteria for choosing measurement tools. No elucidation of methods used for lit search.
Meretoja, R & Leino-Kilpi, H **2001**	**Level II-2**	Twenty one articles including competency measurement instruments	Fifteen final articles yielding 19 different tools reviewed including sample size and tool description	Many tools in early development. Many had critical reliability and validity issues. The Six Dimension Scale of Nurse Performance tool noted to have been used repeatedly with good reliability and validity.	Many tools evaluated competence by self report, and most did not have sound theoretical definition of competence.	**A** - Able to track systematic review methods. Description of reliability and validity measures for tools included.
Robb, Y, Fleming, V, & Dietert, C **2002**	**Level V**	Thirteen nursing competence measurement studies evaluated	Search for reliable and valid nurse competence measurement tools	No single tool found with universal applicability. Two tools found with potential for development for universal use.	Reliability and validity of individual tools not addressed. Many studies evaluated student nurses.	**B** - Able to track review methods. Tool reliability/validity critique not included.

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

(†) Modified from U.S. Preventative Services Task Force Ratings and Johns Hopkins Nursing Evidence-based Practice Rating Scale (Newhouse et al 2007).

Performance and Competence Measurement Literature Review
Semi-Experimental and Descriptive Research

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Azzarello, J **2007**	**Level III** Semi-experimental single group pre-test, post-test design	102 BSN students	Assessment of structural knowledge before and after completion of community health course by use of Pathfinder algorithm.	Student knowledge closest match to Pathfinder model after completion of course ($p<0.001$).	Pathfinder program use is complex. Model development is context dependent. Fairly new and untested technique. Minimal application outside of classroom.	**GOOD** – No detailed discussion of tool validity or reliability. Good sample size. Potential bias in "volunteering" of students by faculty teaching course being measured. Good fit with lit review.
Becker, D, Kaplow, R, Muenzen, PM, & Hartigan, C **2006**	**Level VI** Descriptive study using survey methodology	158 Clinical Nurse Specialists 77 Acute Care Nurse Practitioners	Rating and validation of advanced practice (CNS, NP) practice activities by criticality ratings.	Based on 8 nursing competencies from AACN Synergy Model of Care, CNS rated clinical judgment and clinical inquiry as highly critical, while NP rated clinical judgment as highly critical.	CNS mostly in community hospitals, NP mostly in university medical centers. May not apply to arenas out side of critical care.	**GOOD** – development of survey tool well thought out but explanation of tool development confusing. Good fit with lit review.
Kudless, MS, & White, JH **2007**	Level VI Descriptive study using survey methodology	40 Community Mental Health Nurses in a single setting	Identification of scope of practice and competency frequencies.	All levels of nurses used skills/competencies congruent with scope and standards of practice.	Only frequencies reported. Survey respondents only from one setting.	**FAIR** – sampling bias with only one group evaluated, may not be generalizable.

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

(†) Modified from U.S. Preventative Services Task Force Ratings and Johns Hopkins Nursing Evidence-based Practice Rating Scale (Newhouse et al 2007).

Performance and Competence Measurement Literature Review
Semi-Experimental and Descriptive Research

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Mason, S, Fletcher, S, Perrin, J, & Rigby, A **2005**	**Level III** Semi experimental pilot study, single group, pre-test, post-test design.	17 Emergency Nurse Practitioners (ENP)	Comparison of results from Objective Structured Clinical Examination (OSCE) before and after educational intervention.	Overall scores on OSCE higher after the intervention. Written OSCE scores higher than clinical station scores, P<0.005.	Pilot study therefore generalizablilty limited. ENP from only one institution evaluated. OSCE very time consuming to administer.	**A -** OCSE has been used in other studies. Specifics of OSCE content not included. Adequate fit with lit review.
Sheahan, SL, Simpson, C, & Rayens, MK **2001**	**Level III** Descriptive, Correlation Study	163 Medical Records reviewed for 15 NP staff from a VA Medical Center (from specialty clinic and primary care practices).	Use of peer review by chart review to determine congruency among 15 NP's using 14 item peer review form.	Low level of interrater congruence among NP's (R=0.37), and there were significant differences between NP's as reviewers, and NP's being reviewed (p<.0001)	More charts needed to be reviewed, and not all reviewers participated in the process equally.	**B -**investigators did not consider variables that would negatively impact chart review, i.e., time, provider motivation. Demographic variables, like experience may have helped define differences.

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

(†) Modified from U.S. Preventative Services Task Force Ratings and Johns Hopkins Nursing Evidence-based Practice Rating Scale (Newhouse et al 2007).

Performance and Competence Measurement Literature Review
Single Qualitative Studies

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Benner, P **1984**	**Level III** Qualitative study using observations and interviews	21 paired interviews of beginning and expert critical care nurses in six hospital settings. Additional 51 expert nurses with > 5 years of experience Interviewed.	Identification of themes, meaning and content using Heideggerian phenomenology.	Interviews and observations of "critical incidents" resulted in 31 competencies from which, inductively 7 domains of nursing care were developed. Five levels of proficiency from the Dreyfus skills acquisition model affirmed.	Some minimal participation of the observer in nursing care. Do the "critical incidents" describe complex situations, and can they be reproduced.	**A** – Difficult to understand qualitative process of data collection. Fairly good fit with existing literature.
Dewing, J, & Traynor, V **2005**	**Level III** Emancipatory Action Research Qualitative observation	Dementia Nurse Specialists described as Admiral Nurses	Identification of common themes for development of competency framework.	Thirteen themes found consistent with nurses work, out of which eight competencies were created.	Only one subset of nurses involved with limited applicability to other nursing subspecialties.	**B** – Data collection very difficult to follow and understand. Fair fit with lit review.
Dunn, SV, et al **2000**	**Level III** Qualitative study with use of observation and interviews combined with chart reviews. Use of constant comparison data collection technique.	Over 800 hours of observation of Critical Care Nurses in 57 Australian hospitals.	Analysis of nursing performance by describing observed nursing characteristics.	Twenty competency standards identified and grouped into six domains of practice. Performance criteria developed for each competency. Domains and standards universally applicable, but performance criteria subspecialty specific.	Very broad scope of practice review. Performance criteria are examples and not all inclusive.	**A** – very good description of competence definition and concept. Very good fit with lit review

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

(†)Modified from U.S. Preventative Services Task Force Ratings and Johns Hopkins Nursing Evidence-based Practice Rating Scale (Newhouse et al 2007).

Performance and Competence Measurement Literature Review
Single Qualitative Studies

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Allen, P, Lauchner, K, Bridges, RA, Francis-Johnson, P, McBride, SG, Oliverez, A 2008	**Level III Qualitative/Descriptive**	25 Nurse Leaders participating in Conference	Evaluation of Competency Measures	Conference attendees identified components of competency evaluation, barriers and challenges to evaluating competence and recommendations for competency evaluation	Synopsis and consensus from conference attendees No reliability or validity testing of results.	**B –** Consensus of nursing leaders invited to conference. Good description of Nursing Competency.
Keating, SB, Rutledge. DN, Sargent, A, Walker, P **2003**	**Level III** Qualitative, descriptive pilot study done by observation and survey self report.	21 observations of senior AD, BSN and new grads (< 1 year) from Med/Surg units.	Identifying differences in competency levels of AD/BSN students and new grads with use of California Based Differentiation Model (CBDRM).	New grads matched the competent level, and students were rated most often at novice level. No differences noted between AD & BSN students. Sites found tool useful in evaluating competencies.	May not apply to more expert nurses and may be most reflective of student competence.	**C** – Description of tool not included in article, quantitative data reportedly collected, but not included in report. Very weak link with lit review.

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

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Performance and Competence Measurement Literature Review
Competency Measurement Frameworks/Tools Reports

Author and Date	Evidence Type(*)and Rating(†)	Article Summary and Review
Arcand, LL & Neumann, JA **2005**	**Level III** Implementation Report **Grade - A**	Excellent and thorough review of an organization wide implementation of a competency framework at the Mayo Clinic. It was specific to the competency assessment of hospital, ambulatory and advanced practice, and nursing roles. Examples of framework included in the article with precise description of the implementation processes. Framework has potential applicability to other organizations and settings.
Bingham, JW, et al **2005**	**Level III** Healthcare Matrix Tool **Grade A**	The Accreditation Council of Graduate Medical Education (ACGME) developed a Healthcare Matrix tool to evaluate six core competencies of physicians in training. The article describes the history of the development of the tool, and examples of the tool are included. The tool has potential applicability to other healthcare providers as well.
Johnson, T, et al **2000**	**Level III** Implementation Report **Grade A**	Detailed two part report of the implementation of a competency assessment framework for a medicine/oncology nursing department. Competency assessment focused on vascular access devices, chemotherapy administration, tracheostomy care, mechanical ventilation, and central blood line draw and dressing change. Measurement tools used were written tests, hands-on demonstration of skills at clinical stations, and scenario discussions. Final evaluation included nurse performance, unit performance, departmental performance, participant feedback, manager feedback, and patient satisfaction.
Kalb, KB, et al **2006**	**Level III** Report of the integration of PHN Competencies into a Performance Review Instrument **Grade B**	Described as a pilot study, but did not meet criteria for descriptive or qualitative research. Useful for developing competency based performance appraisals. Performance elements included as well as standards and competencies for Public Health Nurses.

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

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Performance and Competence Measurement Literature Review
Competency Measurement Frameworks/Tools Reports

Author and Date	**Evidence Type(*)and Rating(†)**	**Article Summary and Review**
Kleinpell, R, & Gawlinski, A **2005**	**Level III** – Report **Grade A**	Article describes the use of quality indicators and evidence based practice to document Advanced Practice Nursing (APN) outcomes and performance. Authors also make recommendations on the identification of APN outcome variables and the selection of practices and strategies for improvement as well as methodologies to measure implement and analyze them
Melander, S, Kleinpell, R & McLaughlin, R **2007**	**Level III – Expert** Statement **Grade B**	Brief article that describes the need for Nurse Practitioners (NP's) working in acute care settings to demonstrate skills competencies. The authors briefly list strategies to ascertain clinical competence.
Swider, S, et al **2006**	**Level VII** – Implementation Report. Match of Community Health Graduate program to practice competencies. **Grade B**	The article describes Rush University's process of translating practice competencies into the graduate community health program. It included an example of the template used by the University which includes levels of proficiency in eight domains of practice.

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Performance and Competence Measurement Literature Review
Regulatory/Organizational Literature

Author and Date	Evidence Type(*)and Rating(†)	Article Summary and Review
ANA – **2006** Position Statement	**Level III** **Grade A**	Description of 2006 position statement concerning credentialing and privileging of advanced practice nurses. Main focus in focus on peer review through the use of a collaborative nursing model
NANN – **2002** NNP education competency statement	**Level III** **Grade A**	Review of the process of the development of NNP education standards, competencies and evaluation of student competence.
Joint ANA/NANN Neonatal Nursing Scope and Standards of practice – **2004**	**Level III** **Grade B**	Includes description of basic standards for neonatal nursing for RN and APN practice. Includes underlying assumptions for scope and standards of practice. Includes measurement criteria.
NCC – **2007** Initiation of Continuing Competency Pilot Program	**Level III** **Grade B**	Brief description of current ongoing pilot to evaluate the competence of WHNP by comparison of self report (survey) to written tests. Participation selection completed, September 2007. Testing planned for October and November 2007 with final report due in 2008.
AACN – **2004** Acute Care Nurse Practitioner Competencies	**Level III** **Grade A**	Competencies developed by the National Panel for Acute Care Nurse Practitioner Competencies in conjunction with the National Organization of Nurse Practitioner Faculties (NONPF). It describes the entry level competencies for graduates of acute care NP programs and a basis for practice for all subspecialty critical care NP's to build upon
HRSA – **2002** NP Competencies	**Level III** **Grade A**	Competencies described for Adult, Family, Gerontological, Pediatric and Women's' Health Nurse Practitioners. Completed for the HRSA in conjunction with NONPF. It describes entry level competencies of NP graduates of above named NP programs.

(*)U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

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Performance and Competence Measurement Literature Review
Regulatory/Organizational Literature

Author and Date	Evidence Type(*)and Rating(†)	Article Summary and Review
The Citizen Advocacy Center Roadmap to Continuing Competency Assurance **2004**	**Level III Grade A**	The Citizen Advocacy Center makes recommendations for two phases to maintain and improve health professional competence. By conducting and analyzing competency research across all health professions, seeking legislative and regulatory mandates, incorporating evidence-based methods to demonstrate continuing competence, changing and reforming both educational and continuing education programs the group "maps" a path for competency development that can apply to all health professionals.
Swankin, D, LeBuhn, RA, Morrison, R **2006**	**Level III Grade A**	The Citizen Advocacy Center recommends that new laws need to be implemented to require that all health professionals demonstrate ongoing competence. The report makes recommendations for the individual provider as well as for regulatory agencies. They recommend the elimination of continuing education requirements and suggest that health professionals seeking re-certification/re-licensure participate in continuing professional development programs. Professional development programs need to "demonstrate assessment, development, execution and documentation of a learning plan". A key recommendation is for ongoing demonstration of competence.

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Appendix B

PICC Line Insertion

Literature Review

PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Ainsworth, SB, Clerihew, L, McGuire, W **2007**	**Level I**	Meta-analysis of 4 randomized controlled trials	Comparison of delivery of parenteral nutrition via PICC line vs. peripheral IV-evaluated growth & development, nutrient input, & complications	No evidence found that PICC lines increased the risk of negative events, including infection.	Only four studies met the inclusion criteria. All four studies did not evaluate all outcome measures.	**A**
Aly, H, et al **2005**	**Level II-1**	536 infants with birth weight of < 1500 grams	Measured infection rates before and after implementation of change in central line care and management protocols	Central line-related blood stream infection significantly reduced (p < .001) after implementation of protocol.	Retrospective chart review. Unable to randomize to groups.	**A**
Camara, D **2001**	**Level III**	NA	Review of risks and benefits to PICC lines in Neonatal Population	Literature documentation of benefits and risks. Key point is for nurses at bedside to be aware of PICC complications and benefits	Literature search not explained. Literature that was reviewed included all appropriate NICU hallmark PICC line studies	**B**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Cartwright, DW **2004**	**Level III**	2186 silicone central venous lines in neonates over an 18 year period in one Australian Center	Data was collected retrospectively from neonatal data base and paper chart reviews. All reasons for removal were documented.	All lines were peripherally inserted & the majority (1644) were placed in infants under 1500 grams. The most common reason for removal was completion of therapy (69.7%). 5.3% of catheters were removed due to sepsis. Author recommends keeping PICC records and adherence to strict insertion and management guidelines	Retrospective chart review of neonates from a single center and generalizablilty is limited.	**B**
Chedid, F, Abbas, A, Morris, L **2005**	**Level III**	3 case reports	Case report of inadvertent paraspinal PICC line insertion in three neonates	All catheters were inserted via into the left femoral vein via the left saphenous route. Inserting contrast material will help to identify misplacement.	Case report including only 3 infants. Does build on similarly reported case studies in the literature	**B**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Chen, C, Tsao, P, Yau, KT, **2001**	**Level III**	Single case report	Paraplegia seen with inadvertent insertion of PICC line through left saphenous vein into lumbar venous plexus	Authors recommend confirmation of placement via saphenous route by cross table lateral x-ray.	Single case report, not generalizable	**B**
Chien, L, et al **2002**	**Level II-2**	19,507 infants in 17 Canadian NICU's	Incidence and risk of catheter related blood stream infection was analyzed in patients with umbilical venous catheters, percutaneously placed catheters, and Broviac catheters.	The use of central venous lines increased the overall incidence of catheter related blood stream infections, and in percutaneously placed and Broviac lines the risk was 70-80% higher than for umbilical venous catheters.	There were wide variations in use of types of central catheters among the 17 centers.	**A**
Clark, P, Wadhawan, R, Smyth, J, & Emmerson AJ **2003**	Level III	Two neonatal case reports.	In two separate cases Parenteral hyperalimentation solution was found in CSF with catheterization of left saphenous vein.	PICC lines inserted via the left saphenous route may enter the femoral vein and become inadvertently placed into left ascending lumbar vein with resultant extravasation of TPN	Case reports linked to previously reported similar incidents, but not generalizable	**C**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Garland, JS, et al **2008**	**Level II-2**	82 neonates from a nested randomized trial in one NICU in Wisconsin	Intervention was the administration of a vancomycin-heparin flush solution to one group, and the other group received the standard heparin flush solution. The researchers were looking at blood stream infections (BSI) without and identified source, definitive catheter related BSI & probable catheter related BSI.	The control group (heparin flush only) had a significantly higher BSI from all three sources ($p = 0.01$, by X^2 test) than the intervention group (vancomycin-heparin flush solutions). The most frequently discovered BSI in the control group were in the definitively catheter related group (60%). The authors recommend a PICC line management approach that reduces the potential manipulation & contamination of the PICC catheter.	Use of vancomycin flush solutions may have reduced efficacy in regards to the development of resistant organisms, in particular MRSA.	**A**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Golombek, SG, et al **2002**	**Level III**	100 catheters placed in 89 patients weighing less than 1000 grams were evaluated over 15 months in a single center in New York.	The center implemented a strict PICC line insertion and management protocol. The center evaluated the incidence of catheter related infections.	Before the protocol implementation the catheter related infection rate was 25% in the population of infants < 1000grams. The catheter related infection rate post protocol implementation was reduced to 7.1%. The researchers recommend a strict approach to PICC line insertion and management	The catheters used before and after protocol implementation were not identical. In addition the threshold for catheter removal for suspected problems was higher with the implementation of the protocol.	**B**
Graham, PL, et al 2006	Level II-2	Total of 217 infants in two separate centers in New York City. Case study group = 48, control group = 169. All infants classified as very low birth weight (VLBW) or < 1500 grams.	Case group were VLBW infants with documented gram negative BSI. Controls were randomly matched infants without BSI. Goal was to identify risk factors predictive of grams negative BSI	The number one predictor of gram negative sepsis was having a central venous catheter in place for > 10 days (p = 0.003). The best predictor of gram negative BSI was catheter dwell times of > 21 days (p < .001)	The study evaluated only the first episode of gram negative sepsis even if there were more. One of the study units had an outbreak of K. Pneumonia during the study creating potential bias.	A

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Hoang, V, et al 2008	Level III	396 neonates with 477 PICC lines placed in a single center	Comparison of complication rates for upper extremity vs. lower extremity inserted PICC lines	CRBSI was the most common complication and was higher in upper extremity lines (NS). Incidence of Coagulase negative staph infection was higher in the upper extremity lines ($p < .05$). The only other statistically significant complication was cholestasis which was also higher in upper extremity lines ($p < .05$). Authors recommend use of lower extremity when extended PICC line use is needed.	Single center observational study with limited generalizablilty.	B
Linck, DA, Donze, A, Hamvas, A 2007	Level III	Reviewed a 14 year period of PICC line insertions in neonates at one center.	Development of PICC line insertion team	Development of a PICC line insertion team, improved success rates. Data base developed for QI needed to be more complete	How catheter related blood stream infections were defined changed over the 14 year period. No data analysis available.	B

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
McMahon, DD **2002**	**Level III**	Adult PICC line insertions in single center by RN PICC team.	The author evaluated a paper based tracking log to monitor insertion success and complications rates.	The paper tool enabled tracking of specific PICC line outcomes and RN provider performance. Contents of log were included. Data from logs assisted in development of PICC line specific QI initiatives.	Non experimental description of tool implementation.	**B**
Nadroo, AM, et al **2001**	**Level III**	Case study of 2 neonatal deaths as a result of a PICC line complication.	At autopsy one line with documented placement in RA showed TPN in pericardial sac. Second line placed in SVC at autopsy had migrated into RA and perforated pericardium.	Questionnaire subsequently sent out to 83 NICU's and 24% noted similar complications. Recommend no right atrium placement & close monitoring for PICC line migration.	Case study report linked to questionnaire. Limited generalizablilty.	**B**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Paulson, FR, & Miller, KM **2008**	**Level III**	Summary of PICC line data collected in level II-III NICU over a 7 year period	Descriptive data regarding number of PICCs placed, reason for placement and number PICCs removed. Data also included insertion and post-insertion complications.	Authors make recommendations regarding line insertion techniques, troubleshooting, & prevention of complications. Includes set of nursing guidelines for care of infants with PICCs.	Descriptive statistics specific to single unit.	**B**
Perlman, SE, Saiman L, Larson, El **2007**	**II-2**	In two New York City Hospitals, 2,935 infants were evaluated over a two year period to determine the risk factors for catheter related and non catheter related BSI. This was done in conjunction with evaluation of hand hygiene products.	Evaluated birth weight, presence of central line, administration of total parenteral nutrition, ventilator support and the presence of gram positive vs. gram negative infections.	More infants with BSI than without BSI were < 1000 g, more babies with BSI had central catheters, more likely to have had surgery, been ventilated, on nasal CPAP, and had a longer LOS (all p < .001). The incidence of BSI and hand hygiene products was not statistically significant.	Not all BSI potential risk factors were included.	**A**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Petit, J **2003**	**Level III**	NA	None	Includes brief anatomical review. Identifies appropriate PICC line solutions She identifies most common complications and how to avoid them. Presentation of literature review is fairly complete.	All recommendations may not be universally applicable in all settings.	**A**
Petit, J **2002**	**Level III**	NA	None	Part one of a two part series on the assessment, treatment and prevention of most common PICC line complications. Includes venous anatomy review, and organizational standards for infusion therapy. She also recommends standardized documentation methods.	None	**A**

