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Mapping Perinatal Nursing Process Measurement Concepts to Standard Terminologies

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Abstract

The use of standard terminologies is an essential component for employing data to inform practice and conduct research; perinatal nursing data standardization is needed. This study explored whether 76 distinct process elements important for perinatal nursing were present in four American Nurses Association (ANA)-recognized standard terminologies. The 76 process elements were taken from a valid paper-based perinatal nursing process measurement tool. Using terminology -supported browsers, the elements were manually mapped to the selected terminologies by the researcher. A five-member expert panel validated 100% of the mapping findings. The majority of the process elements (n=63, 83%) were present in SNOMED CT, (n=21, 28%) in LOINC, (n=26, 34%) in ICNP, and (n=11, 15%) in CCC. SNOMED CT and LOINC are terminologies currently recommended for use to facilitate interoperability in the capture of assessment and problem data in certified electronic medical records. Study results suggest that SNOMED CT and LOINC contain perinatal nursing process elements and are useful standard terminologies to support perinatal nursing practice in electronic health records. Terminology mapping is the first step toward incorporating traditional paper-based tools into electronic systems.

Keywords

nursing informatics; standard terminology; perinatal nursing; SNOMED CT; LOINC; ICNP; CCC

Nurses interact with data every day. Since the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act authorized the Centers for Medicare & Medicaid Services (CMS) to offer financial incentives for the adoption of electronic documentation systems that demonstrate “meaningful use” of healthcare technology (health IT), over 85 percent of eligible hospitals now participate in the incentive program and over 75 percent of those participating have received payment for implementing systems^{1, 2}. With electronic data capture now commonplace, the amount of data collected and stored is staggering. However, the process of retrieving data, translating data into useful information and generating knowledge from that information is cumbersome and resource intensive.

Nurses are essential for patient care and the first line of defense in terms of medical error prevention³. For nursing across specialties, quality measures, such as patient falls and pressure ulcers, are categorized as “nurse-sensitive,” meaning they may be influenced by nursing care. However, the specifics related to nursing surveillance and individualized interventions remain underrepresented in previous research associated with outcomes, efficiency, efficacy, and patient safety^{3, 4}.

Perinatal nurses provide the primary care for women throughout the labor and birth process; their decisions have substantial impact upon outcomes for mothers and babies. Surveillance-continually acquiring, interpreting and making decisions based upon patient data⁵- is a key perinatal nursing function. Making decisions based on data is challenging for the perinatal nurse. Perinatal nursing surveillance includes monitoring fetal heart rate (FHR) characteristics and maternal uterine activity, which are captured and archived by electronic fetal heart monitoring (FHM) systems. However, nursing assessment of electronic FHM data and uterine activity, and decisions made based on such assessment data, including associated nursing interventions, may be documented in a HIT system separate from the FHM system, along with other important data such as physical assessment findings, maternal coping with labor, and vital signs. Adding further complexity, additional data necessary for perinatal nursing decision-making is the woman's prenatal record, containing historical data about her pregnancy that contributes to nursing decisions. Rarely is prenatal data integrated with inpatient EHRs, requiring the perinatal nurse to access these data separately. Like other nursing specialties, little emphasis has been placed on the adoption of standards to improve perinatal nursing data interoperability, limiting its use for decision support, data benchmarking, or research.

Nursing data standardization is facilitated by the use of standard terminologies that support nursing practice; twelve terminologies are recognized by the American Nurses Association (ANA)⁶. Benefits of using a standard terminology for nursing include better data capture among nursing providers, along with increased nursing visibility, competency assessment, and adherence to nursing standards⁷. While the use of standard terminologies for electronic nursing documentation is improving and national standards for certification of electronic health records recommend them², no standard terminologies that support nursing practice are yet widely deployed in hospital EHRs. For perinatal nurses, the lack of standardization at the very least contributes to documentation burden and also results in EHR data being less useful for real-time decision making, or for practice comparison across settings.

Therefore, assessment and improvement of perinatal nursing care processes remains a retrospective, manual process, using primarily paper-based tools. One example of a nursing care process measurement tool is the failure to rescue process assessment tool, adapted specifically for perinatal care (P-FTR) by Kathleen Rice-Simpson⁸. Figure 1 graphically depicts the investigator's interpretation of P-FTR.

Two key components of failure to rescue are 1) evidence-based surveillance/monitoring with recognition of problems, should they occur and 2) appropriate intervention for problems, which can include mobilization of a care team or transfer to a higher level of care⁸. Data elements of P-FTR include elements captured by electronic fetal monitoring systems and nursing assessment, as well as common interventions initiated by perinatal nurses when maternal or fetal status warrants. This paper describes a study in which elements of P-FTR were mapped to ANA recognized standard terminologies to identify which elements were present or missing. Providing the corresponding terminology codes for P-FTR elements is a first step toward their use in information models to facilitate interoperability and real-time decision making.

PURPOSE

The purpose of this study was to determine which P-FTR data elements were present in selected ANA recognized standard terminologies. Focusing on the elements of P-FTR illustrates the ability of adapting paper-based tools, like P-FTR, into an electronic format to facilitate interoperability and real-time, specialty-specific process assessment. It is the first known study to explore standardization of data used for perinatal nursing process assessment.

BACKGROUND

P-FTR was developed to retrospectively assess nursing care provided during labor and birth by auditing medical records⁸. By identifying process deficiencies using P-FTR, measures may be undertaken to improve them. The concept of failure to rescue originated in the surgical population, with failure to rescue being defined as unexpected complications or death following surgery⁹, that were preventable. As previously described, P-FTR examines processes within two care domains: 1) careful monitoring (surveillance) of mother and fetus, along with the timely identification of problems, and 2) intervention when suitable which may include team mobilization to facilitate a cesarean birth or transfer of a mother/baby to a more critical care level⁸. Timely cesarean birth and/or transfer to a higher level of care correspond to the concept of “rescue” for this population. