STANDARDIZING FAILURE TO RESCUE ELEMENTS IN

PERINATAL NURSING DOCUMENTATION

By

Catherine H. Ivory

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Nursing Science

December, 2011

Nashville, Tennessee

Approved:

Professor Elizabeth (Betsy) Weiner

Professor Mary Jo Gilmer

Professor Nancy M. Lorenzi

Professor Patricia A. Trangenstein

Professor Patricia McCartney

ACKNOWLEDGEMENTS

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CHAPTER I

INTRODUCTION

Approximately 4.3 million births occur in the United States every year at an

annual healthcare cost related to pregnancy and birth of approximately $16 billion

dollars.   The current healthcare climate with rising costs, decreased reimbursement, and

increased transparency necessitates both fiscal responsibility and a focus on quality.

Elements of the 2010 Healthcare Reform legislation tie patient safety and quality

outcome measures to reimbursement (Hogan & Kissam, 2010; Werner, Kolstad, Stuart,

& Polsky, 2011). Healthcare literature stresses the need for increased healthcare safety

and quality across specialties (Hillestad, Bigelow, Bower, Girosi, Meili, Scoville, &

Taylor, 2005; Institute of Medicine, 2000; Ortiz & Clancy, 2003; Werner et al, 2011). For

nursing, specific quality indicators such as patient falls and pressure ulcers are

categorized as "nurse- sensitive" or dependent on nursing care. In perinatal nursing, the

ability to assess, intervene, and recognize an emergency for mother or fetus can

significantly affect the outcome for both. All these factors support the need for

retrievable, accurate perinatal data and for tools that assess clinical processes and help to

quantify perinatal safety and quality outcomes. An example of such a tool for the

childbearing population is perinatal failure to rescue (P-FTR) (Simpson, 2005), endorsed

by the Agency for Healthcare Research and Quality (AHRQ).

AHRQ endorses and supports an online clearinghouse for tools for use by health

systems and researchers to assess patient safety and healthcare quality. The agency is also

a strong advocate for the adoption of healthcare information technology (HIT). Since 1969, AHRQ has advocated for, and funded initiatives supporting HIT implementation, considering HIT to be essential for achieving and sustaining high quality healthcare (Ortiz & Clancy, 2003).

Another technology adoption initiative, the Health Information Technology for Economic and Clinical Health (HITECH) Act, signed by President Obama in early 2009, allocates more than 2 billion dollars for HIT initiatives (HHS, 2010). In addition to funding the HIT infrastructure, HITECH also promises to allocate funds for public and private healthcare providers and health systems to implement HIT. In order to be eligible for HITECH funding, entities must demonstrate "meaningful use" of technology. Included in current requirements for "meaningful use" are mandates for the development of standards that promote interoperability (the ability for information to flow across systems), as well as the ability to electronically report and exchange data in a standard format (Office of the National Coordinator, 2011). A necessary element for HIT interoperability is the incorporation of standard terminology (language) into electronic systems.

Standard languages are the framework of interoperable electronic systems, permitting widespread aggregation of measurable data from multiple sources (Walker, Pan, Johnston, Adler-Milstein, Bates, & Middleton, 2005). There are many standard languages, some specifically developed to support nursing practice. Currently, no standard language that supports nursing practice is widely deployed in perinatal settings. Fortunately, the implementation of standard languages (as they contribute to standardized data collection) in all specialties is likely to improve with the prospect of government

reimbursement for doing so. Simply, meaningful use requirements may be impossible to implement without standards development and the use of standard languages.

Presently, neither IT adoption nor standard language use is widespread; this fact is true across nursing specialties including perinatal nursing. When a standard language is used, it is the ICD-9 that is the most frequently used standard terminology, for provider coding and reimbursement. Neither the development of comprehensive data sources (for quality reporting and process measurement), nor the ability to retrieve nursing interventions and correlate them with outcomes will progress without standardized language use and widespread HIT adoption. In the perinatal setting, there is currently no comprehensive, researchable electronic source of data that relates perinatal diagnoses (medical or nursing) with corresponding interventions, making it impossible to correlate interventions with outcomes. Therefore, retrieving elements from tools such as P-FTR from perinatal electronic systems is difficult and may be impossible.

In its current paper-based format, P-FTR is meant for retrospective manual medical record review. However, if the elements of P-FTR were standardized and adapted for use in an electronic system, it is possible that they could be reliably and consistently retrieved and used at the point of care to help guide bedside nurses' care decisions in real-time. Even if documentation remains on paper, the use of a standard language would improve the ability to retrieve the elements and compare them to another facility also using the standard language. While P-FTR tool has demonstrated validity (Simpson, 2006) and the elements have been operationally defined (Simpson, 2005), it is not clear whether perinatal nurses across all settings would document the P-FTR elements across settings in the same way. Also, while there are 12 standard nursing languages currently recognized

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by the American Nurses Association (ANA) as supporting nursing practice, it is not clear which ones contain the most P-FTR elements and which elements may not be included at all in an existing standard language.

The purpose of this study was to explore the feasibility of reaching consensus regarding words used to document the elements of P-FTR and, once the elements were consistently named, to identify which elements existed in selected nursing languages. The study explored two questions:

1. What are consensus definitions of the elements included in P-FTR?
2. Can P-FTR elements be mapped to four ANA-recognized standard languages?

Significance of the Issue

Since 1999, when the Institute of Medicine (IOM) reported that as many as 98,000 people may die from medical errors in U.S. hospitals every year and that medical error is the eighth leading cause of death in the United States, attention to safety and quality has been pervasive. Patient safety is defined by the IOM as care that is free from accidental injury and error (1999). Healthcare quality melds the definition of safety with value, and includes the patient's perception of the healthcare experience (IOM, 2001). The U.S. healthcare delivery system is increasingly complex, with patients interacting with a myriad of providers, procedures, and machines; each interaction is a potential opportunity for error (Rosow & Grimes, 2003). Even in the perinatal setting, where the population is predominately healthy, increased medical interventions such as elective induction of labor, continuous electronic fetal monitoring, and surgical birth increase the

risk of error and the likelihood of adverse outcomes (Cherouny, Frederico, Haraden, Leavitt-Gullo, & Resar, 2005). HIT is purported by many (Hillestad, et al, 2005; National Quality Forum (NQF), 2007, 2008; Ortiz & Clancy, 2003; Walker, et al, 2005) to be integral to healthcare quality and patient safety initiatives.

However, for HIT to impact healthcare quality and safety, electronic systems must uniformly measure concepts in a standard format (NQF, 2008). The NQF perceives the lack of precise definitions and lack of universal adoption of standard terminology, whether in electronic or paper formats, to be obstacles to accurately measuring and improving patient safety and healthcare quality (2008). To be useful, according to the NQF (2007), clinical definitions must be precise, universally adopted, and include nursing contributions to hospital care. This study addresses the ability to identify process deficiencies that, if corrected, could improve both safety and quality. It also addresses the feasibility of standardizing the use of perinatal process measurement tools, specifically P-FTR. Finally, the study highlights the unique contribution of the perinatal nurse to safety and quality.

McCartney (2006) notes that while national and private entities endorse the use of technology to improve patient safety, few research studies have been published supporting this notion and almost none come from the perinatal setting. The paucity of research in the perinatal setting may be due, in part, to the overall small number of adverse outcomes in this population. Pregnant women are predominately healthy and birth is a normal event. However, despite the overall healthy nature of the population, there is an increasing call to improve perinatal safety and quality (Adams & Corrigan, 2003; Cherouny, et al, 2005; Sakala & Corry, 2008; the Joint Commission, 2004, 2009).

The World Health Organization identified 29 nations with lower maternal mortality rates than the United States (14/100,000) (Hill, Thomas, AbouZahr, Walker, Say, Inoue, & Suzuki, 2007). A new report by the World Health Organization now lists more than 40 countries with better neonatal mortality rates than the United States (4.3 per 1000 births) (Oestergaard, Inoue, Yoshida, Mahanani, & Gore, 2011). The U.S. Department of Health and Human Services, in a review of progress toward meeting Healthy People 2010 objectives, noted increased childbirth complications, increased pre-term birth rates, and decreased overall birth weight (2006). The Joint Commission published two Sentinel Event Alerts on the subject of perinatal safety. The first, in 2004, recommended improved communication and standards relating to fetal surveillance after noting that more than 70% of perinatal adverse events are related to communication problems. In 2010, the Joint Commission recommended the development of strategies for early identification and team response for conditions associated with an increased risk of maternal death, such as hemorrhage and preeclampsia. While the elements of P-FTR do not provide an exhaustive list of perinatal interventions, the three segments of the tool (careful monitoring, appropriate intervention, and activation of a team response) are important areas to explore for perinatal safety.

In a national survey of over 1500 mothers who gave birth in 2005, over 70% experienced continuous electronic fetal monitoring, more than a third had labor artificially induced, and over 80% received epidural analgesia, despite evidence that such interventions are mostly unnecessary (Declercq, Sakala, Corry, & Applebaum, 2006). Perinatal care is not unique in the use of non-medically indicated interventions. Tools like P-FTR were created to assess appropriate management of such interventions and

appropriate action in the event of complications during their use (Simpson, 2005). In fact, Sakala and Corry (2008) note that some interventions are used for either patient or provider convenience and some may be based on the perception that they decrease perinatal liability. In terms of liability, perinatal care remains the specialty area with the highest number of dollars paid out for malpractice claims (Walker, 2004). Despite the lack of evidence for many perinatal interventions, women who responded to the survey indicated they were satisfied overall with the quality of their labor and birth care, supporting the notion that women may choose some unnecessary interventions themselves (Declercq et al, 2006). Despite interventions, most women leave the hospital in good health, with a healthy infant, supporting the typical definition of "quality". Therefore, ongoing monitoring of processes that promote the safest care, despite interventions, is necessary. The competing interests of national entities concerned with healthcare safety and quality, the condition of perinatal care in the United States, the increased liability risk, and the desire to improve maternal and neonatal outcomes all support the need for research regarding tools like P-FTR. The increased national focus on the use of technology supports the need to explore the feasibility of using such tools in an electronic format, or at least in a standard format.

The perinatal nurse's role in safety and quality cannot be minimized. Nursing, according to the NQF (2007), profoundly influences patient safety and quality simply because of the total number of registered nurses and the considerable time nurses spend interacting with and coordinating care for patients. In a healthcare environment describing various patient outcomes as "nurse-sensitive," nursing must be able to demonstrate that nursing interventions do make a difference in patient outcomes and

identify which nursing interventions yield the best patient outcomes. These facts are true across the profession, including perinatal nursing. However, current documentation methods are a hindrance. Current nursing documentation methods may actually decrease care effectiveness and patient safety, decrease nursing visibility, and reduce opportunities to equate nursing care to patient outcomes (Hocking & Shamash, 1998). Perinatal nurses are particularly integral to labor and birth outcomes. It is the perinatal nurse who assesses labor progress, monitors maternal and fetal status, initiates interventions, provides physical and emotional support, communicates with the birth provider, and activates the healthcare team in the event of complications. These are all elements of P-FTR. Unfortunately, variability and lack of standardization in perinatal medical records make it extremely difficult, if not impossible, to determine if the appropriate monitoring and interventions were done.

Perinatal medical records are complex. In addition to traditional elements such as orders, progress notes, provider and nursing assessments, diagnostics, and medications, the perinatal record also includes the electronic fetal monitor tracing and the patient's prenatal history. Some fetal monitor tracings are archived electronically, some are run and stored on paper. In labor, nurses may document on the fetal monitor strip itself and/or in the record; in some instances the paper strip and medical record are stored in separate locations. Such complexity makes retrospective perinatal medical record review cumbersome and reinforces the need for a comprehensive, standardized perinatal record. For example, in the only published study using P-FTR, Beaulieu (2009) recognized a significant study limitation as the inability to locate significant elements of the tool in the more than 140 records reviewed. Tang, Ralston, Arrogotti, Qureshi, and Graham, (2007)

studied the accuracy of quality measures retrieved from an electronic medical record compared with measures retrieved from a paper record. Results were inconclusive, but the study represents one effort to improve the quality of electronic documentation, and called for the use of standard languages, including nursing language, in documentation systems. A study by Eden, Messina, Hong, Osterwell, Henderson, and Guise (2008) found that electronic medical records had fewer missing crucial elements.

Electronic perinatal medical records could facilitate data sharing, communication across settings and multi-disciplinary patient care across the continuum (McCartney, 2006). Realistically, widespread adoption of electronic medical records may be the best way to measure and improve quality but it cannot happen quickly. This study is an important preliminary step toward the overall goal of a comprehensive electronic perinatal medical record. In order for such records to be truly useful for nursing, the use of a standard nursing terminology is essential.

There are many benefits of using a standard nursing language, including better communication among nursing providers, increased nursing visibility, better data collection, increased competency assessment, and increased adherence to nursing standards (Rutherford, 2008). However, little attempt has been made to standardize the nursing vocabulary in such a way that it may be understood equally or consistently by those who read the medical record. Nor is the lack of standardization useful for those who study nursing work and its relationship to patient outcomes. Neither has there been significant demand for use of standard nursing languages by purchasers of electronic systems. Historically, there has been no financial incentive for healthcare systems to pressure HIT vendors to incorporate nursing language into electronic systems. Nursing

care is not reimbursable by ICD-9 code but is included as part of the hospital daily room charge. Further, there has been little administrative incentive to incorporate standard nursing language concepts. Health services researchers and health systems administrators make frequent use of large administrative databases, from which a wealth of information may be gleaned for variables related to patient demographics, diagnoses, co-morbidities, complications, length of stay, and resource utilization. Variables from these databases, such as complications and length-of-stay, for example, may be used as proxies for inpatient nursing care quality because it is too difficult and time consuming to retrieve nursing interventions from the record and even more time consuming to correlate those interventions to corresponding patient outcomes. Roy Simpson (2003) noted that while current electronic systems are great supporters of healthcare financial departments, many systems lack the ability to capture clinical data that could be used for decision-making. In order to improve healthcare quality and patient safety, healthcare systems must improve the visibility of nursing practice and the influence of nursing care on patient outcomes.

In terms of nursing visibility, when a nursing term is standardized, it can be assigned a code. Once coded, the term can be measured. Physicians and other care providers have been documenting medical diagnoses and corresponding treatment in a coded format since the late 1800s, when the International Statistical Classification of Diseases and Related Health Problems (ICD) began (Clark & Phil, 1999). The latest version of ICD, in early stages of implementation is ICD-10. ICD consists of codes that are universally and internationally recognized. Conversely, an example of a standard nursing language is the North American Nursing Diagnosis (NANDA) nomenclature.

Unlike ICD-10, NANDA has never been widely implemented. Standard nursing languages are developed by consultation with expert sources, such as professional nursing organizations, and they incorporate the latest evidence, so using them increases the likelihood of adherence to practice standards (Rutherford, 2008). In all, the American Nurses Association (ANA) has approved 12 standard languages through its Nursing Practice Information Infrastructure Committee (CNPII), but none are widely implemented (ANA, 2006). While the specific purpose of P-FTR is to examine perinatal care processes, it does include nursing interventions that could ultimately be correlated with outcomes. The ability to correlate outcomes to nursing interventions could be enhanced with the use of standard nursing languages because standard languages are designed to include not only nursing interventions, but also observations, treatments, procedures, and clinical judgment (Rutherford, 2008). If such information is standardized, and widely implemented, nursing work is quantified and ultimately visible and that nursing work ultimately correlated to outcomes.

As standard languages are incorporated into electronic systems, data regarding nursing work may be retrieved in real-time, reducing the need for retrospective medical record reviews. Unfortunately, P-FTR is used retrospectively in its current format. So, if after retrospective review, care is determined to be sub-optimal, the care has already happened and therefore cannot be corrected. Real time assessment of whether P-FTR elements are accounted for would allow for earlier intervention and contribute to evidence that earlier intervention yields better outcomes. Standard language use may also contribute to the ongoing assessment of nursing competency, if required care elements

could be retrieved from the record in a standard format and correlated with a specific nurse.

Finally, data gathered in a standard format may be aggregated and stored in large data warehouses, permitting nursing practice to be further quantified across settings. Such accessible, retrievable data specific to perinatal nursing practice would be a rich resource for nursing research and would contribute to a comprehensive perinatal database, with the potential to impact the overall practice of perinatal care.

There is convincing evidence to support the use of standard nursing languages and clear evidence of the need to assure patient safety and improve health care quality. There is a great deal of literature to support the fact that electronic systems contribute to quality patient care by supporting real time data analysis and potential clinical decision support (Slagle, 1999; Ball, Weaver & Abbott, 2003; Ortiz & Clancy, 2003; Maas & Delaney, 2004; Hillestad, Bigelow, Bower, Girosi, Meili, Scoville, & Taylor, 2005; McCartney, 2006; NQF, 2007, 2008). Incorporating tools such as P-FTR into an electronic medical record could contribute to the body of perinatal nursing research by allowing the elements of P-FTR to be extracted and assessed for the impact of perinatal nursing interventions on perinatal outcomes with the goal to improve patient safety and quality. Before the tool may be included in an electronic system, the elements must be consistently used in a standard format. This study is the foundation for future incorporation of P-FTR into an electronic format.

CHAPTER II

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The theoretical framework for this study is the Informatics Infrastructure for Evidenced Based Practice, published by Bakken, Cimino and Hripcsak (2004). When published, the infrastructure was not a graphically depicted model but rather includes a list of common informatics components that may contribute to improved patient safety and evidence-based practice. They include:

1. *Standardized terminologies,* to facilitate data collection, retrieval, and reuse for purposes of information and knowledge generation, as well as monitoring and decision support.

2. *Healthcare data standards* for exchanging, managing, and integrating data across systems must be considered in terms of data and knowledge representation, communication, and confidentiality and security.

3. *Communication technologies,* including network infrastructure and devices such as beepers, cellphones, and combination devices.

4. *Digital sources of evidence* include digital libraries, and sources for evidence such as electronic clinical practice guidelines, meta-analyses, and systematic reviews.

5. *Data acquisition methods,* comprising all the various ways data enters an electronic system. In addition to flowing directly by way of an electronic

system, data may also be entered into a system manually, by any member of the health care team. No one method is superior to another, nor is one method inferior.

6. *Data repositories,* to collect data from many varied sources. Data repositories are designed to store data and retrieve information about individual patients, as well as to aggregate data from patient populations, making them useful for benchmarking, and for patient safety and quality-related analysis.

7. *Rule repositories,* logic modules which are often used in conjunction with clinical event monitors. For example, a rule might be set up to alert the user of a drug allergy or a missing vital sign parameter.

8. *Clinical event monitors,* supporting error prevention in real-time. Clinical event monitors reside above data repositories and, based on rules, generate alerts or reminders based on a clinical event. Clinical events are communicated through a myriad of communication methods.

9. *Data mining techniques,* methods used to obtain information from large data repositories. Data mining may be referred to as knowledge discovery and includes data extraction, manipulation, summarization and also data analysis. (Bakken, Cimino & Hripcsak, 2004)

The infrastructure for evidenced based practice and patient safety proposed by Bakken et al (2004) may be compared to the foundational work by Graves and Corcoran (1988), which described an information flow model for nursing information systems. While Graves and Corcoran acknowledged the need to quantify data gathered about

nursing tasks, as well as the need to store the data and the need to retrieve the data, they did not address the need to do any of these tasks in a standard way. In fact, Graves and Corcoran acknowledged that representing nursing interventions in a standard format, given the varied contexts in which nurses' work, was "problematic" (1988). Informatics research was new in 1988. Even so, Graves and Corcoran stressed the potential benefit of the ability to access and use nursing data in order to improve patient care quality, and to facilitate nursing research. In a white paper published nearly twenty years after Graves and Corcoran, Niland, Rouse, and Stahl (2006) supported using many of the informatics infrastructure's elements to produce information systems with the ability to measure healthcare quality.

To better illustrate the evidenced based practice infrastructure and explain its applicability to this study, a visual model is included as figure 1. The overall purpose of this study was to explore the feasibility of incorporating P-FTR elements into a standard format, suitable for use within an electronic system. If doing so is possible, the tool may be able to contribute to clinical decision support, inform decisions in real-time and contribute to evidence-based perinatal nursing practice. This study focused primarily on two main aspects of the infrastructure: healthcare data standards and standard terminologies. As noted by the visual model (figure 1), healthcare data standards and the use of standardized terminologies provide the foundation for sound data acquisition methods.

Figure 1. Informatics Infrastructure for Evidenced Based Practice & Patient Safety

Adapted from Bakken, Cimino, & Hripcsak, 2004

The informatics infrastructure for evidenced based practice and patient safety

provided structural organization for the study but it may also be considered in the context

of other nursing informatics models. Specifically, Effken (2003) proposed an organizing

framework for informatics research, illustrated in figure 2. Effken derived her model

based on recommendations of the Academy of Nursing's Expert Panel on Quality Health

Care (Mitchell, Ferketich, & Jennings, 1998) and an extension of Donebedian's structure-

process-outcomes model (Donabedian, 1966). The model, called the informatics research

organizing (IRO) framework, was designed to be both broad and abstract. Effken (2003)

noted that such a high level of abstraction allows other models to be incorporated into the

broader model elements. She also suggested that individual components of the model could be operationalized and studied separately. While Effken's model is the most comprehensive for informatics research, it was too broadly focused for this study. The infrastructure for evidenced based practice and patient safety (Bakken et al, 2004) may be operationalized in the intervention component of Effken's model, which focuses on nursing interventions, the flow of nursing information, and the technology used (2003).

Figure 2. Informatics Research Organizing (IRO) Model
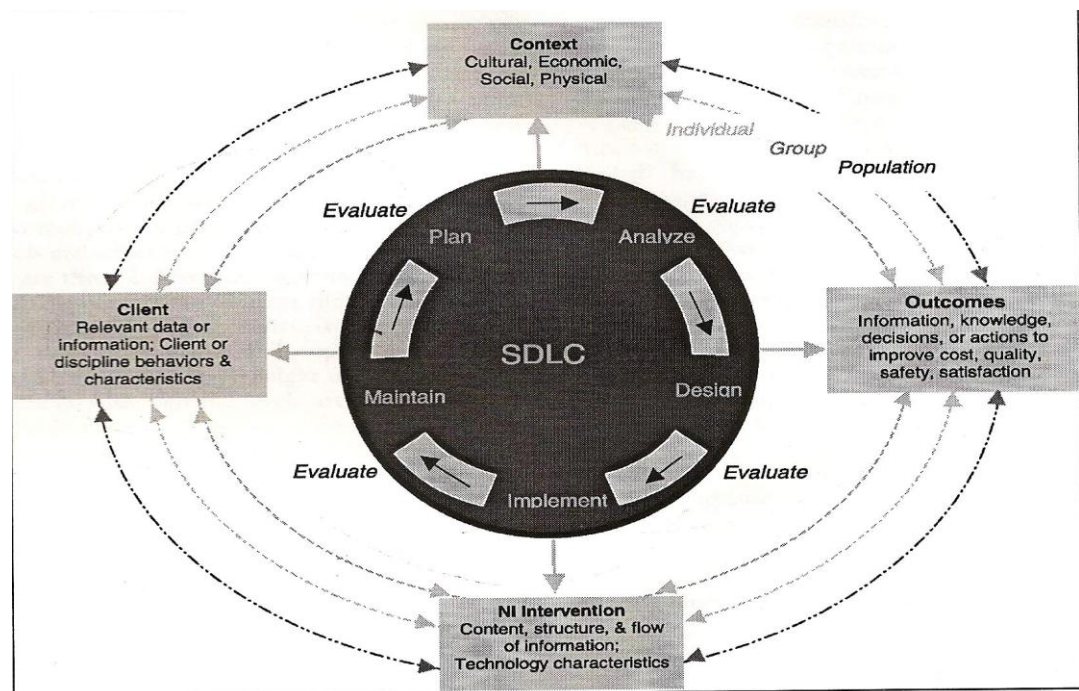
Effken, J.A. (2003). An organizing framework for nursing informatics research. *CIN: Computers, Informatics, Nursing, 21* (6). 316-323. *Permission requested.*

Analysis of the Literature

Patients are hospitalized to receive nursing care. Nurses are essential for patient care and the first line of defense in terms of medical error prevention, yet the nursing role is under-represented in research related to outcomes, efficiency, effectiveness, and patient safety (Ball, Weaver, & Abbott, 2003). As previously mentioned, Roy Simpson (2003) noted that current nursing documentation is not captured in such a way that makes it easy for decision making. Elfrink, Bakken, Coenen, McNeil and Bickford (2001) consider standard nursing vocabularies to be cornerstones of healthcare quality and the use of standard languages essential for decision making and nursing visibility. In order to improve healthcare quality and patient safety, healthcare systems must improve the visibility of nursing practice and demonstrate the influence of nursing care on patient outcomes.

Nursing continues to describe and define its work individually, based on tradition and culture and most often in narrative format, rather than with discrete data elements. Nursing documentation is complex and occurs in a myriad of places including nursing notes, flow sheets, graphic records, and both institutionally-developed and commercially-available forms. The complexity of perinatal medical records was previously described. Every facility has a defined order for its medical record and a specific format in which such narrative nursing documentation occurs. Documentation may be on paper, in an electronic system, or a combination of both. Double documentation is common and error prone. Nursing documentation as it currently exists may actually decrease care effectiveness and patient safety (Hocking & Shamash, 1998), as well as decrease nursing visibility and reduce opportunities to equate nursing care to patient outcomes.

Perinatal nurses are the primary providers of patient care for women during labor and birth and the decisions made by perinatal nurses may significantly impact the outcomes for mother and baby. P-FTR (Simpson, 2005) was created to retrospectively, audit perinatal medical records to determine if perinatal nursing care was appropriate. Little research literature has been published in this area. Simpson published the content validation study for P-FTR in 2006 but only one published study exists to date actually using the P-FTR tool.

In the only published study, Beaulieu (2009) noted some process improvement deficiencies but listed an important study limitation. She found it difficult to determine if care had been appropriate due to the research team's inability to retrieve necessary elements from the record. Some elements were electronic; others were on paper, a few were missing all together (Beaulieu, 2009).

One other study examined the use of electronic medical records for their perceived value in labor and delivery (Eden et al, 2008). The Eden et al study looked specifically at physician documentation and found paper records were more likely to contain missing elements than were electronic systems (2008); the findings support Beaulieu's (2009) observation. No other studies or papers were identified which assessed the quality of perinatal medical records, although one paper examined the ability to retrieve quality measures accurately comparing both paper and electronic records in other healthcare settings (Tang, Ralston, Arrogotti, Qureshi, and Graham, 2007). Results from the Tang et al (2007) study were inconclusive in terms of whether paper or electronic documentation yielded more complete findings, but the authors stressed the need to

improve the quality of electronic documentation by using standard languages, including nursing language, in documentation systems.

Foundational informatics literature, including the early work of Graves & Corcoran (1988), called for nursing information systems to be standardized in terms of structure and language. The greatest emphasis on standard nursing language development occurred in the early 1990's (McCormick, Lang, Zielstorff, Milholland, Saba, & Jacox, 1994). Since that time, published standard nursing language work has focused on nursing language validation (Hardiker, Hoy, & Casey, 2000; Hardiker & Rector, 2001), on which standard nursing language is best for specific nursing specialty's documentation (Henry, Holzemer, Reilly & Campbell, 1994; Eganhouse, McCloskey, Comi, & Bulechek, 1996; Bakken, Cashen, Mendonca, O'Brien, & Zieniewicz, 2000; Coenen, 2003; Dykes, Currie, & Cimino, 2003; Chan, Cohall, Kaufman, Khan, & Kukafka, 2008; Dykes, Kim, Goldsmith, Choi, Esumi, & Goldberg, 2009; Joao, Jesus, Voegeli, Sa-Couto, & Fernandes, 2011) development and refinement of reference terminologies, such as SNOMED-CT, and their relationship to nursing terminologies (Bakken, Warren, Lundberg, Casey, Correia, Konicek, & Zingo, 2001; Coenen, Marin, Park, & Bakken, 2001; Bakken, Warren, Lundberg, Casey, Correia, Konicek, & Zingo, 2002; Goossen, 2006; Matney, DaDamio, Couberg, Dlugos, Evans, Gianonne, Haskell, Hardiker, Coenen, & Saba, 2008; Rosenbloom, Miller, Johnson, Elkin, & Brown, 2008; Kim & Cho, 2009), and whether standard languages developed for other specialties may be used to describe nursing elements (Bakken, Cimino, Haskell, Kukafka, Matsumoto, Chan, & Huff, 2000; Hyun & Bakken, 2006). One recent study explored the incorporation of a Coma Recovery Scale into the ICNP® (International Classification of Nursing Practice),

one example of converting a previously paper-based tool into a standard format (Joao, Simoes, Jesus, Voegeli, Sa-Couto & Fernandes, 2011).

Absent from published literature are papers related to the use of standard terminologies in perinatal nursing. This literature review revealed only one published paper, from 1996, when Eganhouse, McCloskey and Bulechek described the usefulness of Nursing Interventions Classification (NIC) to several domains within maternal child nursing. This study adds to this small body of literature but there is need for much more.

Three recent studies used data retrieved from electronic perinatal systems. The previously described study by Beaulieu (2009), discussed the limitations of using electronic data related to the inability of retrieving data elements from a combination of paper and electronic records. In another example, Hall, Poynton, Narus, Jones, Evans, Varner, and Thornton (2009) analyzed structured perinatal system data to compare nursing effort (measured by the amount of nursing documentation), and patient outcomes such as fetal distress, cesarean birth, labor complications, length of stay, and care cost. Hall et al noted that even though study findings suggest correlations between the amount of nursing documentation and corresponding perinatal outcomes, generalization of findings is difficult due to inconsistent documentation that occurred in a documentation system developed for the study site that did not incorporate a standard terminology (2009). While not related to the perinatal setting, a new study by Shever (2011) explored the concept of failure to rescue related to the use of surveillance as a coded, documented nursing intervention. The study site used NIC (Nursing Intervention Classification) to document nursing care interventions, of which surveillance was one. Using 250 patient records, the researcher was able to equate increased nursing surveillance with fewer

complications (Shever, 2011). This study is an example of the research possibilities when standard nursing terminologies are used to assess safety and quality and how nursing interventions can be correlated with a patient outcome.

Several papers advocate the use of standard terminologies to assess quality in the perinatal setting (Slagle, 1999; Paniers, Feuerbach, & Soeken, 2003; Jenkins, Hewitt, & Bakken, 2006). Another notes the potential for standard language and electronic systems to reduce perinatal risk and liability (George & Bernstein, 2009). It appears that the perinatal healthcare specialty appreciates the benefits of electronic systems and the even the use of standard language, but has been slow to study the implications of using either. Also curious is the fact that no research related to the use of standard languages in the perinatal setting has been published since 1996. The paucity of research in the perinatal setting and the overall support in the literature for doing such research overwhelmingly supports this study.

Failure to Rescue

The specific instrument to be used in the proposed study is the failure to rescue tool adapted for perinatal care (P-FTR) published by K.R. Simpson in 2005 (See Appendix A). Content validity of P-FTR was achieved by using guidelines and standards set forth by the American College of Obstetrics and Gynecology (ACOG) and the Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) to determine evidence- based care processes. Following development, the tool was subject to independent review and pilot testing by 10 expert perinatal nurses who achieved inter-

rater reliability near 90% (Simpson, 2006). P-FTR is a process measurement tool, rather than a tool to measure outcomes. It is designed to identify care process deficiencies and variation (Simpson, 2006) so that the identified deficiencies may be improved. The necessary components of the perinatal care process are clearly specified (see Appendix A), meaning P-FTR meets specificity qualifications for a process measurement tool as outlined by the NQF (2002). Specifically, the components include:

- *Careful monitoring*, which includes electronic fetal monitoring characteristics and the frequency of monitoring, as well as the identification of non-reassuring maternal or fetal findings

- *Appropriate intervention,* includes the various nursing interventions necessary when non-reassuring maternal or fetal findings are identified

- *Activation of a team response,* records the nurse's actions regarding a surgical or transport team if a surgical birth becomes necessary or a neonatal transport is indicated

Using P-FTR focused this research study on a finite number of perinatal nursing interventions related to a defined and valid care process. Without a defined focus, studying standard nursing language use in perinatal nursing could be daunting because of numerous possible nursing interventions and perinatal care processes. This study is exploratory and provides the foundation for future work involving the testing of P-FTR in an electronic system and work towards correlation of perinatal nursing interventions with maternal and newborn outcomes.

The concept of failure to rescue as a process measurement tool is well defined for the inpatient acute care setting (Silber, Williams, Krakauer, & Schwartz, 1992) but its use in perinatal care is just beginning (Simpson, 2005). Silber and colleagues (1992) first described failure to rescue (FTR) in a study of post-surgical patients. Proposing that well-known measures of healthcare quality (mortality rates and surgical complications) were misleading when reported separately, Silber and colleagues (1992) used the two variables together. The number of post-surgical patients (specifically gall-bladder or transurethral radical prostatectomy [TURP] surgeries) who died within 30 days of surgery after developing complications, they posited, was a more accurate description of quality (Silber et al, 1992). The authors hypothesized that patients who develop post-surgical complications, such as infection, deep-vein thrombosis (DVT), and pulmonary embolus, die because characteristics (processes) within healthcare systems keep the complications from being accurately identified. In other words, the medical team fails to rescue the patient from complications resulting in death. Silber and colleagues (1992) defined failure to rescue as the unanticipated death of hospitalized patients from complications unrecognized or not-acted upon by caregivers. Since 1992, failure to rescue has been adopted as a national inpatient safety indicator, referred to as FTR-A, by the Agency for Healthcare Research and Quality (AHRQ) and it is now widely used in healthcare process improvement projects as well as throughout health services research (2006).

Debate exists as to which failure to rescue measurement strategy, one that focuses on medical complications and another looking closely at nursing's influence, is best for the hospitalized acute care patient. To better capture nursing-specific indicators, Needleman, Buerhaus, and Mattke (2002) developed FTR-N, which considers a specific

set of complications associated with nursing care. FTR-N is frequently used in nursing research, notably by Aiken, Clarke, Sloane, Lake, and Cheney (2003), where failure to rescue is often associated with poorer nurse to patient ratios and nursing skill-mix.

In terms of the perinatal patient population, circumstances of failure to rescue are quite different. The perinatal population is primarily healthy; maternal and infant mortality are rare events. Conversely, surgical patients may be unwell prior to surgery, making complications more likely. However, similarities do exist. Like patients coming in for elective or routine surgeries, perinatal patients are expected to do well and suffer few, if any, complications. If a complication occurs, the long-term outcome is usually positive, even though the care process may have been less than optimal (Simpson, 2006).

When the rare death occurs in the perinatal population, it is devastating for the patient's family as well as the patient's care givers. When less than optimal care processes go un-identified, the risk of a devastating event increases. P-FTR is a tool to identify system and/or process issues that may be present when adverse events occur. If the process deficiencies are corrected, future adverse events, including maternal and/or infant death, may be avoided (Simpson, 2005).

Simpson notes that P-FTR may be used in a variety of settings: antepartum (during pregnancy), intrapartum (labor and delivery), and postpartum (after birth). This proposed study focuses on the intrapartum period. In the context of perinatal nursing, failure to rescue implies that there has been a change in a patient's condition (mother or fetus) that has gone unrecognized, or for which intervention is not timely. Reviewing the care process, usually by retrospective medical record review, allows the nursing team to

identify process deficiencies, modify the deficient processes, and potentially avoid perinatal adverse events.

As mentioned previously, only one study has been published using Simpson's (2005) P-FTR. Beaulieu (2009) used the tool in a retrospective review of over 140 records for women who had experienced an unscheduled cesarean section during labor. The unexpected cesarean section was used as evidence that the patient (the fetus in this study) was rescued. Cesarean section is the appropriate and necessary intervention in the event of non-reassuring fetal status which does not resolve with less invasive interventions. Medical records used for the study were a combination of paper and electronic documentation. The research team calculated the number of records (53%) in which all four aspects of OB failure to rescue: appropriate monitoring, timely identification (of condition change), appropriate interventions, and activation of a team response, were documented prior to the cesarean section.

This study addresses Beaulieu's (2009) notable study limitation: the number of records in which she could not locate complete documentation of the P-FTR elements or found them only after significant time and effort, as well as the variation in documentation methods. If standard nursing language elements exist for P-FTR, and are deployed, retrospective medical record review using P-FTR may be easier and more accurate. If P-FTR could be incorporated into electronic medical records systems, real-time assessment of P-FTR elements may be possible, enabling decision support and timely intervention. The literature supports using tools like P-FTR to assess healthcare quality and patient safety and further supports their use at the point of care in order to facilitate decision support and prevention of adverse events.

Standard Nursing Languages

As described previously, there is a government-led initiative toward "meaningful use" of healthcare IT. While the use of standard nursing languages is possible with either paper or electronic documentation systems, primary goals of meaningful use focus on implementing useful technology and reporting quality measures electronically. Two recent papers and presentations call upon nursing to define what meaningful use means to our profession, and support using standard languages. Wise (2011) noted that the ability for nurses to collect and report quality data in a standard way is essential. Chow and Beene (2011) reported on nursing initiatives within the Veteran's Administration and Kaiser Permanente Systems with the specific aim to highlight the value of nursing with the use of standard language.

Keenan (1999) defines standard nursing language as "a common language, readily understood by all nurses, to describe care" (p 12). There are currently 12 languages that support nursing care approved by the American Nurses Association (ANA); the languages are summarized in Appendix B. Little attention has been paid to the incorporation of standard nursing language into nursing practice or into healthcare technology (Bakken et al, 2000). Essential elements of a standard nursing language, according to Roy Simpson (2003) include those which describe patient problems and characteristics, healthcare interventions, and document nursing care intensity relative to patient outcomes. Incorporating standard nursing languages into documentation systems (electronic or otherwise) helps justify the cost of nursing to a healthcare system and identifies which nursing interventions are effective and which nursing care models are the most fiscally efficient. Standardizing the nursing language in documentation reduces

documentation redundancy, improves medical record accuracy, and supports practice decisions (Bakken et al, 2000; Simpson, R., 2007).

In a seminal 1998 paper, Zielstorff suggested the following necessary attributes of a complete nursing language:

- *Domain Completeness*: Data and language are complete across the continuum of care, and across all settings.

- *Granularity*: The ability to describe a term in relationship to its characteristics, such as size, shape, and location

- *Parsimony*: The ability to quickly capture nuances and changes in complex health systems.

- *Synonymy*: The ability to express the same concept in different ways

- *Non-ambiguity*: The need for a specific definition for each term, even though the term may be used differently across settings.

- *Non-redundancy*: The ability to use the terms consistently and accurately

- *Clinical utility*: Useful for clinical practice and clinical decision making

- *Multiple axes and combinatorial*: The ability to quickly combine terms without the needs for multiple steps.

Zielstorff approached the language requirements from the perspective of their necessity as part of an electronic documentation system, whereas existing terminologies were not necessarily designed for that purpose. However, the concepts also apply to paper-based

systems. Further, Zielstorff stressed that to assure complete information and improve patient care quality, there is need for standardization of data elements across systems (1999). In other words, even if a standard nursing language is used in an electronic documentation system, the data elements must cross over, when necessary, to non-nursing systems and also to paper-based documentation methods.

Bakken et al (2000) corroborated and expanded on Zielstorff's list of essential nursing language criteria with a list of evaluation criteria that would be necessary in order for a standard nursing language to be implemented in and manipulated by electronic systems:

1. Atomic-based: concepts must have the ability to be separated, as needed, while maintaining their definitions.

2. Compositionality: the ability of atomic concepts to be combined into composite concepts, e.g., pain *and* acute = acute pain.

3. Concept permanence: once a concept is defined, it should not be deleted from a terminology.

4. Language independence: support for multiple expressions.

5. Multiple hierarchies: accessibility of concepts through all reasonable hierarchical paths with consistency of views.

6. Non-ambiguity: explicit definition for each term

7. Non-redundancy: one preferred way of representing a concept

8. Synonymy: support for synonyms and a mapping method for synonyms within and among terminologies. (page 82)

Standard nursing languages are not interchangeable nor does one-fit-all. Nursing languages recognized by the ANA include some that are domain specific. For example, NIC (Nursing Intervention Classification) includes only nursing interventions; NANDA includes only nursing diagnoses. The CCC (Clinical Care Classification) combines coded nursing diagnoses and coded nursing interventions with coded nursing care plans. (Saba, 2007).

Other ANA recognized languages are reference terminologies, sometimes referred to as meta-languages. Reference terminologies are concept- oriented languages that support broad representation of concepts across domains and professions. Reference terminologies represent systems of precisely defined concepts formatted for computer processing (Bakken, Cashen, Mendonca, et al, 2000). Not only are reference terminologies not domain specific, they may include non-nursing concepts but have been approved as languages that support nursing practice. Examples of ANA approved reference terminologies include LOINC (Logical Observation Identifiers, Names, and Codes), the ICNP (International Classification of Nursing Practice), and SNOMED-CT® (see Appendix B).

Research related to the use of standard terminologies focuses on two primary areas, modeling and mapping. Modeling includes two types, terminology modeling and information modeling. Mapping is the matching of terms to a standard language and/or matching terms from one language to another. This study used terminology modeling, rather than information modeling, and mapping. Terminology modeling focuses on how single (atomic) concepts relate to others in a particular terminology. Information modeling is the graphical description of how terminology concepts relate to and interact

with one another, irrespective of a particular terminology. Information models are the roadmap for incorporating evidence-based practice and decision support tools into electronic systems. Since the questions as to whether consensus definitions for P-FTR were even available, and whether the concepts existed at all in standard nursing languages was unknown when the study began, information modeling was not appropriate for this research study .

Terminology models are depictions of relationships between concepts and how the concepts form particular expressions, while maintaining a single definition (Bakken, Cimino, Haskell, et al, 2000). Terminology models provide the semantic structure to a terminology itself or for the researcher who is attempting to assimilate concepts not already in a standard terminology into a standard language (precisely the intent of this research), and essential if attempting to relate concepts from one standard terminology to a reference terminology. Hardiker and Rector (2001) consider terminology modeling to be the preferred method of cross-mapping and validating terminologies. Each standard terminology has its own model, or semantic structure. There are studies that examined both options.

Examples of research using terminology models specifically created for the research itself include Goossen's 2006 study that used the newly developed International Standard Nursing Reference Terminology model (IS 18104) to cross-map terms from three different nursing languages for purposes of identifying similarities and differences among language concepts. The International Standards Organization (ISO) International Standard (IS) 18104 terminology model for nursing was proposed by the International Medical Informatics Association- Nursing Informatics Special Interest Group (IMIA-NI)

and the International Council of Nurses (ICN) and approved by the ISO in 2003 (ISO, 2003). IS 18104 includes several models and supporting definitions for nursing diagnoses and nursing actions (ISO, 2003). Also in 2003, the new IS 18104 model was evaluated in a study by Moss, Coenen, and Mills, who used the model to explore whether pain-related nursing interventions could be dissected from medical records and mapped to any of the six IS 18104 categories (action, target, recipient of care, means, route, and site). Their findings supported the model in that 100% of interventions could be mapped to at least two IS 18104 categories (action and target) (Moss, Coenen, & Mills, 2003).

In 2008, Rosenbloom, Miller, Johnson, Elkin, and Brown proposed a model for evaluating interface terminologies. Interface terminologies are designed to facilitate data sharing across disparate systems, and to support human–terminology interaction (Rosenbloom, Miller, Johnson, Elkin, & Brown, 2006). Rosenbloom et al (2006) suggested that a model to evaluate interface terminologies must include at least three attributes, 1) term coverage, accuracy, and expressivity, 2) the percentage of terms that consistently reflect natural human language, and 3) whether the terminology is appropriate for use across multiple systems (2008). A commonly used interface terminology in computerized systems is Health Level 7 (HL7), which uses the ISO Open System Interconnection (OSI) model (Kim & Cho, 2009). Kim and Cho (2009) tested the HL7 model for its usefulness in the exchange of data related to medication administration and identified that although the OSI model did contribute to the transfer of data across disparate systems, further modeling was needed in order to actually use that data to generate information that would guide decision making (2009).

Dykes, Currie, and Cimino (2003) used a concept domain model proposed by Campbell et al in 1997 to determine the adequacy of standard nursing terminologies to depict concepts from automated clinical pathways that were designed to promote adherence to guidelines for management of clinical heart failure. Bakken, Warren, Lundberg, Casey, Correia, Konicek, & Zingo (2002) evaluated two terminology models, the European Committee for Standardization (CEN) and the ISO reference terminology model (RTM) for their utility in mapping nursing diagnoses and nursing interventions into SNOMED-CT®.

After reviewing the research related to the creation and testing of terminology models, the researcher determined that using the specific terminology models already present within each language was most appropriate for this study. Creating a terminology model would have required a complete list of consistent concepts with corresponding consistent definitions and whether the concepts existed at all in the selected terminologies was the research question. Concept consensus definitions were also a study goal, therefore creation of a separate terminology model was premature.

Terminology models present in LOINC have been used in studies by Bakken, et al (2000) and by Matney, Bakken, and Huff (2003) who evaluated the models for usefulness as semantic structures for LOINC nursing assessment measures. LOINC terminology models were also used by Hyun and Bakken (2006) to map nursing documentation section headings to the LOINC terminology semantic structure.

Terminology models within the ICNP were used in at least two studies. Matney, et al (2008) used ICNP terminology models to integrate nursing diagnoses from the

Clinical Care Classification (CCC) nursing terminology. Similar to Matney et al's 2003 study with the LOINC model, discussed above, Dykes et al (2009) used ICNP models to assess their adequacy for electronic nursing documentation. In an example closer to the perinatal setting, a study in Taiwan examined gynecological nursing records using ICNP models (Kuo & Yen, 2006). No studies were identified that explored perinatal nursing records and using terminology models to facilitate mapping perinatal terms to a standard terminology. For this proposed study, terminology modeling may be necessary to determine which standard language best represents the elements of P-FTR. Research clearly supports the need for using terminology models to assess the adequacy of a terminology to meet the needs of a specific population. Which terminology models to use depends on which terminologies will be assessed.

While information modeling was not used in this study, a brief overview of information modeling provides the foundation for its importance in future phases of this research. Returning to foundational informatics literature, Graves and Corcoran acknowledged that the variability in nursing practice contributes to standardization barriers and also stressed the importance of structured information flow (1988). Current literature related to research using information modeling focuses on nursing knowledge development and clinical decision support. As Park, Cho, and Byeun (2007) note, information modeling is necessary because "the existence of an appropriate terminology for capturing nursing information does not necessarily solve the problem of how the information will be transformed from concepts in a nurse's mind to codes in the computer's database" (pg. 736). Goodwin, VanDyne, Lin & Talbert (2003) note that just using standard terminologies alone will not contribute to nursing knowledge development

and that modeling is necessary in order retrieve and manipulate data usefully. One example of the usefulness of information modeling to future informatics research for perinatal nursing used structured labor and delivery data to measure nursing effort and relate nursing effort to outcomes (Hall, Poynton, Narus, and Thornton, 2008). This was the only published study related to the perinatal setting and underscores the need for further research for the specialty.

In addition to modeling, the second strategy used in informatics research related to terminologies is mapping or cross-mapping. Mapping is the matching of concepts from any source to a standard language or the matching of concepts among two or more standard languages. Informatics researchers have developed and published object-oriented algorithms that facilitate cross-mapping, most notably the work by Fridman-Noy, and Musen (1999), Fridman-Noy, Fergerson, and Musen (2000), and Fridman-Noy and Musen (2000). However, the most common mapping method is manually matching concepts using either a document based list of language concepts, such as the printed tables provided with CCC (Saba, 2007), or by using an electronic search engine. Given the relatively small number of concepts in this study and considering the inexperience of the researcher, manual cross-mapping was used for this study.

The most comprehensive search engine for language mapping is the Unified Medical Language System® (UMLS), maintained by the National Library of Medicine (NLM). The UMLS includes all the ANA approved languages that support nursing practice, as well as other classification and coding structures, and provides a metathesaurus, located within a robust electronic search engine (NLM, 2011). The UMLS metathesaurus may be used free of charge by registered users. In addition to the semantic

structures contained within individual standard languages, the UMLS metathesaurus has its own semantic structure. Therefore, after consultation with a nursing terminology research expert (S.A. Matney, personal communication, May 18, 2011), the researcher decided that the truest mapping results would be achieved by using the semantic structures within the selected terminologies themselves.

After a thorough review of the literature, the following four languages were selected for this study:

- CCC (Clinical Care Classification System™): developed by Virginia Saba, the CCC permitted exploration of P-FTR from a nursing care plan perspective, by providing a semantic structure geared toward the plan of care. The CCC has been used in nursing informatics research and it has a defined semantic structure. Important to note is that the CCC was designed to be used in conjunction with other terminologies; its concepts are very broad (Saba, 2007). The inability to locate atomic P-FTR concepts in CCC is unexpected.

- International Classification of Nursing Practice (ICNP®): is a reference terminology, or meta-language, containing both atomic-level nursing concepts and a semantic structure to formulate relationships among concepts. The ICNP was developed by the International Council of Nurses (ICN) to be the unified language for nursing (ICN, 2011). Recent research, described previously, using the ICNP® was published by Dykes et al (2009). The ICNP® is freely distributed to registered users, who must agree to use ICNP® in a single system or for research. Registered users may download the most recent copy of the language as well as have registered access to the online search engine.

- LOINC® (Logical observation identifiers, names, and codes): this ANA recognized terminology was originally developed by the Regenstrief Institute for laboratory systems but has evolved to include clinical concepts relevant to nursing and other specialties. Analysis of the literature revealed the majority of published nursing terminology research involved LOINC®. Nursing research exploring LOINC® was previously described (Matney, Bakken & Huff, 2003; Bakken et al 2000; Hyun and Bakken, 2006). LOINC® is available free to registered users and also has a free search engine called RELMA.

- SNOMED-CT® (Systemized Nomenclature of Medicine-Clinical Terms) was not originally considered for this research because published nursing research using it was minimal; more studies using SNOMED-CT® have been published from the medical informatics community. However, regulations governing meaningful use of HIT include the recommendation that SNOMED-CT® is the preferred terminology (ONC, 2011). Therefore, it was necessary to include SNOMED-CT® in this study. Truly a meta-language, SNOMED-CT® is a reference terminology created by the College of American Pathologists and currently maintained by the International Health Information Technology Standards Development Organization (IHTSDO) (UMLS, 2011). SNOMED-CT® has a defined semantic structure and access to is free to registered users, when requested through the UMLS. A SNOMED-CT® search engine, called CliniClue® Xplore, is also available free-of-charge from the Clinical Information Consultancy (2011).

The four terminologies were selected based on their previous use in nursing informatics research, their defined semantic structure (terminology model) and the researcher's

ability to freely access them. As subsequent results will demonstrate, the four terminologies provided a broad overview of the presence of P-FTR elements in standard nursing terminologies.

Definitions

Within P-FTR are four broad conceptual variables: appropriate monitoring, timely identification (of condition change), appropriate interventions, and activation of a team response. For study purposes, all four conceptual variables are defined, based on Simpson's (2005) published criteria (also see Appendix A):

1. Careful monitoring: More than 70% of laboring women receive continuous electronic fetal and uterine monitoring in labor (Declerq et al, 2006), despite the fact that such monitoring has poor specificity in detecting fetal compromise (Simpson, 2005). Simpson defines careful monitoring based on guidelines established by ACOG, the American Academy of Pediatrics (AAP), and AWHONN, which recommend that fetal heart rate (FHR) patterns be assessed every 30 minutes during the active phase of the first stage of labor for women or fetuses without identified risk factors, and every 15 minutes during the second stage of labor. For women or fetuses with identified risk factors, FHR assessment frequency increases to every 15 minutes during the first stage of labor and every 5 minutes during the second stage (Simpson, 2005). Unfortunately, no definitive list of maternal/fetal risk factors exists; therefore there is no clear definition as to when increased monitoring frequency should occur. Simpson (2005) notes that

appropriate FHR assessment includes: the baseline FHR, FHR variability (beat-to-beat variation in the FHR), the presence or absence of FHR accelerations, and the presence and type of FHR decelerations. Standard definitions for FHR characteristics exist and were recently updated by a committee convened through the National Institute of Child Health and Human Development (NICHD) (Macones, Hankins, Spong, Hauth, & Moore, 2008). Recommendations are summarized in Table 2. In addition to documenting individual FHR characteristics, Macones et al (2008) proposed that FHR characteristics (see Table 2) be classified into three categories:

Category I

- Baseline FHR between 110-160 beats per minute (bpm)

- Moderate baseline FHR variability

- Late or variable decelerations – absent

- Early decelerations – present or absent

- Accelerations – present or absent

Category II *Includes all tracings not category I or III*

- Baseline rate: bradycardia, not accompanied by absent variability, or tachycardia

- Baseline variability: absent, minimal, or marked

- Absence of induced accelerations (after fetal stimulation)

- Periodic or episodic decelerations

    o   Recurrent variable decelerations with minimal or moderate variability

- o Prolonged decelerations

- o Recurrent late decelerations with moderate variability

- o Variable decelerations with uncommon characteristics

Category III

- Absent baseline variability and any of the following:

    - o Recurrent late decelerations

    - o Recurrent variable decelerations

    - o Bradycardia

    - o Sinusoidal pattern

The NICHD committee followed the lead of European entities in recommending categorization of the fetal heart rate patterns (as specified above) in order to focus future FHR monitoring related research. Category I tracings are considered normal, with substantial literature to support positive fetal outcomes when Category I characteristics are present. Conversely, Category III tracings are considered abnormal; literature supports fetal compromise occurs when Category III tracings are not recognized and intervened upon promptly. The overwhelming majority of tracings fall in to Category II, where research has been inconclusive and where the NICHD suggests further research should be concentrated (Macones et al, 2008).

Perinatal nurses may or may not document FHR tracing Categories I, II, or III as part of their assessment; there is debate as to whether doing requires "diagnosis" and is therefore outside of nursing's scope. However, the categories are important to include as part of a complete definition of appropriate monitoring and the study attempted to reach

consensus on the issue of whether documenting assessment findings using the defined categories was common in practice settings. In later research, the categories may be used as part of an information model because, in an electronic medical record, categorizing fetal heart rate tracings could contribute to the structure for decision support.

Simpson (2005) also notes criteria for appropriate monitoring of uterine activity during labor. In labor, uterine activity is assessed along with the FHR Uterine assessment criteria includes the frequency (in minutes) and duration (in seconds) of uterine contractions, as well as assessment (by palpation) of contraction strength as mild, moderate, or strong. Uterine tachysystole, defined as greater than 5 contractions in 10 minutes, averaged over 30 minutes (Macones et al, 2008), is another important uterine activity assessment element because when the uterus contracts too frequently, uterine blood flow decreases and fetal oxygen reserves are compromised.

The concepts related to appropriate assessment of both the FHR and uterine activity are complicated and documentation variation abounds, despite recommended standards. The first study question attempted to achieve consensus around the areas with the greatest degree of variation, including criteria for high risk versus low risk monitoring, and consensus surrounding the actual words used to document FHR monitoring criteria, per NICHD recommendations.

2. Timely identification: involves the accurate interpretation of FHR and uterine activity characteristics per the definitions and frequency described above, as well as the recognition and appreciation of abnormal or non-reassuring findings (Simpson, 2005). In actual fetal monitoring documentation, the appropriate

characteristics may be appropriately documented in the medical record. However, if the characteristics are not normal, there may not be documentation by the nurse that he or she recognizes the abnormality and needs to intervene based on the abnormality. The study attempted to reach consensus as to what such recognition might actually look like (what words are used) in the medical record.

3. Appropriate interventions: are based on FHR pattern findings, recognition of those findings, and taking action based on those findings (Simpson, 2005). Evidenced-based nursing interventions, as described by Simpson (2005) include:

   a. Lateral positioning

   b. Intravenous fluid bolus of approximately 500 milliliters (ml) of lactated Ringer's solution

   c. Discontinuing Oxytocin, if infusing, to reduce uterine activity

   d. Removing or withholding prostaglandin agents, such as misoprostol and dinoprostone, to reduce uterine activity

   e. If the above interventions do not improve the FHR, oxygen administered at 10 liters per minute per non-rebreather facemask

   f. Amnioinfusion, instilling warm saline solution into the uterus to reduce pressure on the umbilical cord

   g. Tocolytic medications, such as Terbutaline 0.25 milligrams

   h. If during second stage labor, in addition to the above interventions, delayed pushing to allow passive fetal descent, or pushing with every other contraction.

4. Activation of a team response: in a broad sense, is the notification and mobilization of any necessary healthcare team members, based on the clinical situation (Simpson, 2005). Activation of a team response may include:

    a. Notification of the provider (physician or nurse–midwife), with accurate information and requests for specific orders or bedside evaluation, based on the clinical situation. Accurate information includes all FHR characteristics, FHR pattern evolution, clinical associations and urgency.

    b. Timely response by the provider to the request for bedside evaluation

    c. In the absence of a timely response to the bedside, evidence of continued efforts to resolve any disagreement, including administrative members of the team with the authority to act toward resolution

    d. Support by the provider for interventions by other members of the perinatal team (if applicable)

    e. In the event a cesarean birth is necessary, timely response by members of the surgical team, and the neonatal resuscitation team

    f. Neonatal resuscitation based on AAP guidelines

    g. Timely notification of a neonatal transport team and accepting facility, if necessary.

Timely activation of a team response may have the greatest amount of variability of all P-FTR elements, but may be the most crucial. The Joint Commission, in a 2004 Sentinel Event Alert, recognized that more than 70% of perinatal adverse events are caused by poor communication. Currently, no national guidelines specifically define

terms such as "timely response". This study sought to decrease the variation by reaching

consensus related to variables concerning timely team response.

CHAPTER III

RESEARCH DESIGN AND METHODS

Because little is known about the use of standard nursing languages in perinatal nursing and no prior exploration of the feasibility of incorporating elements of P-FTR into standard nursing languages has been published, this was an exploratory study with mixed methods. An assumption of exploratory studies is that the researcher desires an in-depth exploration of a subject when little is known about the subject (Wood & Ross-Kerr, 2006). Mixed methods included a modified Delphi study and subsequent cross-mapping of terms to four standard languages, with cross-mapping validation by an expert panel. Expert panels and consensus studies are commonly used in informatics research, including many of the studies reviewed for this study, to validate definitions, models, and results of cross-mapping. Qualitative methods are appropriate when little is known about a subject (Lincoln & Guba, 1985).

This research study explored two questions:

1. What are consensus definitions of the elements included in P-FTR?

2. Can P-FTR elements be mapped to four ANA-recognized standard languages?

The research questions were explored sequentially. Question one, referred to as study Phase I, was explored first using a modified Delphi approach. Question two, study Phase

II, involved mapping consensus element results from Phase I, with expert panel validation.

Phase I

When plans for this research study began, the researcher assumed that, since P-FTR (see Appendix A) already contained defined elements (names), the defined elements could be mapped to similarly defined standard language elements. However, a conversation with a well-published terminology researcher, Dr. Patricia Dykes, revealed that, since no consensus existed as to the actual words (values) perinatal nurses use to document P-FTR elements in the perinatal record, the first research step must be a consensus study (personal communication, March 26, 2010). Dykes referred to this inconsistency as the need for "name: value pairs" (2010). A modified Delphi approach was used to attempt to reach consensus on P-FTR elements.

Delphi studies are a research technique for obtaining expert opinion on a subject; they originated in the 1950's at the RAND Corporation (Miller & Salkind, 2002). Delphi studies progress through a series of consecutive iterations about a subject. During each iteration (round), group members respond as to their level of agreement with the responses of other group members. In a standard Delphi study, the first iteration asks an open ended question, or merely asks the group to respond to a statement. This approach was modified by providing Simpson's (2005) validated, published P-FTR elements to the group, with a question as to what words (values) they actually used for that element in nursing documentation at their own work setting. Therefore, this was a modified Delphi

approach. The Delphi technique provides structure for group opinion while minimizing interpersonal relationship complications that can occur with group interaction (Goodman, 1987; Miller & Salkind. 2002).

Delphi studies are common in both informatics research (Goossen et al, 2004; Snyder-Halpern, Thompson, & Schaffer, 2000) and information systems related research (Okoli & Pawlowski, 2004), as well as perinatal studies (Becker & Roberts, 2009; Devane, Begley, Clarke, Horey, & O'Boyle, 2007; Mckenna, Hasson & Smith, 2002). Strengths of the Delphi approach include: 1) the use of experts on the given subject, 2) the ability for participants to be distant from each other, 3) panel sizes are modest, and 4) the study design can be flexible (Okoli & Pawlawski, 2004). Weaknesses include the potential for "response fatigue" with multiple study rounds and the ability to recruit and retain a strong expert panel. Prior to recruitment, the researcher assumed that participants would be busy professionals, with limited time to commit to the study. Since McKenna (1994) noted that response fatigue is more likely in Delphi studies with more than two study rounds, the researcher attempted to limit study rounds to as few as necessary.

There is significant debate about what factors make a participant an expert on a given subject (Hasson, Keeney & McKenna, 2000; Okoli & Pawlowski, 2004). To increase the credibility and richness of the panel in this study, criteria for participation was specifically defined. Unlike quantitative studies in which a power analysis provides the basis for sample size, there are no defined panel size criteria in Delphi studies (Akins, Tolson & Cole, 2005). In a summary of Delphi studies used in graduate research, Skulmoski, Hartman and Krahn (2007) noted that panel sizes ranged from 4 to 171 participants. Too few participants is risky because a small panel may not accurately

reflect the subject area, while too many participants may make reaching consensus more difficult. Hasson et al (2000) also cautioned that participant involvement is necessary through all study rounds, so clear expectations must be made up front and rounds must keep moving expediently, to mitigate both response fatigue and participant attrition. Based on identified strengths and weaknesses of the Delphi study method, the model depicted as Figure 3 was used for this study:

Figure 3. Delphi Study Model

Round 1
- P-FTR Tool, survey link to participants
- Free-text responses
- 2-week response time
- Reminders after 1 week and as needed

Qualitative analysis of free-text responses, survey 2 creation

Round 2
- P-FTR, survey link to participants
- Responses selected from previous responses, responses with consensus after Round 1 excluded
- 2 week response time
- Reminders after 1 week and as needed

Quantitative analysis of responses, survey 3 creation as needed

Round 3 (and subsequent, as needed)
- P-FTR, survey link to participants
- Survey contains only items without consensus
- Response time, reminders per previous rounds

Phase II

After Phase I of the study was complete, the individual elements of P-FTR were moved to a spreadsheet workbook format, using Microsoft™ Excel (2010). The spreadsheet format was based on a recommendation from Christine Spisla (personal communication, May, 2011) who coordinates most of the mapping work for SNOMED-CT.   A workbook was created for each of the four standard languages (CCC, ICNP, LOINC, and SNOMED-CT). Within each workbook, separate worksheets were created for each broad P-FTR category (careful monitoring/timely identification, appropriate intervention, activation of team response). Because each language has its own organized semantic structure, each worksheet contained columns for the domains (categories) within that structure. Each P-FTR individual element was categorically included in the language spreadsheet workbooks, one element per row, with each element "name" followed by its corresponding defined "value". Using the search engines for each language, or in the case of the CCC, printed tables, the individual elements of P-FTR were searched to see if a matching term (concept) was present in the language. If a concept was located, its code, definition, and semantic domain were recorded in the spreadsheet. Finally, results of the mapping were validated by a five-member expert panel whose members included expertise in both terminology and perinatal nursing.

Description of Research Setting

The research setting was virtual, using online and electronic means. As stated previously, one advantage of Delphi studies is that participants do not have to be

together, geographically or physically, to participate. Participant recruitment, informed consent, and surveys were all electronic. The expert panel validation session was also virtual, using a well-known video conferencing software.

Sample and Sampling Plan

Phase I

As stated previously, there is no consensus as to the appropriate panel size in a Delphi study. Delphi studies have been published with panels as small as 10 to several hundred participants (Akins, Tolson, & Cole, 2005; Keeney, Hasson, & McKenna, 2006). Larger panels potentially increase credibility but may also increase the number of rounds necessary to reach consensus. Hasson, Keeney, & McKenna (2000) also note that large samples contribute to difficulties with data handling and analysis, therefore potentially decreasing credibility. To include representation from a broad range of perinatal nursing units, the goal for this study was a purposive sample of 20 participants.

Participants for the Delphi study were recruited through an online Perinatal Nursing Discussion List (PNATALRN). The Perinatal Nursing Discussion list was established in 1995 by perinatal nurses, as a vehicle for discussion about perinatal nursing practice, education, and research, as well as for information sharing and support (McCartney, 1999). The more than 800 discussion list members reside in the United States, Canada, and several other countries. Members hold a variety of positions

including staff nurses, students, educators, administrators, and researchers. Work settings include ambulatory and acute care, urban, rural, community, and academic health systems (McCartney, 1999). Non-nurse members with an interest in perinatal care also participate.

The perinatal nursing discussion list supports perinatal nursing research; there are frequent calls for participation posted to the list. Hasson, Keeney, and Mckenna (2000), noted that placing a general call to a discussion list may not yield positive results. However, as a member of the perinatal discussion list, the expertise of regular list contributors was known to the researcher and a positive response without personal invitation was anticipated.   Also, although the discussion list has over 800 members and therefore a large pool of potential study participants, it was not known how many list members actively contribute to the list and how many are "lurkers", subscribers to a discussion list who do not actively participate (Mendelson, 2007). If initial response was not positive, personal invitations to members known to the researcher was planned.

A general call for participation went out to the entire online nursing discussion list, describing the purpose of the study and requirements for participation. As Okoli and Pawlowski (2004) suggested, strengthening credibility of the panel could be enhanced by defining participant criteria. Therefore, the following requirements for study participation applied:

- At least five-years of experience as a labor and delivery nurse

    - Expertise in electronic fetal heart monitoring (FHM), as evidenced by at least one of the following:

- o Completion of an AWHONN Intermediate or Advanced Fetal Heart Monitoring (FHM) course within 2 years

- o Current electronic fetal monitoring (C-EFM) certification through the Nurses Credentialing Center (NCC)

- o Current certification as an AWHONN FHM Instructor

- Currently practicing in one of the following levels for inpatient care (AAP & ACOG, 2007):

  - o Level I

  - o Level II

  - o Level III

- Experience with current perinatal quality improvement efforts, such as:

  - o Facility participation with the Institute for Healthcare Improvement (IHI) perinatal initiatives

  - o Medical record review for quality improvement purposes

  - o Familiarity with P-FTR

Having had no prior experience with perinatal quality improvement (QI) efforts did not exclude a participant from the study, but having previous QI experience supported the potential participant's expertise and ability to meaningfully contribute. In order to mitigate selection bias, caused by limiting participation only to members of the

discussion list, snowball sampling by list members forwarding the call for participation outside the discussion list was encouraged.

Phase II

A five-member panel of expert informatics and perinatal nurses was used to validate cross-mapping findings. For congruency, perinatal nursing experts who participated in Phase I were invited to participate in Phase II, because they were already familiar with the purpose and scope of the study. Three informatics experts were invited to participate, who were selected from individuals known to have an interest or expertise in the area of standard nursing terminology.

This research study received approval under 45 CFR 46.110 (F)(7) by the Institutional Review Board at Vanderbilt University (IRB #101619). For both phases of the research, once a potential participant responded indicating interest, an informed consent document (see Appendices B and C) was forwarded to him or her by e-mail. Other measures to ensure the protection of study participants were also necessary.

For internet-based research, Im and Chee (2002) noted that issues concerned with the protection of human subjects include anonymity and confidentiality, security, self-determination and authenticity, full disclosure, and fair treatment. Anonymity and confidentiality of the participants were addressed by requesting that participants directly communicate only with the researcher. Despite the request for direct communication with the researcher privately, inexperienced discussion list members might have indicated their interest in participation by responding to the entire discussion list. If this had

happened, the researcher would have responded to the individual(s) privately; it did not

occur. All e-mail correspondence to the participants as a group had blinded addresses, so

that e-mail addresses of participants were not revealed to the others. Each participant had

a unique numeric identifier known only to the researcher. Results of each Delphi study

round were aggregated so that the individual participant's answers and opinions were not

revealed to others.

While the ultimate security of information shared electronically cannot be

definitively assured (Im & Chee, 2006), efforts to minimize security risk included

limiting electronic communication only to the researcher's Vanderbilt University e-mail

address, which is subject to strict data encryption policies. All security policies for data

encryption and anti-virus protection were followed when the researcher accessed

Vanderbilt University mail at home. Demographic data and Delphi study round results

were initially stored on a separate encrypted thumb drive, stored in a locked cabinet.

Once study rounds were complete, data was uploaded to REDCap™, a secure web-based

application used to manage online surveys and for data storage, available through

Vanderbilt University (2011).

By completing and returning the statement of informed consent (Appendices B &

C), self-determination was implied. However, authenticity in internet based research may

be complicated (Im & Chee, 2000, 2006) and involves trust that the respondent is indeed

the respondent. The threat to authenticity was minimized, but not eliminated, by

specification of inclusion criteria, along with the participant's electronic reply, indicating

the participant met the inclusion criteria and understood their expectations relative to the

study. A potential complication to the fair treatment of participants in internet research is

the unintentional exclusion of subjects who cannot be identified through internet means. As stated previously, discussion list participants were encouraged to forward the call for study participation to others outside the internet community. However, since consent was requested by e-mail and surveys were electronic, internet access was necessary. Therefore, lack of internet access was a limitation in this study.

Data Collection and Analysis

Phase I

Delphi study rounds were facilitated using SurveyMonkey™ (2010). SurveyMonkey™ is a secure, internet-based survey tool that allows anonymous distribution and response, aggregation of responses, basic statistical analysis, and the ability to export results into statistical software. Using SurveyMonkey™ allowed the researcher to send links to the survey anonymously and to send pre-scheduled reminders during study rounds to those who had not yet responded.

For round one, participants received a copy of P-FTR (Appendix A) and instructions to refer to it as they were responding to the survey. During round 1 only, the survey included demographic questions such as work experience, work setting, as well as information about fetal heart monitoring expertise. Originally, the informed consent document was planned to include a brief demographic questionnaire but gathering this information through SurveyMonkey™ was determined to be both more secure and more anonymous.

As previously described, the research goal for Phase I was to obtain each participant's comments about P-FTR (see Appendix A) relative to the specific words used to document the elements in the medical record. For example, while there are published standard recommendations by the NICHD for terminology to describe characteristics of the FHR (Macones et al, 2008), bedside nurses may or may not use them. If a perinatal nurse assesses the characteristics appropriately, he or she may only document words indicating that the fetal strip was assessed, and may not list the individual FHR characteristics.

For Round 1, the intent was to limit free-text responses as much as possible in order to facilitate aggregation of responses. However, because this was the first study round, free text fields were necessary to allow all participants to meaningfully respond and fully explain their responses. Appendix D is an example of the format for Round 1 questions.

In terms of the various P-FTR elements (see Appendix A), it was assumed that the greatest variability, and therefore the greatest difficulty in reaching consensus, would occur related to the definitions of "high-risk" and "low-risk" fetal monitoring criteria (Simpson, 2005). Interpretation of high versus low risk criteria is left to the institution, increasing the variability of fetal monitoring frequency across institutions.

Variability was also assumed related to documentation of language used by the perinatal nurse to indicate activation of a team response (see Appendix A). The "team" may mean different things to different facilities and specifics of notification may also vary significantly. For example, activation of a team response might be accomplished

simply by notifying the attending healthcare provider, alerting him or her that patient findings are non-reassuring. Or, an entire surgical team may be requested to facilitate an emergent cesarean section. Variability was also assumed relative to whether or not perinatal nurses documented the NICHD defined categories I, II, and III.

Delphi study rounds progressed as illustrated in the previously described model. Participants were given two weeks to respond to the Round 1 survey. Through SurveyMonkey™, automated reminders were generated after one week to those who had not yet responded, with another reminder sent 24-hours before closing the survey. For consistency, the same notification procedure was followed for subsequent rounds.

Due to the amount of free-text and narrative data received in Round 1, qualitative and quantitative analysis techniques were necessary. As suggested by Creswell (2009), similar terms were color coded to help determine the frequency that they were mentioned. Similar terms were aggregated with the word used most frequently for the term becoming the "value". Results were reported back to participants in the second round survey and the percentage of participants who used this aggregated word or "value".

For round 2, the survey was modified to include the list of responses from round 1, which were reported to the participants along with the percentages of prior responses. This time, respondents could choose only from the previous responses. However, to increase credibility, some free-text comment boxes were available so participants could give additional information about their choices and suggest others if they felt strongly that other choices should be included.

There is no definitive number of rounds necessary for Delphi studies (Hasson, Keeney, & McKenna, 2000). However, consensus is necessary. For this study, consensus was defined as 75% agreement on any element. Seventy-five percent is suggested in the literature as a meaningful percentage for consensus in Delphi studies, although suggested consensus percentages vary. Suggested consensus percentages range from 51% to over 90% (Hasson, Keeney, & McKenna, 2000; Jones & Hunter, 1995; Keeney, Hasson, & McKenna, 2006). For this study, with variability anticipated for several responses, a simple majority (51%) consensus would have limited the credibility of the findings; more than 75% may have been impossible.

Limiting free-text capability facilitated consensus building. However, as stated previously, participant comments were encouraged. After Round 2, percentages of responses were automatically calculated by SurveyMonkey™. To validate the percentages, the percentages for various questions were randomly checked and calculated by the researcher. Consensus of at least 75% was reached for many P-FTR elements after Round 2, but a Round 3 survey was necessary. Survey questions for Round 3 were identical to those in Round 2, with only the questions without 75% consensus included in the survey. Updated percentages of responses from Round 2 were also included.

It is important to note a potential limitation of the Delphi method, described previously as response fatigue, that may occur when busy professionals and heavily scheduled clinicians are study participants. To mitigate the risk of response fatigue, only one- week was planned between survey rounds, and questions in subsequent rounds were limited to only those questions without 75% consensus. After Round 1, the large amount

of free text responses increased the analysis time needed to two weeks instead of one. The delay was communicated to study participants.

In addition to the Delphi survey results, descriptive statistics were analyzed, relative to the demographic information gathered from each participant. Descriptive statistics were important to quantify due to the goal that participants represent most aspects of the perinatal nursing specialty.

Phase II

For Phase II, mapping of the P-FTR elements to the four identified nursing terminologies was accomplished by the researcher based on the previously described method. Reliability and validity of the cross-mapping exercise was assessed with assistance from a small expert panel. For perinatal expertise, one panel member was a participant in the Phase 1 Delphi study, another was a certified informatics nurse who is also a perinatal nurse, and the third was the author of P-FTR. Informatics expertise included two terminology experts, one with published research regarding terminologies such as LOINC and ICNP and the other is responsible for the perinatal content development for SNOMED-CT. Both informatics experts and one perinatal expert also had prior working knowledge of CCC.

Expert panel sessions were conducted with SCOPIA (Radvision, 2010), a video conferencing option available through Vanderbilt University School of Nursing. SCOPIA requires computer access (with web camera and headset) and a high-speed internet connection. Requirements for participation were included in the informed

consent document for Phase 2 (see Appendix C). If the expert panel participant needed either a webcam or headset, one or both was provided by the researcher. SCOPIA allowed synchronous virtual meetings where panel members were present simultaneously and were able to see each other, participate in discussion, and share resources. To improve the reliability of cross-mapping findings, as previous research noted, it was important for the informatics experts to have the perspective of the perinatal nursing experts, and vice-versa, and for the entire group to engage in open discussion (Dykes et al, 2009).

Once the mapping exercise was completed by the researcher, an online survey using Doodle ®, an online scheduling tool that allowed participants to choose from more than five options for meeting dates and times, was sent to consented participants (2011). Unfortunately, due to the scheduled of the expert panel members, one time for all was not possible. Two validation sessions were held. To assure a balanced panel, the two terminology experts were split, with one attending the first panel and one attending the other. To minimize potential panel bias, comments from the first panel were not shared with the second. All panel findings were summarized together. The inability of the entire panel to meet together was unfortunate and a noted study limitation.

CHAPTER IV

RESULTS

Phase I

Twenty-nine participants agreed to participate in the modified Delphi study and 27 participants completed all three study rounds. Notably, only 27 of 29 participants completed the demographic questions included with the first survey. The majority (63%) of participants who completed demographic information had more than 20 years labor and delivery nursing experience; more than 90% had at least 10 years of experience. Figures four through seven illustrate the years of experience, work setting, number of annual births, and fetal monitoring experience of the 27 participants.

Figure 4. Years of Labor and Delivery Experience
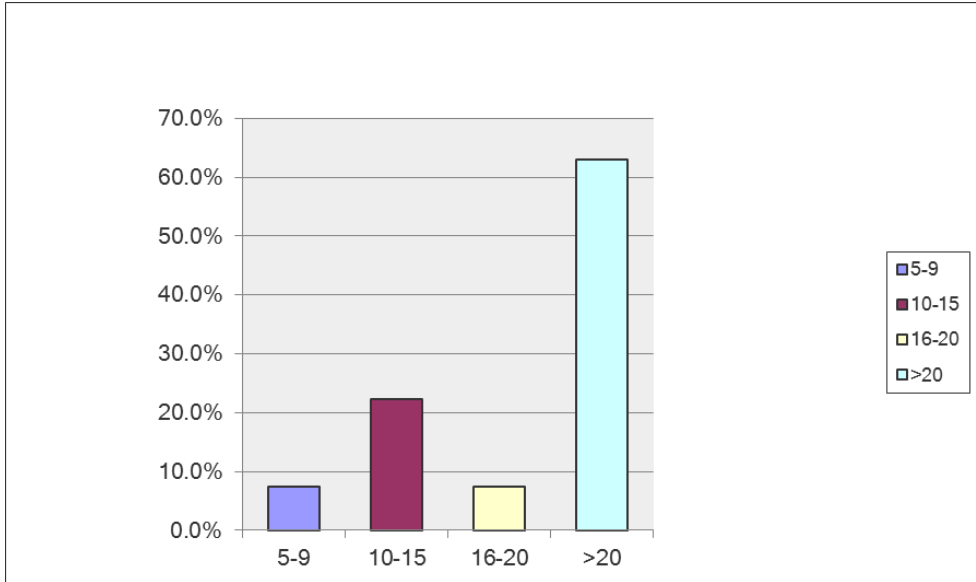
Figure 5. Work Setting
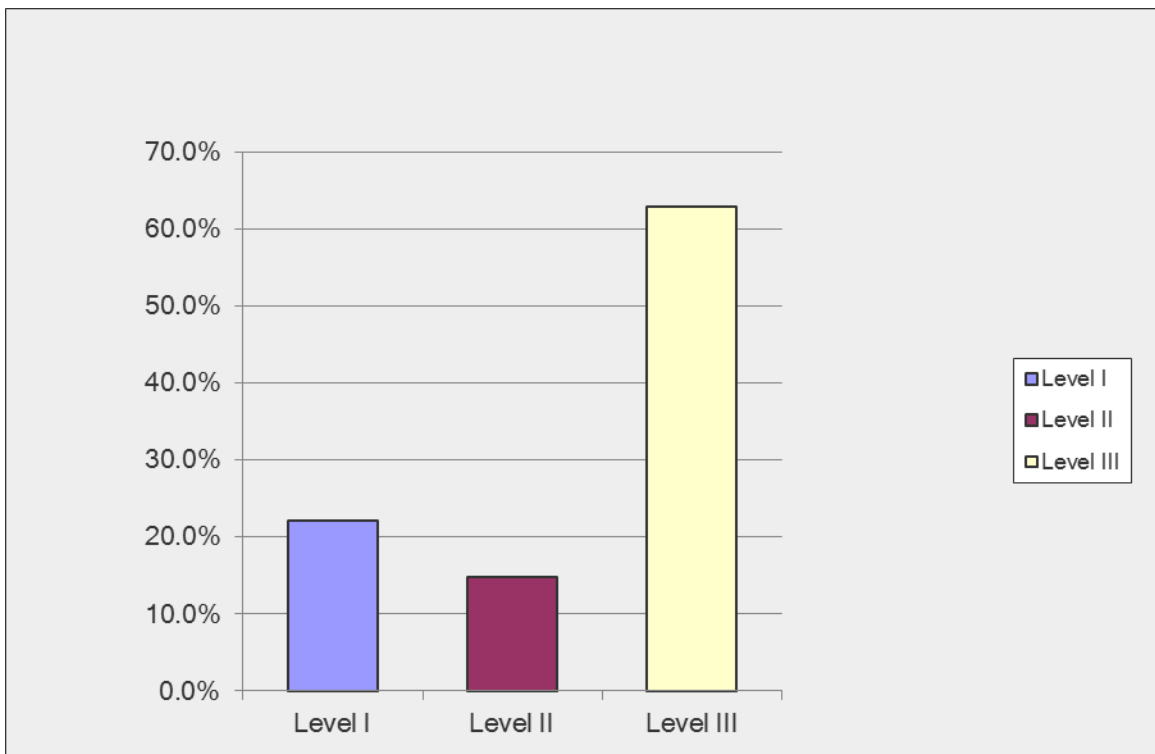
- Level I Facilities: provide basic care and must have equipment and personnel available to care for infants at least 35 weeks gestation and be able to stabilize infants less than 35 weeks gestation prior to transfer.

- Level II Facilities: have supplies and personnel capable of caring for infants born at more than 32 weeks gestation and weighing more than 1500 grams, or moderately ill infants who are expected to improve quickly.

- Level III Facilities: provide the highest level of comprehensive care, for as long as required, for newborns who are high risk and or critically ill (AAP & ACOG, 2007).

More than 60% of participants represented facilities providing the highest level of perinatal care (Level III), but participants also represented both Level II facilities and a few worked in Level I facilities. The high percentage of participants in Level II facilities supported the need for an expert panel, as one would presume nurses working in a Level III environment experience a wide variety of labor and birth experiences and more complicated cases. However, nurses working in smaller Level I and Level II facilities must still possess the ability to assess and appropriately intervene as necessary during labor and birth.

Figure 6. Number of Births per Year
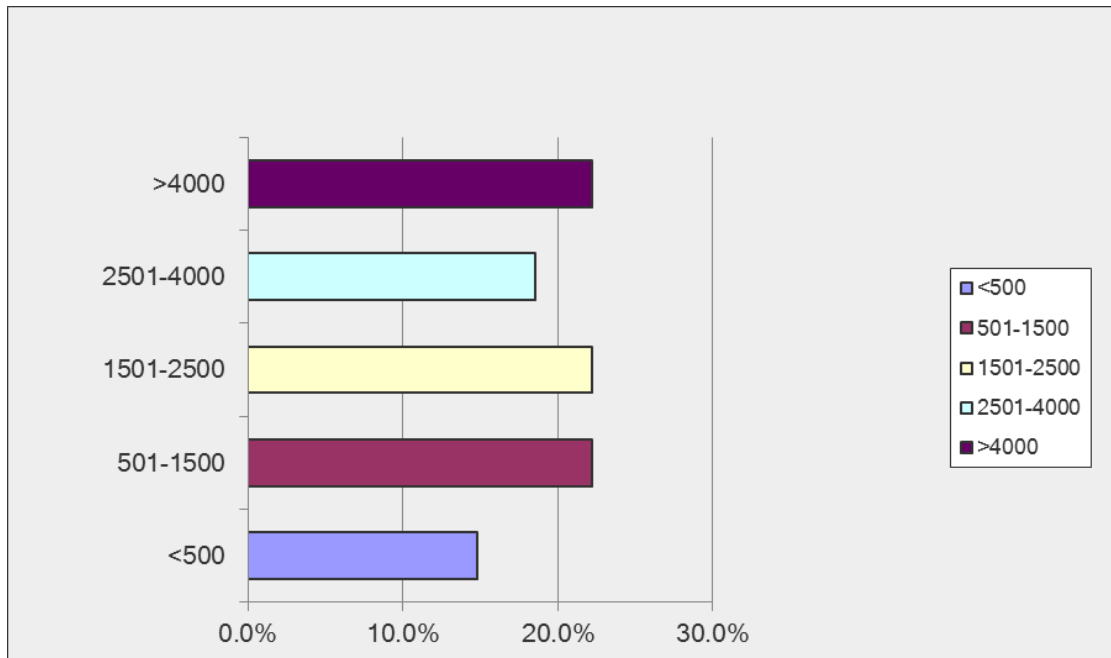
The participant panel members were well-distributed relative to facility birth volume.

Birth volume, rather than geographic location, was purposively considered for this study.

While perinatal nursing practice varies throughout geographic areas, smaller facilities

with fewer annual births may have fewer available educational resources and therefore

may be less likely to use the most current terminology, compared to facilities with larger

birth volumes.

Figure 7. Fetal Heart Monitoring Expertise
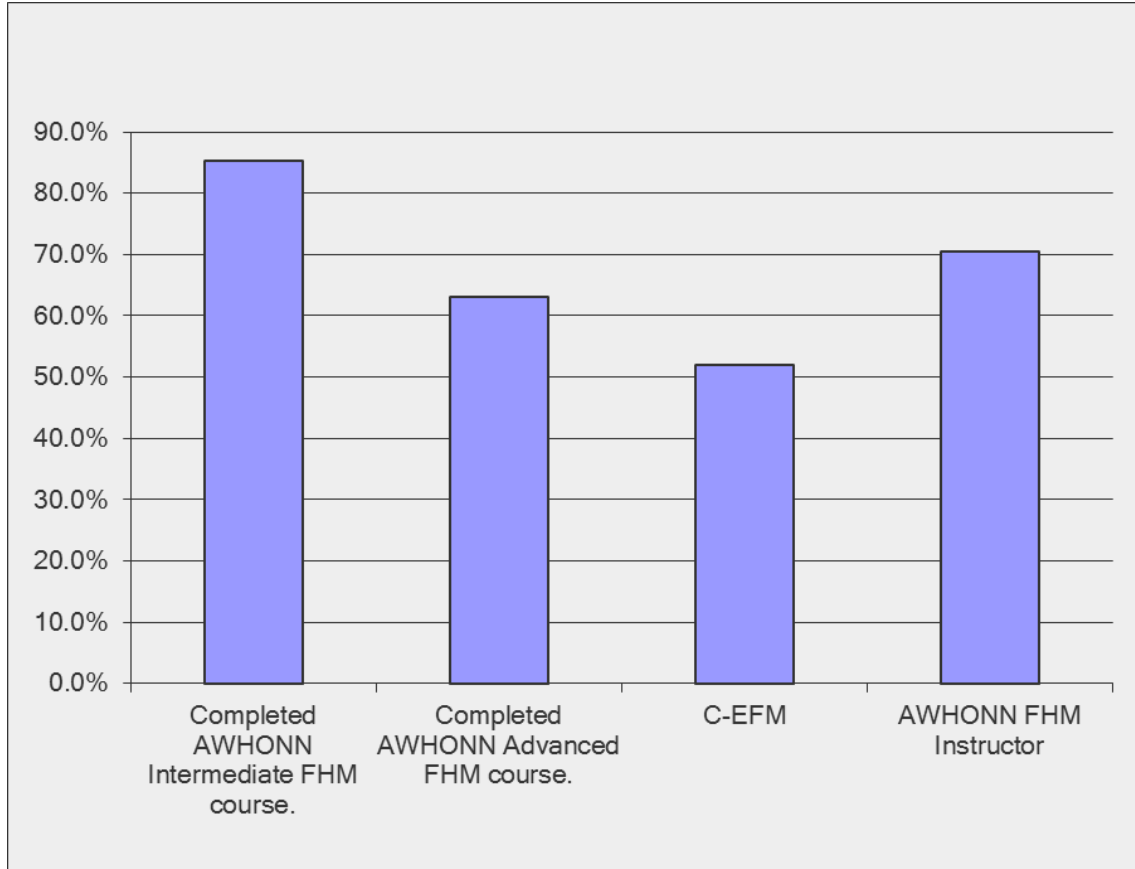
Since so much of the focus of P-FTR is the assessment, interpretation, and intervention related to electronic fetal heart monitoring (FHM), expertise in FHM was crucial. The Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) is a primary provider of FHM educational content, offering both intermediate and advanced EFM courses. (AWHONN, 2011). Perinatal nurses may choose to become approved AWHONN FHM instructors. More than 80% of panel participants had taken an AWHONN EFM course and approximately 70% were EFM instructors. Also, the National Certification Corporation (NCC) offers a certification examination for electronic fetal monitoring (NCC, 2011). After successful completion of the certification exam, nurses may use the credential C-EFM and are required to demonstrate ongoing

competency in electronic fetal monitoring. More than half the panel participants were certified in EFM.

Expectations for careful monitoring and timely identification

As described previously, Delphi study rounds involved online surveys, each divided into three pages or sections, one survey page for each page of P-FTR (see Appendix A): Expectations for Careful Monitoring and Timely Identification, Appropriate Intervention, and Activation of a Team Response. Because recommendations for the frequency of FHR assessment varies based on risk, implicit within the concept of careful monitoring is the identification of mother and fetus as either high or low risk. Whether a woman or fetus is classified as high or low risk has not been precisely defined so, during round 1, participants listed diagnoses, characteristics, or conditions that they believed classified a woman or fetus as high risk. Participants also listed characteristics for classification of mother or fetus as low risk. Tables 3 and 4 summarize high and low risk characteristics for mother and fetus. In bold are the characteristics that received at least 75% consensus.

In the first Delphi study round, 100% (n=29) of respondents indicated they documented FHR characteristics using NICHD defined terminology. Also in round 1, 100% (n=29) of participants indicated that complete FHR documentation includes baseline FHR, baseline variability, and the presence or absence of decelerations; 97% (n=28) said they documented the presence or absence of accelerations and/or the type of deceleration. In survey round 1, participants indicated that fetuses classified as low risk

should have "reassuring" FHR characteristics, meaning baseline FHR is normal, baseline

FHR variability is moderate, and FHR decelerations are absent,. Consensus for how

reassuring FHR characteristics should be documented was achieved in round 2, when

93% (n=25) of participants indicated such reassuring characteristics should be

documented as Category I (normal). Only 7% (n=2) of respondents thought that

reassuring characteristics should be documented as having a reactive FHR tracing or fetal

non-stress test (NST).

Conversely, participants were unable to reach consensus, even after three study

rounds, regarding how to document non-reassuring FHR characteristics. The majority of

participants in round 3 (n=18), or 67%, indicated that specific individual non-reassuring

FHR characteristics (FHR baseline, variability, and/or decelerations) should be

documented, rather than documenting Category II (indeterminate) or Category III

(abnormal) as 9 participants (33%) chose. Majority percentages were reversed between

study rounds 2 and 3. In round 2, a slight majority (52%) indicated they would document

either Category II or Category III, with 48% choosing to document specific individual

characteristics. Participants in Delphi study rounds may consider how other participants

previously responded to a question prior to choosing their next response. Obviously, this

tendency did not prove to be true for this particular question even though 89% (n=24) of

participants believe the NICHD categories should be documented.

Consensus regarding whether documentation of FHR categories is appropriate

was not reached until round 3. The overall opinion of the participant panel that NICHD

categories should be documented, the consensus opinion that documenting reassuring

FHR findings using the NICHD defined Category I (normal), along with the inability of

participants to reach consensus as to whether or not to use NICHD defined FHR

Categories II or III for non-reassuring FHR findings, supports the debate among perinatal

nurses as to whether doing so is within the nurses scope of practice. Of the 27 responses

to the question in study round 3, when non-reassuring FHR characteristics are identified,

85% (n=23) of participants believed that complete documentation included both the

specific FHR characteristics themselves, along with the nursing interventions to mitigate

them. Only 15% (n=4) thought listing the non-reassuring FHR characteristics without the

corresponding interventions was appropriate. These findings related to documentation of

FHR characteristics clearly indicated that concepts related to both the individual FHR

characteristics defined by the NICHD as well as the NICHD defined summary categories

(I, II, and III) would be necessary to include in the terminology mapping in study phase

II.

Careful monitoring of the mother and fetus in labor also includes assessment of

uterine contraction characteristics; consensus was reached for these in study rounds 2 and

3 which each had 27 participants. According to 93% (n=25), uterine contractions in

active labor should be documented as regular, with the addition of the qualifiers mild,

moderate, or strong. Only one participant believed that documentation of "regular"

contractions alone was appropriate; one other participant indicated "regular, painful"

contractions should be documented. Assessment of contraction strength occurs by

palpation. However, if uterine contractions are assessed by intrauterine pressure catheter

(IUPC), documentation of contraction strength may be in Montivideo units (MVUs), a

measurement calculated by measuring contraction peak intensity for all contractions

within a 10-minute period (Caldeyro-Barcia, Pose, & Alvarez, 1957). In study round 1,

67% (n=18) of 27 respondents indicated that they documented MVUs. While this percentage did not equal the 75% for true consensus as defined by study parameters, narrative comments from round 1 participants indicated a great deal of variation as to whether or not they included documentation of MVUs, and doing so depended on many factors. Therefore, it was clear the concept "MVU" had to be included as a P-FTR element in study phase II and so the question related to MVUs was not included in subsequent study rounds. In round 1, all 29 participants indicated that complete uterine assessment includes documenting contraction frequency (in minutes); 90% (n=26) document uterine resting tone as soft or firm, and 24 (83%) indicated they considered average contraction length (in seconds) as part of complete documentation.

Guidelines for frequency of fetal and uterine assessment apply for the woman in active labor, unless the care provider (or risk status) specifies otherwise. Therefore, careful monitoring of mother and fetus and timely identification of non-reassuring findings are dependent on the definition of active labor. Mattson and Smith (2011) define active labor as cervical dilation between 4 and 7 centimeters. However, in practice as it relates to documentation, the definition of active labor may vary. Study participants (n=27) reached consensus on the following characteristics of active labor: cervical dilatation of 4 centimeters or greater (85%, n=23), as well as present and/or progressive cervical change (85%, n=23).

When documenting fetal and uterine characteristics, 23 of 28 participants (82%) indicated they include all individual fetal and uterine characteristics in documentation. Only 5 (18%) said they use a summary statement such as "status unchanged" or "RN assessed strip", even if findings remained unchanged from previous assessments.

Appropriate interventions

Consensus definitions for most interventions included in P-FTR (see Appendix A) were achieved during study rounds 2 and 3, each with 27 responses. The interventions, as specified by P-FTR (see Appendix A) include:

- **Oxygen:** a notation that the FHR, which may be described, is unchanged, Oxygen (O2) at 10 liters/min (89%, n=24). Only 2 respondents (7%) thought that merely documenting the initiation of oxygen, without clarifying that FHR characteristics were unchanged, was sufficient. One (4%) chose the words "no improvement" to describe the FHR pattern.

- **Intravenous bolus of lactated Ringer's solution:** Intravenous (IV) bolus of _____ ml lactated Ringer's (LR) (82%, n=22). Results indicate the majority of respondents believed that including the total amount of the bolus was necessary for complete documentation. Only 19% (n=5) thought that merely documenting the administration of the bolus, without the amount, was sufficient.

- **Discontinuation of Oxytocin:** Pitocin discontinued (DC) (78%, n=21). Six respondents (22%) would document "Pitocin off".

- **Terbutaline 0.25 milligrams SQ:** Terbutaline 0.25 mg SQ, with location (96%, n=26). Only one participant chose not to include the location in documentation.

- **Amnioinfusion:** All 27 participants (100%) indicated they would document amnioinfusion at _____ ml/hr. Again, participants believed the total amount of solution administered should be part of complete documentation.

- **Modified pushing efforts:** Pushing with every second (third) contraction, with the reason specified was the appropriate documentation chosen by 82% (n=22) of

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participants. Three participants (11%) indicated they would document only that the patient was pushing with every second or third contraction and two (7%) would add the modifier that the patient was "encouraged" to push with every second or third contraction.

There were two interventions for which 75% consensus could not be reached after three study rounds. Participants could not agree on the language used for lateral positioning. The majority of participants (63%, n=17) document "left (L) side or right (R) side"; 37% (n=10) document "left (L) lateral or right (R) lateral". Participants could also not agree on language for documentation of provider notification, with 42% (n=11) indicating they would document "Provider (name) notified of _____". Eight participants (31%) document only "MD/CNM notified" and 7 (27%) document "MD/CNM notified of situation, background, assessment, and recommendation (request) (SBAR)". The concept of SBAR as a communication tool is widely recommended for perinatal nursing by the Institute of Healthcare Improvement (IHI) and others, so it was not surprised that 11% of respondents included it as a free-text response in round 1. However, it was surprising that so much variation in the three response choices was still present after round 3.

Activation of a team response

After round 2 there was variation, similar to the variation for provider notification, in the responses participants used to document a request for bedside evaluation by the provider, when there was persistent or progressively worsening

maternal or fetal status. In round 2, nine participants (33%) said they documented

"MD/CNM at the bedside at _____", the time notified and the time arrived were

documented by the majority of participants (56%, n=15), and "MD/CNM at bedside" was

documented by three participants (11%). However, after round 3, 22 participants (85%)

said that documenting the time the provider was notified and the time the provider arrived

was the most appropriate. If a cesarean birth is indicated, 85% (n-=22) responded that the

most appropriate documentation would be "C/S called at _____", supporting the need to

include the time such a decision was made. Since ACOG recommends that no more than

30 minutes lapse between the decision to perform a cesarean section and the start of the

procedure (ACOG, 2004), this finding was not surprising. Finally, 85% of participants

(n=22) indicated that if there was a need to summon a neonatal transport or transfer an

infant to a higher level of care, they would document "transport (transfer) team notified".

In summary of study phase I, participants reached at least 75% consensus on most

elements of P-FTR. There was over 60% agreement about the documentation of laterality

but more variation in phrases used to document provider notification. No consensus was

reached as to whether MVUs should be documented because the reasons for doing so

varied so widely among free-text responses. Also, there was identified disagreement in

whether or not to use defined NICHD categories II and III to document non-reassuring

fetal status. The first study question, "what are consensus definitions for P-FTR?" was

mostly (but not entirely) answered using a modified Delphi study with 29 total

participants, 27 of which completed all three rounds. Consensus definitions identified in

phase I are included in phase II. Where disagreement occurred, all participant- identified

definitions, rather than just the majority response, were included in phase II.

Phase II

The purpose of phase II was to determine whether the defined elements of P-FTR existed in any or all of the four selected ANA approved standard terminologies. Facilitated by Microsoft Excel (2010), P-FTR elements were ordered as per the pages of the tool (see Appendix A) with workbooks for 1) Careful Monitoring/Timely Identification, 2) Appropriate Intervention, and 3) Activation of a Team Response. Each workbook contained separate spreadsheets for each selected terminology (CCC, ICNP®, LOINC, and SNOMED-CT). Searches were undertaken using the strategy (manual or electronic) provided by the particular terminology. An effort was made to locate P-FTR elements specifically as defined (using the exact words or phrases). Sometimes, concepts needed post-coordination. Post-coordination involves the combination of individual concepts across semantic classes or domains. When post-coordination was necessary, the terminology's existing semantic structure was used without modification. If the concept was found intact, or with a suitable synonym, reviewing the terminology's semantic structure validated that the concept was in a suitable context. Search strategies and a brief description of each terminology's semantic structure follows:

•   Clinical Care Classification (CCC): As stated previously, CCC is a terminology developed to standardize care planning in order to highlight the nursing process (Saba, 2007). As such, the terminology is organized into four care patterns: health behaviors, psychological, functional, and physiological. Each care pattern includes care component

classes that contain diagnoses, interventions, actions, and outcomes (Saba, 2007). Element searches in CCC were manual, using Saba's (2007) user's manual.

• International Classification of Nursing Practice (ICNP®): Concepts in ICNP® are organized into domains including diagnosis, intervention, means, focus, judgment, client, location, time, and action. ICNP® offers web-based electronic search capability for developers and researchers through ICNP® C-Space (2011).

• Logical Objects, Identifiers, Names and Codes (LOINC): LOINC began and remains a comprehensive terminology for laboratory and diagnostic testing; with a semantic structure that supports these specialties. For clinical care, LOINC is organized into the domains of *property, time aspect, system, scale, method, and class*, along with categories to further describe concepts such as "long common name"; some concepts also include notes related to the origin of the concept. LOINC searches are facilitated by the Regenstrief LOINC Mapping Assistant (RELMA®), a downloadable search engine publically available at no charge to registered users (2011). This study used RELMA® version 5.1.

• SNOMED-CT: Because it is a reference or "meta" terminology, SNOMED-CT contains a complex semantic architecture organized into hierarchies. The scope of this research considered only the concept subtype hierarchy because this hierarchy was sufficient for validating that the context was correct for post-coordinated concepts. Elements of P-FTR were found in the subtypes of *clinical finding, procedure, qualifier value, observable entity, concept with explicit context, and pharmaceutical/biological product*. The CliniClue terminology browser (version 2010.8.0230) was used as the

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search engine for SNOMED-CT (CIC Ltd., 2011). CliniClue is publically available for download by researchers.

There were a total of 76 separate concepts identified in P-FTR (see Appendix A). Careful monitoring/timely identification contained 58 concepts, 25 concepts related to maternal or fetal risk (16 high risk and 9 low risk), 19 related to fetal heart monitoring, and 14 uterine monitoring or assessment concepts. Appropriate intervention contained 13 concepts and activation of a team response had 5 concepts. Overall, the majority of P-FTR concepts (83%, n=63) were found in SNOMED-CT, ICNP had 34% (n=26), LOINC had 28% (n=21) and CCC had only 15% (n=11). Tables 5-10 illustrate the individual concepts and identify the terminologies in which they were found.

Expectations for careful monitoring and timely identification

As previously stated, the frequency of maternal and fetal assessment depends on maternal and fetal risk status classification. There were 10 indications identified in Phase I that at least 75% of participants indicated classify a woman or fetus as high risk, as well as 6 maternal medical complications that Phase I participants considered high risk (see Table 5). Of the four terminologies explored, 15 of 16 concepts (94%) were found in SNOMED-CT. The only high-risk related concept not found in SNOMED-CT was "multiple gestation", meaning a pregnancy with two or more fetuses. ICNP and LOINC each had 50% (n=8) of the concepts; CCC had only 25% (n=4). Only one concept, previous cesarean section, required post-coordination. Within ICNP, the concept of cesarean section is within the "means" domain, referring to the method of delivery. When

the concept of "cesarean section" is combined with another ICNP concept "risk for complications during childbirth", the concept of "cesarean section" is captured within the context of risk.

Table 6 illustrates the concepts associated with a low risk of complications, as defined in Phase I. The majority of concepts relating to "low risk" were found in SNOMED-CT (67%, n=6), three concepts (44%) were found in both CCC and LOINC, none were found in ICNP. Interestingly, the absence of complications and a negative medical history were concepts not present in any of the four terminologies. However, all four terminologies included at least one coded concept related to pregnancy, labor, or childbirth risk. In CCC, within the care component "safety" there were care concepts of "childbirth risk" and "labor risk". ICNP contains concepts for "risk for complications during childbirth" and "risk for complications during labor". In previous work by Matney, Bakken & Huff (2007), various clinical assessment terms from CCC, including "labor risk" were mapped and eventually included in LOINC. Therefore, "labor risk" is now also a coded LOINC concept. SNOMED-CT includes two risk related concepts, "high risk pregnancy" and "low risk pregnancy".

The greatest number of careful monitoring/ timely identification concepts (19) refer to fetal heart monitoring (FHR) (see Table 7). SNOMED-CT contains 15 of 19 (79%) of fetal heart monitoring concepts, none were found in CCC, only one (fetal heart rate) was in LOINC and ICNP had only three FHR concepts, two of which required post-coordination. In order to capture the context of FHR bradycardia and tachycardia, the concepts of "heart rate" with the client "fetus" were combined with the concepts of "bradycardia" and "tachycardia". While SNOMED-CT contained most elements of

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NICHD (2008) defined FHR terms, the terminology does not currently contain concepts for the NICHD assessment categories I, II, or III, or concepts for the assessment finding "non-reassuring". The concept "reassuring" is present in SNOMED-CT, but it is within the "intervention", rather than "clinical finding" subtype and may require modification to have the appropriate context intended by P-FTR.

Table 8 includes the concepts related to uterine assessment and active labor definition. Of the 14 concepts included in this category, 11 (79%) were found in SNOMED-CT, none in CCC, only one (7%) in LOINC, and five (36%) in ICNP. Uterine assessment occurs by one of three methods: palpation, external toco, or intrauterine pressure catheter (IUPC) (see Table 8). The concept of uterine assessment by palpation was derived by post-coordination in both ICNP and SNOMED-CT. In ICNP, the concept of "contraction monitor", a "means", was combined with the "action" of palpating. In SNOMED-CT, "uterine contraction monitoring" was combined with the qualifier value "by palpation". Similarly, post-coordination was necessary in ICNP for the concepts of contraction frequency, length, contraction strength (mild), and contraction strength (moderate) (see Table 8). Frequency and duration were derived by combining the concept of "contraction monitor", with the "time" concepts of "frequency" and "duration" and contraction strength by using the "judgment" concepts of "mild" and "moderate". Once again, SNOMED-CT contains all the NICHD (2008) defined uterine monitoring terms, except one. The concept of "uterine tachysystole" defined as greater than 5 uterine contractions in a 10 minute period, averaged over 30 minutes (Macones, 2008), is not present in SNOMED-CT. However, the earlier NICHD defined concept of "uterine hyperstimulation" is present in SNOMED-CT.

Finally, careful monitoring criteria for the woman in active labor were defined, in Phase I, as at least 4 centimeters cervical dilation and the presence of cervical change over time. None of the four languages include a concept relating to "cervical change" and only two, LOINC and SNOMED-CT, contain the concept of cervical dilation.

Appropriate intervention

There are 13 concepts in P-FTR related to appropriate intervention (see Table 9). All of the concepts except one (modified pushing) are present in SNOMED-CT. LOINC and ICNP each contain 5 concepts (39%) and CCC contains 6 (46%). Recall that CCC is a terminology focused on the nursing process. Since nursing interventions are an important part of the nursing process, the presence in CCC of many of these "appropriate intervention" related concepts such as patient positioning, medication administration, and stopping medication was not surprising.

Post-coordination was required in ICNP and SNOMED-CT for the concepts related to lateral positioning. In ICNP, the intervention concept of "positioning patient" was combined with the location concepts of "laterality", "left", and "right". Conversely, SNOMED-CT contains concepts for "turning patient in bed", a "procedure", and includes qualifier values of "right lateral" and "left lateral". Also, it is important to note that SNOMED-CT contains qualifier values for "left side" and "right side", since participants in Phase 1 of this research could not come to consensus as to whether they would use "side" or "lateral" as it relates to positioning.

Activation of a team response

Of the five concepts related to activating a team response (see Table 10), all five are present in ICNP, four of the five are in SNOMED-CT, three are in LOINC and only one is present in CCC. All four terminologies have a concept for provider notification. ICNP, LOINC and SNOMED-CT contain concepts to capture notification and arrival times. After post-coordination, the concept of the decision to perform a cesarean section (cesarean section called), was derived in ICNP by combining the "means" concept of "cesarean section" with the "time" concept of "time interval or point in time" and the action concept of "informing". In SNOMED-CT, a code exists for "emergency cesarean section", a "procedure". Only ICNP contains a concept representing notification of a transfer or transport team, "initiating managing transporting", an "intervention".

Phase II findings were validated by a panel of five nurse experts. They included Joanne Barnes, MS, RNC-OB, an experienced perinatal nurse who participated in Phase I of this research and also has prior experience working with a perinatal electronic system vendor; Melissa Barthold, MSN, RN-BC, CPHIMS, FHIMSS, a Senior Clinical Solution Consultant whose clinical experience is in perinatal nursing; Patricia C. Dykes, RN, DNSc, a published nursing terminology expert; Kathleen Rice-Simpson, PhD, RNC, FAAN, the author of P-FTR; and Christine Spisla, MSN, RN, Clinical Informatics Consultant with the College of American Pathologists (CAP), an experienced perinatal nurse and the consultant responsible for perinatal content development for SNOMED-CT. The researcher sought out experts who understood the clinical content and also understood standard terminologies. After receiving the informed consent document and acknowledging consent, as previously described, the nurse experts met virtually with the

researcher. One week prior to meeting, panel members received (by e-mail) electronic copies of the Microsoft Excel (2010) workbooks containing results of the P-FTR concept mapping. Due to conflicting schedules, two validation sessions were held, each lasting approximately two hours. Each expert panel member participated in one session, with the researcher attending both. One panel session included Barnes, Barthold, and Dykes and the second included Simpson and Spisla, so that each panel session included one panel member with particular expertise in nursing terminologies. Both panels included members with perinatal nursing expertise.

During the validation sessions, panel members reviewed each individual spreadsheet with the researcher. Experts validated 100% of concept mapping findings, without exception. Experts were specifically asked to assess the accuracy of the findings, within each specific terminology, and whether findings captured the intended context, especially if post-coordination was necessary.

In summary, SNOMED-CT contains the most P-FTR elements, CCC contains the fewest. Various elements exist in ICNP and LOINC. The fact that SNOMED-CT contains so many NICHD defined fetal monitoring concepts is encouraging because so much of the P-FTR process depends on the careful monitoring of mother and fetus and the timely identification of problems. Also, very few concepts in SNOMED-CT required post-coordination in order to capture context. This finding was also encouraging as it facilitates understanding by the novice terminology user, and may support future information modeling.