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Pettit, J **2003**	**Level III**	NA	None	Part II in a two part series. Author describes assessment treatment and avoidance of less common but potentially more serious PICC line complications.	Treatment of complications may not have universal applicability.	**A**
Pettit, J 2007	**Level III**	NA	None	Author presents modified Seldinger technique to inset PICC lines in small peripheral veins in infants. This allows the use of smaller veins that would not permit access via larger bore introducers.	Technique requires additional training and supplies.	**A**
Petit, J & Wyckoff, MM **2007**	**Level III**	NA	None	Second edition of the National Association of Neonatal Nurses Guidelines for PICC insertion and management.	None	**A**

***)** U.S. Preventive Services Task Force Ratings: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates*, 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

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PICC Line Insertion
Literature Review for Electronic Note Documentation

Author and Date	Evidence Type (*)	Sample and Sample Size	Outcome Measures	Results and Recommendations	Limitations	Rating (†)
Smith, PB, et al **2008**	**Level III**	1540 PICC lines in 882 neonates in a single center	Incidence of catheter related BSI retrospectively	Out of the 1540 PICC lines inserted 135 had CRBSI (8.8%). Infants with birth weights of < 750 g had the highest incidence of CRBSI (39.2%). The most common organism was coagulase negative staph. Increased dwell time was correlated with decreased risk of infection.	Retrospective analysis. Some infants in the study had more than one PICC in place when diagnosed with CRBSI. Majority of CRBSI studies link increased dwell time with increased risk of infection.	**C**
Webster, NJ, Page, B, Kuschel, CA, Battin, MR **2004**	**Level III**	117 digital radiographs for PICC line placement in 98 infants.	Successful catheter tip location with digital imaging compared to standard radiography with contrast and using 3 separate observers.	Digital imaging does not appear to improve the ability to accurately locate catheter placement. The three observers agreed on tip visualization 55 of the cases, and out of that 55, but the observers agreed on tip location in only 37 cases.	Moderate variation between 3 observers when identify catheter placement may indicate problems with inter-rater reliability.	**B**

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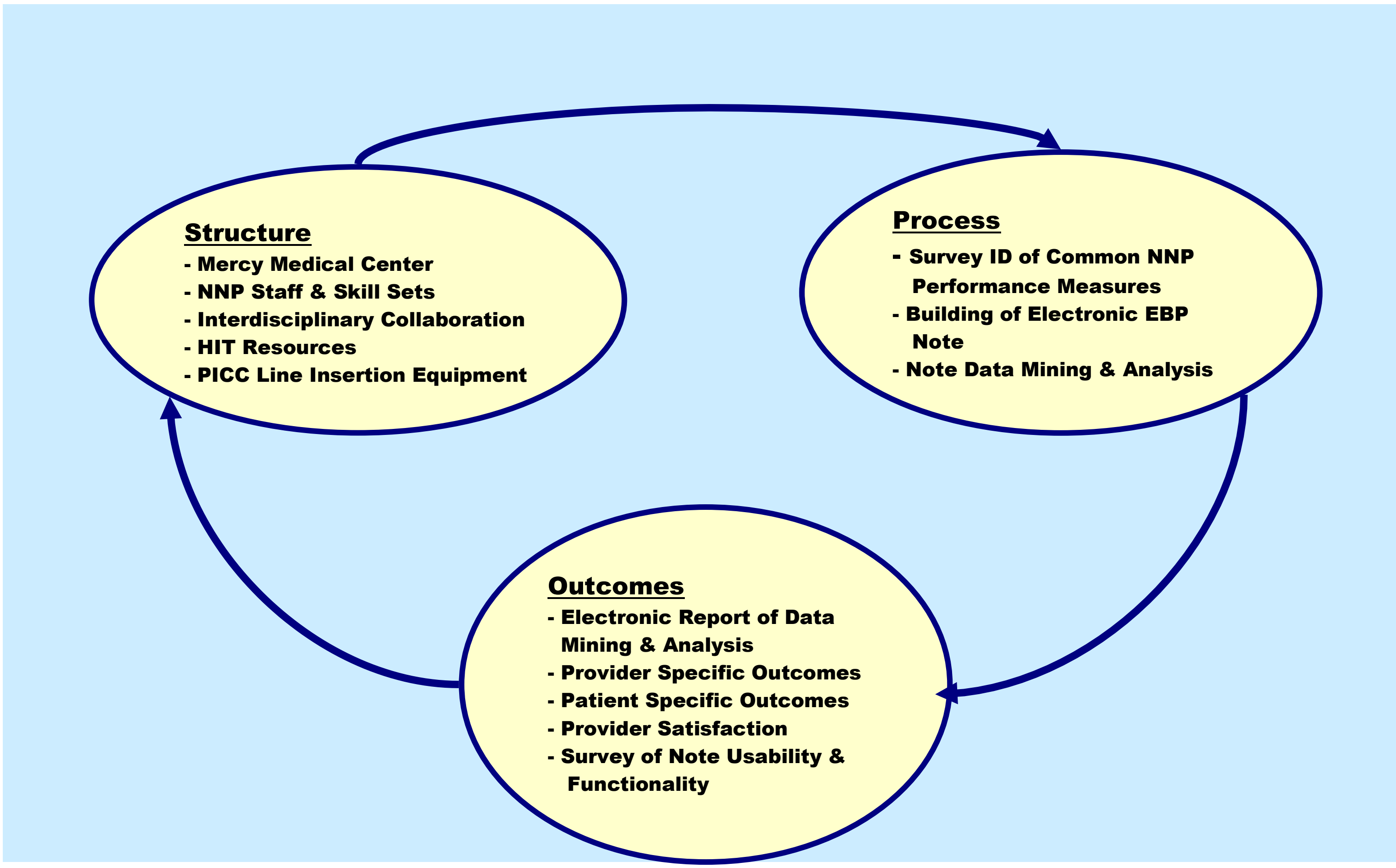
Appendix C

Figure 1

Theoretical Framework



Appendix D

Hospital Survey

Identification and Perception of Common PICC Line Procedural Competence Measures

Sample Survey

Part I

Completing this telephone survey indicates your consent to participate in this study.

This study is being conducted to identify how Neonatal Intensive Unit (NICU) Nurse Practitioner (NP) staff measure Percutaneously Inserted Central Line (PICC) procedural competence. Please answer the following questions to the best of your ability.

What is the level of your NICU? Level IIIA____ IIIB____ IIIC____

IIIA – Provides conventional ventilation (tidal volume or continuous airway pressure) modes only. Availability of some pediatric subspecialties, perform minor surgical procedures like surgical placement of central venous catheter or inguinal hernia repair. Can accept risk appropriate neonatal transports.
IIIB – Provides multiple modes of neonatal ventilation including advanced respiratory support like high frequency ventilation. Nitric oxide may or may not be used. May accept risk appropriate neonatal transports.
IIIC – Provides advanced modes of neonatal ventilation and life support, including high frequency ventilation, nitric oxide and or extracorporeal membrane oxygenation. Accept neonatal transports. Pediatric subspecialty services available.

Are Nurse Practitioner PICC line procedural competencies measured in your NICU?
Yes_____ No_____

If PICC line procedural competencies are measured, who in the unit or hospital is responsible for coordinating the review?

_____________ __________ __________
_____________ __________ __________

Part II

The following questions relate to PICC line competency measurement tools that you might use in your NICU. The definition of the each tool will be presented and then you will be asked to give a yes or no answer regarding its use in your NICU.

Competency Measure Tool	**Used Yes**	**Used No**
Procedure Checklists		
Peer Review		
Paper Chart Review		
Electronic Chart Review		
Real Time Observation		
Use of Physical models		
Written Tests		
Computer Generated Tests		

If you measure Nurse Practitioner PICC line procedural competence and do not use these measurement tools, what tools are used to measure PICC line procedural competence in your NICU?

______________ __________ __________

______________ __________ __________

Part III

Please answer the following questions to the best of your ability. You will be read a statement and then asked if you agree (A), strongly agree (SA), disagree (D), strongly disagree (SD), with the statement, or are neutral (N) to the statement.

1.) The use of annual checklists is an adequate tool to measure Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

2.) Peer Review is an adequate tool to measure Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

3.) Use of the patient's paper chart to review Nurse Practitioner procedure notes is an adequate tool to measure Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

4.) Use of the patient's electronic medical record to review Nurse Practitioner procedure notes is an adequate tool to evaluate Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

5.) Real time observation of Nurse Practitioner PICC line insertion performance is an adequate tool to measure Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

6.) The use of physical models to demonstrate Nurse Practitioner PICC line insertion performance is an adequate tool to measure Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

7.) Written examinations evaluating Nurse Practitioner insertion of PICC lines are adequate tools to evaluate Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

8.) Computer based examinations evaluating Nurse Practitioner insertion of PICC lines are adequate tools to evaluate Nurse Practitioner PICC line procedural competence.

SD	***D***	***N***	***A***	***SA***
1	2	3	4	5

Tool Definition

Tool	Tool Definition
Procedure Checklists	A list of PICC line procedures that are reviewed annually (monthly, quarterly) and “checked off” to denote completion in a satisfactory manner.
Peer Review	Nurse Practitioners complete a peer review form to evaluate colleague’s ability to insert PICC lines (monthly, quarterly, annually).
Paper Chart Review	PICC line insertion procedure notes written by Nurse Practitioner staff are reviewed on a regular basis (monthly, quarterly, annually).
Electronic Chart Review	PICC line insertion procedure notes entered into the EMR by Nurse Practitioner staff are reviewed on a regular basis (monthly, quarterly, annually).
Real Time Observation	Nurse Practitioner PICC line insertion performance is observed as it is performed and observations are scheduled on a regular basis (monthly, quarterly, and annually).
Use of Physical Models	On a scheduled basis (monthly, quarterly, annually), simulation models are used to observe Nurse Practitioner PICC line insertion performance.
Written Tests	Written tests are given on a regular basis (monthly, quarterly, annually) and test the Nurse Practitioner’s ability to demonstrate appropriate PICC line insertion procedure steps, complication identification, theory and documentation.
Computer Tests	Tests taken in computer format that test on a regular basis (monthly, quarterly, annually) the Nurse Practitioner’s ability to demonstrate appropriate PICC line procedure steps, complication identification, theory and documentation.

Total Number of Survey Respondents ___________

Variable	**Frequency**	**Percent**
NICU Level IIIA		
NICU Level IIIB		
NICU Level IIIC		
Nurse Practitioner PICC Line Procedural competencies are measured		
Nurse Practitioner PICC Line Procedural competencies are not measured		

Other Competency Measures described

___________ ___________

___________ ___________

___________ ___________

Table 3

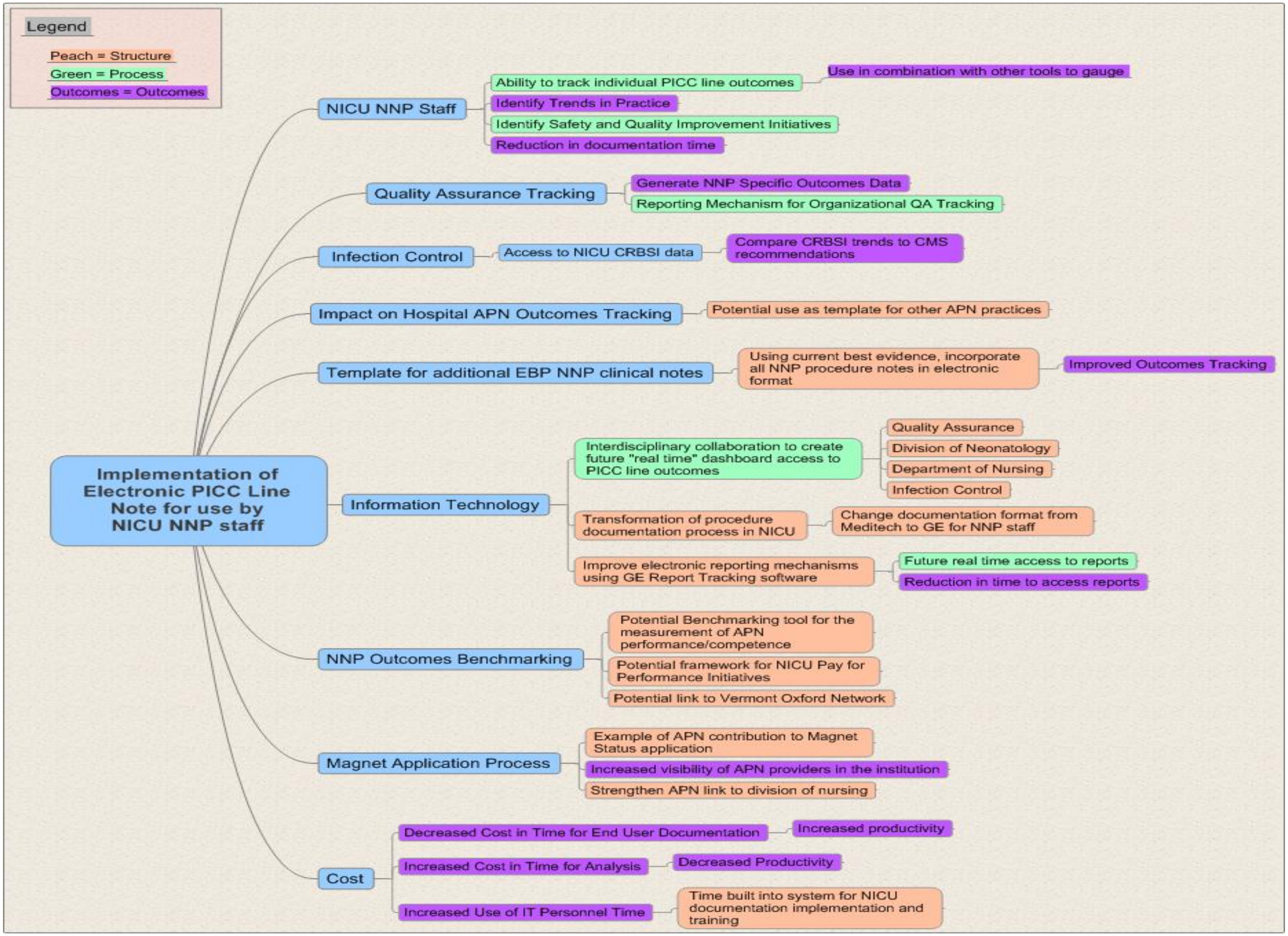
Variable	Frequency	Percent
Checklists		
Peer Review		
Paper Chart Review		
EMR Chart Review		
Real Time Observation		
Use of Physical Models		
Written Tests		
Computer Tests		