CHAPTER V

DISCUSSION AND IMPLICATIONS

This study explored whether a defined number of perinatal nursing concepts were

present in selected ANA-approved standard nursing terminologies. The fact that 29

experienced perinatal nurses agreed to participate in the Delphi study during Phase I and

27 of them completed all three study rounds implies that there is interest in the topic of

standard language use in perinatal nursing. While not representative of everything the

perinatal nurse does, the concepts included in P-FTR represent key aspects of nursing

care for the laboring woman and her unborn child, including careful monitoring of both

mother and fetus, timely identification of problems, appropriate interventions, and

activation of the necessary team members to handle an emergent cesarean birth or to

transfer an infant in trouble. The first study question highlighted the need for consensus

definitions in P-FTR. Consensus was needed in order to standardize the words actually

used in perinatal nursing documentation to describe the elements of P-FTR, thereby

giving a "value" to each P-FTR element "name".

Careful monitoring, as included in P-FTR, implies that women in active labor are

monitored and assessed at time intervals recommended by current guidelines (Harmon,

2009). Risk classification is necessary to determine monitoring and assessment

frequency during labor but deciding who is high risk and who is low risk has always been

a decision left up to the individual facility or perinatal nurse. Phase I consensus findings

represent criteria expert nurse participants believe should be used to classify a pregnant woman or fetus as either high risk or low risk, criteria which may support or refute current individual perinatal nursing practice. Consensus findings related to high risk characteristics, including hypertensive disorders, diabetes, bleeding disorders, cardiac complications, and multiple gestation are also listed as high risk characteristics by Bowers, Curran, Freda, Krening, Poole, Slocum, and Sosa (2008).

Phase I findings also suggest a consensus definition for active labor, as the definition applies to assessment frequency. Consensus related to the definition of active labor was important because hospitalized pregnant women may be monitored continuously in the hospital setting, regardless of whether "labor" has been identified. However, the purpose of P-FTR is to assess care processes specifically during active labor, so the consensus definition could be used later for information modeling.

Participants, by consensus, also supported the use of current NICHD recommended fetal monitoring terminology, with some notable variation. While over 80% of study participants agreed that NICHD defined categories I, II, and III should be documented and 93% said they would document a normal FHR tracing as category I, participants did not reach consensus as to whether the categories to describe indeterminate (category II) or abnormal (category III) FHR tracings should be used in perinatal nursing documentation. As previously stated, NICHD terminology recommendations were originally published in 1997 but recommendations to group particular FHR characteristics into categories I, II and III were just published in 2008. Study findings may represent ambiguity related to the perceived value of documenting the categories. Further, study results (67% of responses) suggest that participants may be

more comfortable describing individual fetal heart rate characteristics, rather than summarizing them using the three categories.

There were two other P-FTR elements for which Phase I participants could not reach consensus. Although the majority (63%) of respondents would use the phrase "left (or right) side" to document maternal position, the percentage was less than the 75% necessary for consensus. Likewise, there was no consensus as to the words used to document provider notification. Lack of consensus for the two elements did not affect Phase II processes it merely added additional options for mapping. In terms of maternal position, both "side" and "lateral" were included in the search strategy. For provider notification, the search strategy focused on the concept of "provider notification" because all three possible consensus definitions included "provider notification" plus other qualifiers such as provider name or specific notification structure (SBAR).

Consensus definitions from Phase I led, in Phase II, to the mapping of 76 individual concepts to each of four selected nursing terminologies, CCC, ICNP, LOINC and SNOMED-CT. Findings identified that 83% of P-FTR elements exist in SNOMED-CT; some P-FTR elements are present in each of CCC, ICNP, and LOINC, satisfactorily answering the second research question. Overall, Phase II findings suggest that SNOMED-CT may currently be the language that best represents the perinatal nursing process relative to failure to rescue.

This research contributes another dimension to the one published study using P-FTR (Beaulieu, 2009). As previously stated, Beaulieu noted the difficulty in retrieving P-FTR elements from the medical record as a study limitation. Consensus definitions for P-

FTR elements identified in Phase I address Beaulieu's published limitation by suggesting common language that could be used to represent P-FTR elements in either paper or electronic medical records. Standardization provides the foundation for easier element retrieval.

Further, study findings support subsequent information modeling for possible incorporation of P-FTR elements into electronic documentation systems. Since the original literature review for this study, another study by Cardoso and Silva (2010) was published that used similar methods, including a Delphi study approach and an 18-member expert panel, to validate the suitability of ICNP® to represent maternal and neonatal nursing concepts in Portugal. The concepts were identified from direct observation and record reviews and, interestingly, the identified concepts were much less technology (electronic monitoring) focused but were focused more on concepts such as maternal coping, breastfeeding, and bonding. Since the identified concepts were so different between Cardoso and Silva's study and this research, no comparison could be made between study results.

This research also contributes to prior research regarding the suitability of standard nursing terminologies, notably LOINC (Dykes et al, 2009) and ICNP (Matney, Bakken, & Huff, 2003) to represent elements from other nursing specialties. This study's finding that SNOMED-CT contains the most P-FTR concepts contributes to other research supporting the use of SNOMED-CT for nursing documentation such as that by Lundberg, Warren, Brokel, Bulechek, Butcher, Dochterman, Johnson, Maas, Martin, Moorhead, Spisla, Swanson, and Giarrizzo-Wilson (2008) or for clinical research such as

that by Andrews, Patrick, Richesson, Brown, and Krischner (2008). There were no studies identified that refute SNOMED-CT's usefulness for nursing documentation.

Limitations

Several study limitations are noted. In Phase I, the recruitment of 29 participants exceeded the initial goal of 20. However, having all 29 participants complete all three study rounds and answer all study questions would have been preferred. In all, 27 of 29 participants (93%) completed all three study rounds, similar to a recent nursing Delphi study published by Culley (2011) who reported a 94% response rate over 2 study rounds. This percentage is actually higher than two other recently published nursing Delphi studies, including studies by Chang, Poynton, Gassert and Staggers (2011) that reported 68% response in both rounds 2 and 3, and Castro, Miller-Davis, Cusack, Loscalzo, Matlock, Mayberry, Tondreau, Walsh, and Hastings (2011) who reported an 80% response in round 2 and 73% response in round 3.

Also notable is the fact that not all study participants answered every question. Even though the online surveys were designed to require answers to study questions, meaning participants were prompted to answer any question they had skipped before going to the next question, a few participants exited the surveys before answering every question. It is not known whether this was intentional or was the result of problems with the technology. Several participants contacted the researcher and indicated difficulty completing a survey round. This problem was especially noted in Round 1 and may explain why demographic information was received for only 27 of 29 participants.

However, the overall study objective of 75% consensus was the highest percentage suggested by prior research and helps substantiate overall results despite a few missing responses. In order to maintain confidentiality for the participants and reduce the potential for bias, the researcher did not attempt to correlate missing responses with a particular participant in order to contact that participant to request completion of missing questions.

As previously noted, the requirement for participants to have internet access in order to participate was a study limitation. Those without internet access may have provided valuable insight to perinatal practice.

Also notable from Phase I was the inclusion of only the high and low risk maternal or infant characteristics that achieved at least 75% consensus. There were characteristics that the majority (greater than 50%) of respondents believed placed a woman or fetus at high or low risk (see Tables 5 & 6). It will be important to include these characteristics, and their corresponding percentages, in the publication of study findings and to consider all participant responses in further research related to classification of maternal and fetal risk.

In Phase II, findings were validated by a panel of 5 nurse experts. The panel accepted 100% of the mapping results without exception, which was very encouraging. However, there were notable limitations related to the virtual expert panel sessions. First of all, the schedules of expert panel members could not be coordinated in order for all 5 members to participate during a single session, making two sessions necessary. Care was taken to balance the two sessions by making sure each contained at least one terminology

expert and at least one perinatal nursing expert, but having the panel meet all together

may have led to richer discussion and more debate. In order to participate in the virtual

expert panel sessions, each expert panel member was requested to have a headset and a

webcam. The researcher offered to provide these if needed, and did so for two

participants. The requirements were included in the informed consent document for Phase

II (see Appendix C). The researcher did not follow-up with participants, after they had

given consent, assuming that if either resource was needed, the panel member would

have requested them. However, at least two panel members had trouble with either the

video or audio conferencing aspect of the panel session. One had not noted the need for a

headset but was able to locate a headset after the panel session began, another had not

tested her headset and had to use another computer workstation in order to use the

headset, and another panel member had not seen the printed requirement for either

resource in her informed consent document. Therefore, communication was inconsistent.

In some cases, panel members could not all see each other. Participants without headsets

were able to connect via cellphone and were able to participate even though questions

had to be repeated by the researcher in order for others to hear them.

Implications

At the very least, study findings from Phase I identify consensus definitions for

elements of P-FTR. Publication of these findings may support the use of standard terms

for P-FTR elements in either paper or electronic nursing documentation. The more

standardization is used, the easier medical records may be to audit, which may increase the utility of P-FTR as a process measurement tool.

Study findings suggest that SNOMED-CT contains the most P-FTR elements and therefore may be the best standard terminology on which to base further research and more defined modeling. SNOMED-CT developers have a process by which researchers may request the addition of concepts and there were P-FTR concepts not present in SNOMED-CT which might be added. Specifically, there was not a concept match for "gestation" as it relates to a single or multiple fetal pregnancy. While most elements of the NICHD defined fetal monitoring terminology were present in SNOMED-CT, the FHR assessment categories I, II, and III were missing. Also, SNOMED-CT does not contain a concept to capture the perinatal nurse's impression of FHM findings as either "reassuring" or "non-reassuring". The concept "tachysystole" to describe contractions which occur too frequently is not present in SNOMED-CT. The previous term for frequent contractions was "uterine hyperstimulation"; this concept should no longer be used (Macones, 2008) but is present in SNOMED-CT and should be archived. Also, values for "contraction strength" in SNOMED-CT include mild, moderate, or strong but the value for contraction measurement in millimeters of mercury (mmHg), which is used with intrauterine pressure catheters, should be included. SNOMED-CT contains a concept to capture cervical dilation but not the concept of "cervical change"; both are required components of the definition of active labor. The concept "modified pushing" is not present in SNOMED-CT and is an important nursing intervention to improve fetal status in the second stage of labor. Finally, no concept is present in SNOMED-CT which captures the transport or transfer of an infant to a higher level of care. If these concepts

were added to SNOMED-CT, the terminology would include all elements of P-FTR and could become the standard for information modeling necessary to incorporate P-FTR into electronic documentation systems.

Recommendations for further research

This study represents a foundation for further research. As previously stated, this study's findings support published criteria for high and low risk maternal and fetal characteristics for labor (Bowers et al, 2008). Now, research is needed to correlate risk categories with corresponding recommended monitoring frequency, along with maternal and fetal outcomes. The frequency of maternal and fetal assessment suggested by AWHONN (Harmon, 2010) and ACOG (2010) has not been substantiated by specific research to support it. Further, there is evidence to date that frequent or continuous electronic fetal monitoring assessment does not yield better patient outcomes (Sakala & Corry, 2008). The frequency of assessment plays a role in perinatal staffing because the more frequently the perinatal nurse must assess maternal and fetal well-being, the more his or her attention must be focused on a single patient. Late in 2010, AWHONN released new perinatal staffing guidelines, recommending a 1:1 nurse to patient ratio for the laboring woman. The guidelines were based on studies outside the scope of perinatal nursing, including Aiken and others (AWHONN, 2010). Research is needed to support or refute the need for frequent electronic assessment in labor, not only as it relates to maternal and fetal outcomes, but also as it relates to perinatal nurse staffing.

From a nursing informatics perspective, the next phase in research using P-FTR and standard nursing terminologies is to construct an information model using the defined elements of P-FTR, as they are found in SNOMED-CT. Once a model is complete, retrospective studies, such as Beaulieu's (2009), could be done. A preliminary research question could be whether all elements can accurately be retrieved from the system, addressing Beaulieu's noted limitation. Next, correlation of careful monitoring, timely identification, appropriate intervention, and activation of a team response could be studied in at least two ways 1) in the case of an unfavorable outcome, to determine if there was "failure to rescue" because of process failure, or missing intervention or, 2) to correlate perinatal nursing interventions (and nursing variables) to corresponding positive patient outcomes. Retrospective testing of P-FTR could also include correlation with nursing variables, such as specialty certification, years of experience, or educational preparation. Such testing would be specific to perinatal nursing and supplement recent work by Kendall-Gallagher, Aiken, Sloane, & Cimiotti (2011) that explored the correlation of nursing variables to inpatient mortality and failure to rescue in surgical patients.

Once retrospective testing of the model is complete, P-FTR research could begin in real-time, with testing of decision-support tools to alert the perinatal nurse that "timely identification" is needed and/or "appropriate intervention" is necessary, reducing the potential for "failure to rescue". Real-time use of P-FTR could modify its purpose as a process measurement tool. Instead, if P-FTR was a real-time tool, and perinatal outcomes were positive, P-FTR would become a process validation tool. If the interventions included in P-FTR were consistently quantified and correlated with outcomes, they could

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be associated with a particular nurse. Then, P-FTR could become a competency validation tool. The combination of P-FTR and nursing informatics research could increase the visibility and validate the perinatal nurse's practice, supporting that it is the perinatal nurse who is ultimately responsible for positive maternal and infant outcomes. This study was just the first step.

Table 1.

Standard Languages Supporting Nursing Practice with ANA Recognition Year

Language	Date
NANDA* Email: nanda@nanda.org Website: www.nanda.org	1992
NIC (Nursing Interventions Classification System) * Website: www.nursing.uiowa.edu/excellence/nursing_knowledge/clinical_effectiveness/index.htm	1992
CCC (Clinical Care Classification™) * **Formerly Home Health Care Classification (HHCC)** Website: www.sabacare.com	1992
Omaha System * Email: martinks@tconl.com Website: www.omahasystem.org	1992
NOC (Nursing Outcomes Classification)* Website: www.nursing.uiowa.edu/excellence/nursing_knowledge/clinical_effectiveness/index.htm (NIC/NOC can be obtained from the same source)	1997
NMMDS (Nursing Management Minimum Data Set) * E-mail: Delaney@umn.edu Website: http://www.nursing.umn.edu/ICNP/USANMMDS/home.html	1998
PNDS (PeriOperative Nursing Data Set) * Email: pnds@aorn.org Website: www.aorn.org or www.aorn.org/PracticeResources/PNDSAndStandardizedPerioperativeRecord	1999
SNOMED- CT® ** Email: clundbe@cap.org Website: www.ihtsdo.org/snomed-ct/	1999
NMDS (Nursing Minimum Data Set) E-mail: Delaney@umn.edu Website : http://www.nursing.umn.edu/ICNP/USANMDS/home.html	1999
ICNP® (International Classification for Nursing Practice) ** E-mail: coenena@uwm.edu Website: http://www.icn.ch/icnp.htm	2000
ABC Codes * Email: Melinna.Giannini@alternativelink.com Web Site: www.abccodes.com	2000
LOINC® (Logical Observation Identifiers Names and Codes) ** Email: susan.matney@utah.edu Web Site: http://loinc.org	2002

American Nurses Association (2010)

* Domain or specialty-specific languages

** Reference or meta-languages (ICNP and SNOMED-CT contain the specialty-specific languages)

Table 2. NICHD Recognized Fetal Heart Monitoring Characteristics

Fetal Heart Rate (FHR) Characteristics		
Baseline FHR *bpm = beats per minute*	110 -160 bpm, rounded to the nearest 5 beats and reported as a single number	< 110 bpm is fetal bradycardia > 160 bpm is fetal tachycardia
Baseline Variability *Fluctuations in the FHR that vary in amplitude and frequency*	**Absent:** Undetectable **Minimal:** >undetectable- ≤5 bpm **Moderate:** 6 to 25 bpm **Marked:** >25 bpm	
FHR Acceleration	Visually apparent, abrupt (onset to peak < 30 seconds) increase in FHR	Accelerations longer than 2 minutes are prolonged, and more than 10 minutes are considered a baseline change.
Early Deceleration	Visually apparent, gradual (onset to nadir ≥30 seconds) decrease and return of the FHR associated with a contraction	Nadir of deceleration simultaneous with the peak of a contraction
Late Deceleration	Visually apparent gradual (onset to nadir ≥30 seconds) decrease and return of the FHR associated with a contraction.	Onset is delayed, nadir occurs after the peak of a contraction
Variable Deceleration	Visually apparent, abrupt (onset to nadir < 30 seconds) decrease in FHR.	May or may not be associated with uterine contractions

Macones et al, 2008

Table 3. High Risk Maternal and Fetal Characteristics

Characteristics Round 1 (%)	Response Count (%) Round 2
Hypertensive Disorders (hypertension, pre-eclampsia) (76%)	27 (100%)
Diabetes (controlled, uncontrolled, insulin drip) (52%)	26 (96%)
Previous cesarean section (49%)	26 (96%)
Multiple Gestation (10%)* (21%)**	24 (89%)**
Less than 37 weeks gestation (21%)* (48%)**	24 (89%)**
Growth restriction (IUGR) or small for gestational age (SGA) (45%)	24 (89%)
Maternal cardiac disorders (14%)	23 (85%)
Abnormal maternal vital signs (17%)	22 (82%)
Vaginal bleeding (suspicious of previa or abruption) (17%)	22 (82%)
Induction/Augmentation of labor with Pitocin (55%)	21 (78%)
Known fetal anomalies (17%)	20 (74%)
Oligo/polyhydramnios (10%)	20 (74%)
Maternal renal disorders (14%)	19 (70%)
Maternal pulmonary disorders (7%)	18 (67%)
Prolonged ruptured membranes (>18 hrs) (10%)	18 (67%)
Maternal auto-immune disorders	17 (63%)
Maternal substance abuse (10%)	17 (63%)
Morbid obesity	15 (56%)
Epidural anesthesia/analgesia (17%)	14 (52%)
Greater than 40 weeks gestation (14%)	9 (33%)
Suspected fetal macrosomia (7%)	7 (26%)
Maternal age greater than 35 years (7%)	5 (19%)