Table 5

Variable	Likert Scale Scoring Frequency				
	#SD	#D	#N	#A	#SA
Checklists					
Peer Review					
Paper Chart Review					
EMR Chart Review					
Real Time Observation					
Use of Physical Models					
Written Tests					
Computer Tests					

Appendix E

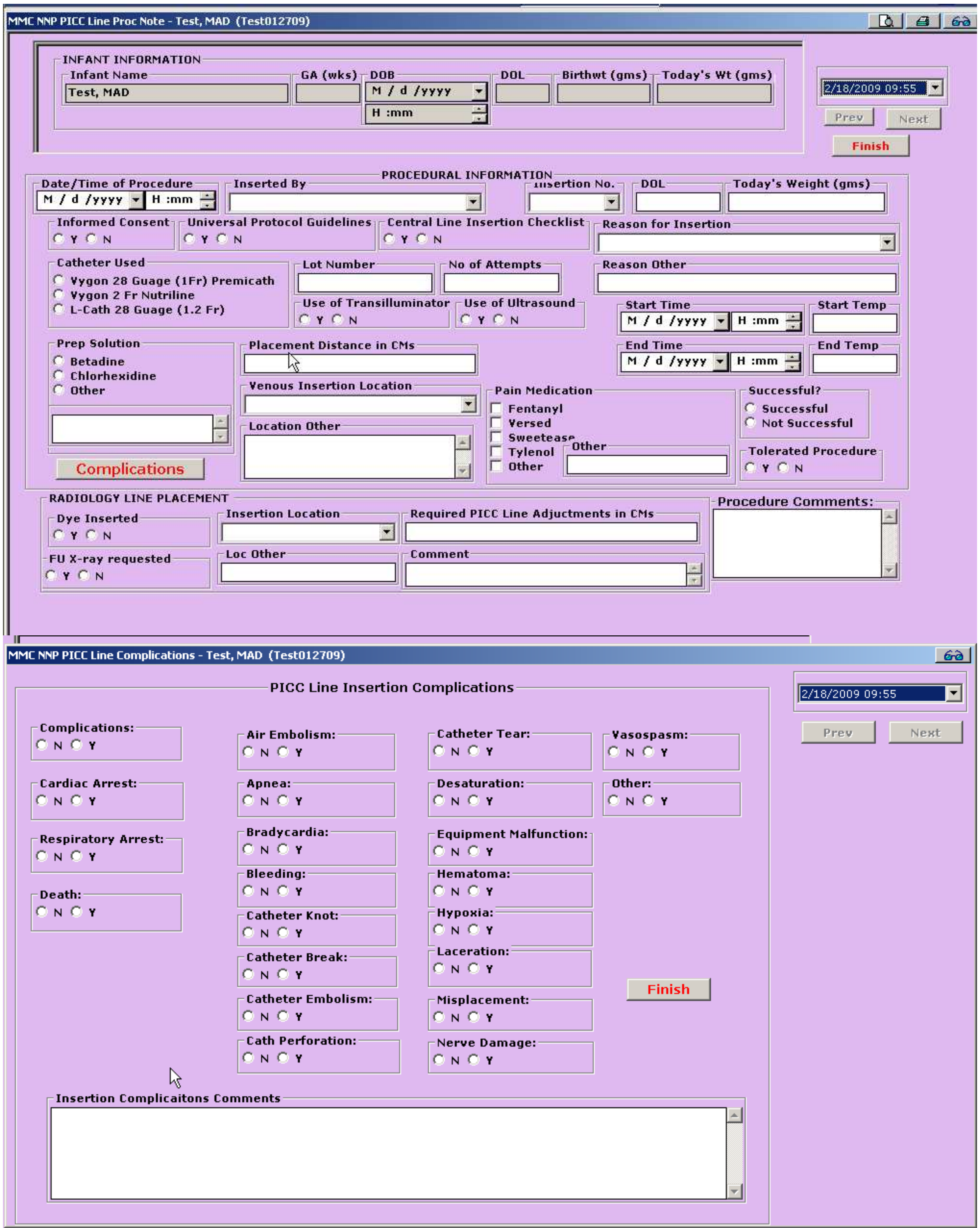
System Analysis


Legend
Peach = Structure
Green = Process
Outcomes = Outcomes
Implementation of Electronic PICC Line Note for use by NICU NNP staff
NICU NNP Staff
Ability to track individual PICC line outcomes
Use in combination with other tools to gauge
Identify Trends in Practice
Identify Safety and Quality Improvement Initiatives
Reduction in documentation time
Quality Assurance Tracking
Generate NNP Specific Outcomes Data
Reporting Mechanism for Organizational QA Tracking
Infection Control
Access to NICU CRBSI data
Compare CRBSI trends to CMS recommendations
Impact on Hospital APN Outcomes Tracking
Potential use as template for other APN practices
Template for additional EBP NNP clinical notes
Using current best evidence, incorporate all NNP procedure notes in electronic format
Improved Outcomes Tracking
Information Technology
Interdisciplinary collaboration to create future "real time" dashboard access to PICC line outcomes
Quality Assurance
Division of Neonatology
Department of Nursing
Infection Control
Transformation of procedure documentation process in NICU
Change documentation format from Meditech to GE for NNP staff
Improve electronic reporting mechanisms using GE Report Tracking software
Future real time access to reports
Reduction in time to access reports
NNP Outcomes Benchmarking
Potential Benchmarking tool for the measurement of APN performance/competence
Potential framework for NICU Pay for Performance Initiatives
Potential link to Vermont Oxford Network
Magnet Application Process
Example of APN contribution to Magnet Status application
Increased visibility of APN providers in the institution
Strengthen APN link to division of nursing
Cost
Decreased Cost in Time for End User Documentation
Increased productivity
Increased Cost in Time for Analysis
Decreased Productivity
Increased Use of IT Personnel Time
Time built into system for NICU documentation implementation and training