* listed by participants as a maternal characteristic

** listed by participants as a fetal characteristic

Table 4. Low Risk Maternal and Fetal Characteristics

Characteristics Round 1 (%)	Response Count (%) Round 2
Without maternal complications (55%)	**26 (96%)**
> 37-40 weeks (term) gestation **(31%*) (43%**)**	**24 (89%)*** **23 (85%)****
Maternal vital signs within normal limits (21%)	**24 (89%)**
Singleton gestation (14%) **	**23 (85%)****
Negative maternal medical history (49%)	**22 (82%)**
Fetal growth within normal limits (46%)	**22 (82%)**
Received prenatal care (31%)	**21 (78%)**
Vertex presentation (11%)	20 (74%)
Mother without risk factors (11%)	19 (70%)
No known fetal anomalies (18%)	19 (70%)
Amniotic fluid within normal limits (21%)	18 (67%)
Not receiving Pitocin (17%)	17 (63%)
Clear fluid, if membranes are ruptured (14%)	16 (59%)
Spontaneous labor/spontaneous rupture of membranes (41%)	13 (48%)
Without an epidural (17%)	11 (41%)

* listed by participants as a maternal characteristic

** listed by participants as a fetal characteristic

Table 5. High-Risk Maternal and Fetal Concepts

Concept Name	Value	CCC	ICNP	LOINC	SNOMED-CT
Induction of labor	Y		X		X
Augmentation of Labor	Y				X
Gestational age	<37 wks			X	X
Previous cesarean section	Y		X++		X
Vital signs (temp)	> 100 ° F	X	X	X	X
Vital signs (systolic BP)	>140 mmHg	X	X	X	X
Vital signs (diastolic BP)	≥ 90 mmHg	X	X	X	X
Multiple gestation	Y			X	
Fetal Growth	IUGR			X	X
Fetal Growth	SGA				X
Maternal Complications					
Hypertension	Y	X	X	X	X
Preeclampsia	Y				X
Eclampsia	Y				X
Diabetes	Y			X	X
Vaginal bleeding	Y		X		X
Cardiac Disorders	Y		X		X

++ post-coordination required

Table 6. Low-Risk Maternal/Fetal Concepts

Concept Name	Value	CCC	ICNP	LOINC	SNOMED-CT
Complications	No				
Medical history	No				
Prenatal care	Yes				X
Gestational age	> 37-40 wks			X	X
Temperature	Normal				X
Systolic BP	Normal				X
Diastolic BP	Normal				X
Fetal growth	Normal			X	X
Gestation	Singleton			X	

Table 7. Fetal Heart Monitoring Characteristics

Concept Name	Value	CCC	ICNP	LOINC	SNOMED-CT
Fetal Heart Rate (FHR)	110-160bpm*		X	X	X
FHR Bradycardia	<110 bpm		X ++		X
FHR Tachycardia	>160 bpm		X ++		X
FHR Sinusoidal	Y/N				X
Acceleration	Y/N				X
Deceleration (late)	Y/N				X
Deceleration (variable)	Y/N				X
Deceleration (early)					X
Deceleration (prolonged)	Y/N				X
Recurrent **	Y/N				X
Variability	moderate				X
Variability	minimal				X
Variability	marked				X
Variability	absent				X
Category I	Y/N				
Category II	Y/N				
Category III	Y/N				
Impression	Reassuring				X
Impression	Non-reassuring				

bpm = beats per minute

*** recurrent may relate to any or all types of deceleration*

++ = post-coordination required

Table 8. Uterine Monitoring and Labor Characteristics

Concept Name	Value	CCC	ICNP	LOINC	SNOMED-CT
Method	palpation		X ++		X ++
Method	toco				X
Method	IUPC				X
Contraction length	seconds		X ++		X
Contraction frequency	minutes		X ++		X
Contraction strength	mild		X ++		X
Contraction strength	moderate		X ++		X
Contraction strength	strong				X
Contraction strength	mmHg				
Contraction regularity	regular				X
Contraction regularity	irregular				X
Tachysystole	Y/N				
Active Labor Concepts					
Cervical dilatation	cm			X	X
Cervical change	Y/N				

++ = post-coordination required

Table 9. Appropriate Intervention Concepts

Concept Name	Value	CCC	ICNP	LOINC	SNOMED-CT
Turning (repositioning)	Yes	X	X		X
Lateral position	Left	X	X++	X	X
Lateral position	Right	X	X++	X	X
IV Bolus	Yes			X	X
Lactated Ringer's solution	milliliters			X	X
Oxygen	Liters/min	X			X
Prostaglandin	Agent name				X
Oxytocin	milliunits/min				X
Medication stop	Yes	X	X		X
Terbutaline	micrograms				X
Medication administered	Yes	X	X	X	X
Amnioinfusion	milliliters/hour				X
Modified pushing	Yes				

++ post-coordination required

Table 10. Activation of Team Response Concepts

Concept name	Value	CCC	ICNP	LOINC	SNOMED-CT
Provider notification	Y/N	X	X	X	X
Time notified	time		X	X	X
Time arrived	time		X	X	X
Cesarean section called	Y/N		X++		X*
Transfer/transport team notified	Y/N		X		

* refers to emergency cesarean, not decision

Appendix A

Failure to Rescue for Perinatal Care (P-FTR)

Evaluating Appropriate Responses to Clinical Situations based on
AHRQ's (2003) *Failure to Rescue* Patient Safety Indicator (Adapted to Perinatal Care)

Rescue Process for Nonreassuring (Indeterminate / Abnormal) Fetal Heart Rate Patterns					
Rescue Process Components	Yes	No	UTBD	NA	Comments/Additional Descriptions of Processes
Expectations for careful monitoring					Includes characteristics of FHR patterns and uterine activity
For women/fetuses without identified risk factors					
Every 30 min during the active phase of first stage labor					% of 30 min time frames with assessment data
Every 15 min during the active pushing phase of second stage labor					% of 15 min time frames with assessment data
For women/fetuses with identified risk factors					
Every 15 min during the active phase of first stage labor					% of 15 min time frames with assessment data
Every 5 min during the active pushing phase of second stage labor					% of 5 min time frames with assessment data or summary notes q 15 min indicating continuous bedside attendance and assessment during pushing
Score	0			1	2
Timely identification					
Within the timeframe outlined in the expectations for careful monitoring (e.g. q 30 min, 15 min or 5 min based on identified risk factors)					Time:
Accurate interpretation and appreciation of the implications of the clinical data displayed (based on agreement between medical record documentation and fetal monitoring strip)					Time:
Nonreassuring (indeterminate/abnormal) characteristics of the FHR pattern	List characteristics:				
Score	0			1	2

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Failure to Rescue for Perinatal Care (P-FTR)

Rescue Process for Nonreassuring (Indeterminate / Abnormal) Fetal Heart Rate Patterns					
Rescue Process Components	Yes	No	UTBD	NA	Comments/Additional Descriptions of Processes
Appropriate interventions* (Based on the FHR pattern)					See Guide to Intrauterine Resuscitation Measures*
Lateral positioning					Time:
Intravenous fluid bolus of lactated Ringer's solution					Time:
Discontinuation of oxytocin if infusing					Time:
Removing dinoprostone cervical insert if in place					Time:
Withholding scheduled prostaglandin agents such as misoprostol and dinoprostone					
If no resolution after initiating above interventions, oxygen at 10 liters per min per nonrebreather facemask (discontinued as soon as possible based on fetal status)					Time:
Amnioinfusion					Time:
Terbutaline 0.25 milligrams SQ					Time:
If during second stage pushing, (in addition to above interventions as applicable to the clinical situation) modifying pushing efforts e.g. pushing with every other or every third contraction to maintain a stable baseline rate and minimize number of decelerations; If no resolution, maternal rest / passive fetal descent until FHR is reassuring (normal)					Time:
Score	0		1		2

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Failure to Rescue for Perinatal Care (P-FTR)

Rescue Process Components	Yes	No	UTBD	NA	Comments/Additional Descriptions of Processes
Rescue Process for Nonreassuring (Indeterminate / Abnormal) Fetal Heart Rate Patterns					
Roles of perinatal team members / Activation of team response					
Notification of the physician or nurse midwife with accurate information and specific requests for appropriate orders and/or a direct bedside evaluation based on the clinical situation. This notification includes the following: baseline rate, variability, presence of absence of accelerations/decelerations, pattern evolution, clinical associations and urgency.					Time:
Timely response to request to come to the bedside to evaluate maternal-fetal status					Time:
If response from the primary care provider is not timely or appropriate, ongoing efforts to resolve clinical disagreement including notification of other members of the team who are in a position of authority to move the process forward successfully					Time:
Support by physician or nurse midwife for appropriate interventions by other members of the perinatal team (if applicable)					
If cesarean birth is indicated, timely response by members of the surgical team (surgeon, first assistant, scrub technician, anesthesia provider, circulating nurse) and the neonatal resuscitation team (professional whose sole responsibility is to the baby and someone with neonatal intubation skills)					Times: Decision for cesarean birth / Notification of: charge nurse — anesthesia provider / circulating nurse — scrub technician / resident physician — first assistant / neonatal team / Arrival of surgical team in OR — Arrival of patient in OR / Arrival of neonatal team in OR — Incision / Birth
Neonatal resuscitation according to the AHA & AAP guidelines					Time:
If neonatal transfer is indicated, timely notification of the neonatal transport team and accepting facility					Times: Notification of transport team/accepting facility / Arrival of team
Score	0	1	2		

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Appendix A

Failure to Rescue for Perinatal Care (P-FTR)

Key:
*UTBD: Unable to Be Determined From Review of Medical Record/EFM Strip/Conversations with Clinicians
*NA: Non-Applicable
*Nonreassuring (indeterminate/abnormal) fetal heart rate pattern: one or more of the following characteristics (tachycardia or bradycardia, absent/minimal/marked variability, sinusoidal pattern, late, prolonged, recurrent variable decelerations, absence of induced accelerations after fetal stimulation) *based on the individual clinical situation*

	Guide to Intrauterine Resuscitation Measures*	
Clinical Situation and/or FHR Characteristics	Goal	Techniques / Methods
Minimal to absent variability Recurrent late decelerations Recurrent variable decelerations Prolonged decelerations Tachycardia Bradycardia Variable, late or prolonged decelerations occurring with maternal pushing efforts Uterine hyperstimulation/tachysystole (more than 5 contractions in 10 min, contractions lasting 2 min or more, contractions of normal duration occurring within one min of each other)	Promote fetal oxygenation	Lateral positioning (either left or right) Oxygen administration at 10 L/min via nonrebreather facemask (discontinue as soon as possible based on fetal status) IV fluid bolus of approximately 500 mL of lactated Ringer's solution Discontinuation of oxytocin / removal of Cervidil / withholding next dose of Cytotec Modification of pushing efforts; pushing with every other or every third contraction or discontinuation of pushing temporarily (during second stage labor)
Uterine hyperstimulation/tachysystole (more than 5 contractions in 10 min, contractions lasting 2 min or more, contractions of normal duration occurring within one min of each other)	Reduce uterine activity	Discontinuation of oxytocin / removal of Cervidil / withholding next dose of Cytotec IV fluid bolus of approximately 500 mL of lactated Ringer's solution Lateral positioning (either left or right) If no response, terbutaline 0.25 mg subcutaneously may be considered
Recurrent variable decelerations	Alleviate umbilical cord compression	Repositioning Amnioinfusion (during first stage labor) Modification of pushing efforts; pushing with every other or every third contraction or discontinuation of pushing temporarily (during second stage labor)
Maternal hypotension	Correct maternal hypotension	Lateral positioning (either left or right) IV fluid bolus of approximately 500 mL of lactated Ringer's solution If no response, ephedrine 5 mg to 10 mg IV push may be considered

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Appendix B

Statement of Informed Consent (Phase I)

My name is Cathy Ivory and I am a PhD candidate at Vanderbilt University School of Nursing. My advisor is Dr. Betsy Weiner. I am conducting a research study titled *Incorporating Failure to Rescue Elements into Perinatal Electronic Documentation.* You are invited to participate in this research study if you: 1) have worked as a labor and delivery nurse for at least 5 years, 2) have either completed an AWHONN Intermediate FHM course in the last 2 years, are certified in electronic fetal monitoring (C-EFM), or are an AWHONN FHM Instructor, 3) currently practice in an inpatient acute care setting (Level I, II, or III). I would also like to know if you have any experience in perinatal quality improvement work but you may participate if you have not.

This letter explains the research project and the time commitment involved so that you can make a decision whether or not to participate. If you choose to participate, please reply to this e-mail message stating that you agree to participate.

What is the study about?

The purpose of the study is to explore whether elements of a process improvement tool developed by Kathleen Rice Simpson in 2005 exist in a standard nursing terminology and whether the tool can be re-formatted to fit into electronic medical record systems.

What does participation in the study involve?

This is a Delphi study, which means you will be asked to participate in several rounds of a web-based survey about your definition and documentation patterns of the process improvement tool elements, until there is consensus among participants. Each round is

expected to take approximately 30 minutes of your time and study rounds will be

approximately four weeks apart. After round one, survey results will be calculated by me

and the results sent to all participants, who respond to the questions again. Rounds

continue until there is 75% agreement among all participants. There will be a minimum

of two rounds, and a third round is likely. Rounds will be three weeks apart and you will

have two weeks to respond to each round. **It is very important that all participants**

complete each round.

Why am I being asked to participate?

You are being asked because of your expertise in perinatal nursing and your experience

with fetal heart monitoring (FHM). This tool is heavily focused on assessment and action

related to FHM.

Are there risks to participation in the study?

No research is completely risk-free but I do not expect that you will harmed or distressed

by participating. If any part of the study becomes uncomfortable, you may stop your

participation at any time, without consequences.

Are there benefits to participation?

I do not expect any direct benefits to you from participation in this study. However, your

participation may benefit you indirectly by contributing to perinatal nursing knowledge.

Does it cost anything to participate? Will I receive payment?

There is no cost to participate in this study and there will be no payment for participation.

How will my confidentiality be protected?

Your name and identity will be known only to the researcher. Your name and identity

will not be revealed to other participants, or published with the results of this study. Your

e-mail address will not be shared with other participants. The researcher will store data

from the study on an encrypted thumb drive in a locked location. When the data is no

longer needed, it will be destroyed.

By responding to this e-mail letter, you ate saying that you have read this form, that you

understand the risks and benefits of participation in this study, and that you know what is

expected of your participation. If you have any further questions, feel free to contact me

at catherine.h.ivory@vanderbilt.edu.

Appendix C

Statement of Informed Consent (Phase II)

My name is Cathy Ivory and I am a PhD candidate at Vanderbilt University
School of Nursing. My advisor is Dr. Betsy Weiner. I am conducting a research study
titled *Incorporating Failure to Rescue Elements into Perinatal Electronic
Documentation.* You are invited to participate in this research study because of your
expertise in nursing informatics, especially related to standard nursing languages, or your
expertise in perinatal nursing. This letter explains the research project and the time
commitment involved so that you can make a decision whether or not to participate. If
you choose to participate, please reply to this e-mail message, per the instructions below,
stating that you agree to participate.

What is the study about?

The purpose of the study is to explore whether elements of a process improvement tool
(P-FTR) developed by Kathleen Rice Simpson in 2005 exist in a standard nursing
terminology and whether the tool can be re-formatted to fit into electronic medical record
systems.

What does participation in the study involve?

You will be asked to participate on an expert panel to evaluate a proposed terminology
model and the results of cross-mapping of the elements of P-FTR to three identified
ANA-recognized standard nursing languages. It is expected that two 2-hour sessions will
be required. Panel sessions will be held virtually and will require access to a computer
with high-speed internet access, a headset, and a webcam. Two sessions will be held, one

to evaluate the terminology model and one to evaluate the subsequent cross-mapping.

Each session will last no more than two (2) hours.

Why am I being asked to participate?

You are being asked because of your expertise in perinatal nursing and your experience

with fetal heart monitoring (FHM), and/or your experience with informatics nursing.

Are there risks to participation in the study?

No research is completely risk-free but I do not expect that you will harmed or distressed

by participating. If any part of the study becomes uncomfortable, you may stop your

participation at any time, without consequences.

Are there benefits to participation?

I do not expect any direct benefits to you from participation in this study. However, your

participation may benefit you indirectly by contributing to perinatal nursing knowledge,

as well as contributing to nursing informatics research.

Does it cost anything to participate? Will I receive payment?

There is no cost to participate in this study and there will be no payment for participation.

A high-speed internet connection is required as is a webcam and headset. If you do not

have a webcam or headset, they will be provided to you at no charge.

How will my confidentiality be protected?

Your name and identity will be known to the researcher and to other group participants.

Contact information and identification of your specific workplace will remain

confidential unless you choose to reveal such information to the group. Your e-mail

address will not be shared with other participants. The researcher will store data from the

study on an encrypted thumb drive in a locked location. Regulations require the data be stored a minimum of three years. When the data is no longer needed, it will be destroyed. If you would like to participate, please respond by e-mail with the following statement: "*I have read and understand the Statement of Informed Consent and agree to participate.*" By responding to the e-mail containing this Statement of Informed Consent, you are saying that you have read the Statement of Informed Consent, that you understand the risks and benefits of participation in this study, and that you know what is expected of your participation. If you have any further questions, feel free to contact me at catherine.h.ivory@vanderbilt.edu, or 423-737-1299. You may also contact my faculty advisor, Betsy Weiner, at betsy.weiner@vanderbilt.edu, or the Vanderbilt University Institutional Review Board Office at (615) 322-2918 or toll free at (866) 224-8273.

Appendix D

Perinatal Failure to Rescue (P-FTR) Documentation

1. Expectations for Careful Monitoring

This page will contain questions about the first page of P-FTR.

1. Patients WITHOUT identified risk factors should have uterine activity and FHR characteristics assessed every thirty (30) minutes during the active phase of the first stage of labor, and every fifteen (15) minutes during the pushing phase of the second stage of labor. What patients do you consider to be "women/fetuses without identified risk factors" or low risk?

The following women meet the definition of low risk: [_____]

The following fetuses meet the definition of low risk: [_____]

Other: [_____]

2. Patients WITH identified risk factors should have uterine activity and FHR characteristics assessed every fifteen (15) minutes during the active phase of the first stage of labor, and every five (5) minutes during the pushing phase of the second stage of labor. What patients do you consider to be "women/fetuses WITH identified risk factors" or high risk?

The following women meet the definition of high risk during the FIRST stage of labor: [_____]

The following fetuses meet the definition of high risk during the FIRST stage of labor: [_____]

The following women meet the definition of high risk during the SECOND stage of labor: [_____]

The following fetuses meet the definition of high risk during the SECOND stage of labor: [_____]

Other: [_____]

3. How do you define "the active phase of first stage labor"?

[_____]

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