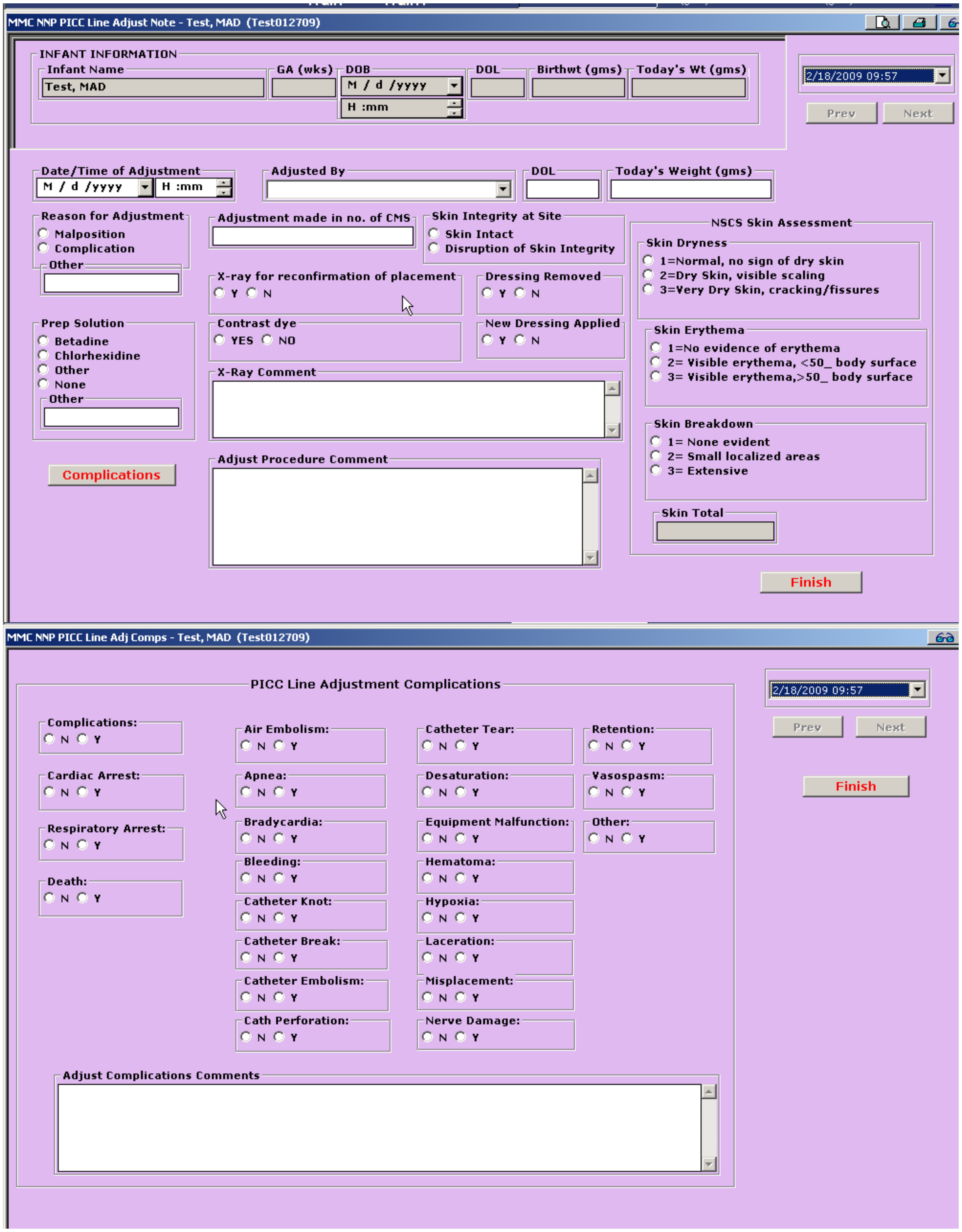
Appendix F

Three Part PICC Line Note
Insertion
Adjustment
Removal

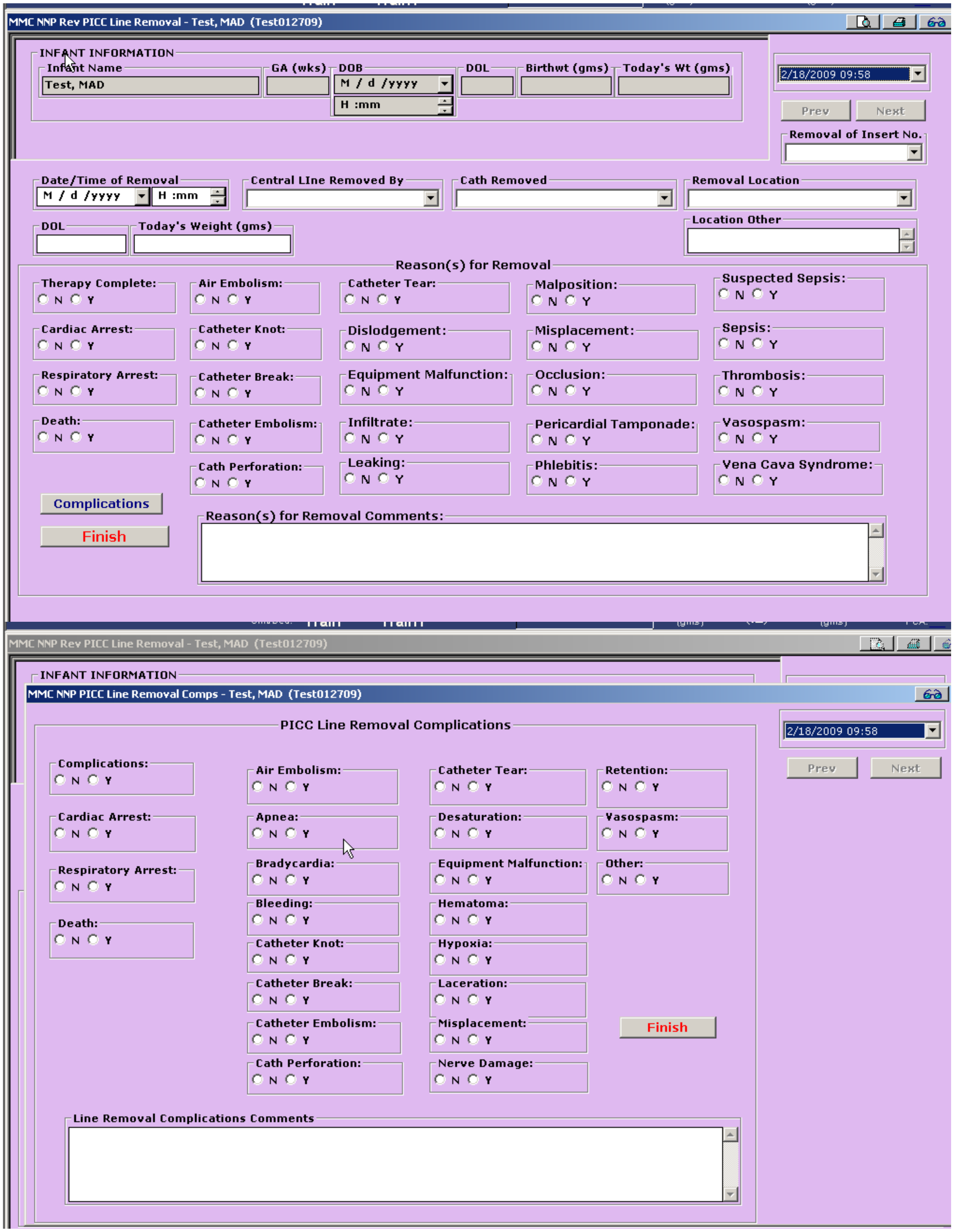
PICC Line Insertion Note



PICC Line Adjustment Note



PICC Line Removal Note


MMC NNP Rev PICC Line Removal - Test, MAD (Test012709)

INFANT INFORMATION

Infant Name: Test, MAD | GA (wks) | DOB: M / d /yyyy, H :mm | DOL | Birthwt (gms) | Today's Wt (gms)

2/18/2009 09:58

Prev | Next

Removal of Insert No.

Date/Time of Removal: M / d /yyyy, H :mm | Central LIne Removed By | Cath Removed | Removal Location

DOL | Today's Weight (gms) | Location Other

Reason(s) for Removal

Therapy Complete: N Y | Air Embolism: N Y | Catheter Tear: N Y | Malposition: N Y | Suspected Sepsis: N Y

Cardiac Arrest: N Y | Catheter Knot: N Y | Dislodgement: N Y | Misplacement: N Y | Sepsis: N Y

Respiratory Arrest: N Y | Catheter Break: N Y | Equipment Malfunction: N Y | Occlusion: N Y | Thrombosis: N Y

Death: N Y | Catheter Embolism: N Y | Infiltrate: N Y | Pericardial Tamponade: N Y | Vasospasm: N Y

Cath Perforation: N Y | Leaking: N Y | Phlebitis: N Y | Vena Cava Syndrome: N Y

Complications

Finish

Reason(s) for Removal Comments:

MMC NNP Rev PICC Line Removal - Test, MAD (Test012709)

INFANT INFORMATION

MMC NNP PICC Line Removal Comps - Test, MAD (Test012709)

PICC Line Removal Complications

2/18/2009 09:58

Prev | Next

Complications: N Y | Air Embolism: N Y | Catheter Tear: N Y | Retention: N Y

Cardiac Arrest: N Y | Apnea: N Y | Desaturation: N Y | Vasospasm: N Y

Respiratory Arrest: N Y | Bradycardia: N Y | Equipment Malfunction: N Y | Other: N Y

Death: N Y | Bleeding: N Y | Hematoma: N Y

Catheter Knot: N Y | Hypoxia: N Y

Catheter Break: N Y | Laceration: N Y

Catheter Embolism: N Y | Misplacement: N Y | Finish

Cath Perforation: N Y | Nerve Damage: N Y

Line Removal Complications Comments

Appendix G

Clinical Information System Implementation Effectiveness Scale

Instructions for completing the CISIES:

1. Select the answer that corresponds to your level of disagreement or agreement with each item: Strongly Disagree, Disagree, Somewhat Agree, Agree, or Strongly Agree.
2. Read each item carefully. **WATCH OUT FOR "NEGATIVELY" WORDED STATEMENTS.** For example, in response to the statement **"Broccoli is one of my least favorite foods," – you would answer Strongly Disagree or Disagree if you love broccoli.**
3. In the statements below, 'system' refers to__________.
4. Please carefully review the statements to make sure you have answered all of them – your input is very valuable to us.

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
1. Overall, I prefer using the system than the old way of doing things.	1	2	3	4	5	6
2. I can depend on the accuracy of the system.	1	2	3	4	5	6
3. The training I received was adequate.	1	2	3	4	5	6
4. I feel confident in my ability to assist others in using the system.	1	2	3	4	5	6
5. Adequate resources were available when I was learning to use the system.	1	2	3	4	5	6
6. I feel the use of the system has improved the quality of patient care.	1	2	3	4	5	6
7. The use of the system reduces errors.	1	2	3	4	5	6
8. The system is more efficient than the old way of doing things.	1	2	3	4	5	6
9. The system has improved my practice.	1	2	3	4	5	6
10.The system allows me to spend more time on other aspects of patient care.	1	2	3	4	5	6
11. Information from the system enables me to make better decisions about patient care.	1	2	3	4	5	6
12.The system has added to my workload.	1	2	3	4	5	6
13. The system has added to my stress level.	1	2	3	4	5	6
14. With the system, patient information is more confidential/secure.	1	2	3	4	5	6
15. The system leads to better adherence to policies and procedures.	1	2	3	4	5	6
16. I have first hand knowledge that problems with the system have interfered with patient care.	1	2	3	4	5	6
17. I don't get as much help as I need to fix problems with the system.	1	2	3	4	5	6
18. When the system is unavailable, the backup way of doing things works adequately.	1	2	3	4	5	6
19. My department had a role in the introduction of the system at my facility.	1	2	3	4	5	6
20.People who I work with on a daily basis support me in my use of the system.	1	2	3	4	5	6
21. I'm committed to the successful use of the system.	1	2	3	4	5	6
22. People who use the system should have had more to say about the design of the system.	1	2	3	4	5	6
23. It takes too much time to help others who don't know how to use the system.	1	2	3	4	5	6
24. The system facilitates communication of patient information among members of my profession that I work with.	1	2	3	4	5	6
25. The system facilitates communication of patient information among members of our health care team.	1	2	3	4	5	6
26. The system makes me feel like I am no longer functioning as part of a team.	1	2	3	4	5	6
27. I feel my colleagues sometimes resent the time it takes me to get things done using the system.	1	2	3	4	5	6
28. I feel the use of the system has improved patient outcomes.	1	2	3	4	5	6

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
29. Using the system takes a lot more time than the old way of doing things.	1	2	3	4	5	6
30. Information almost never gets lost in the system	1	2	3	4	5	6
31. I am physically comfortable while using the system's equipment.	1	2	3	4	5	6
32. Members of other disciplines should receive more training regarding how their entry of information affects my use of the system.	1	2	3	4	5	6
33. The system takes into account the specific needs of my care area(s).	1	2	3	4	5	6
34. Overall, the introduction of the system has been effective.	1	2	3	4	5	6
35. I am satisfied with the mechanism for making suggestions for improvements in the system.	1	2	3	4	5	6
36. I am satisfied with the mechanism for identifying/reporting issues that need to be fixed in the system.	1	2	3	4	5	6
37. When one reports problems with the system that need fixing, one receives adequate feedback.	1	2	3	4	5	6

Thank you for completing all the items on the CISIES.

http://cisevaluation.com/home_page.html

Clinical Information System Implementation Evaluation Scale

C I S I E S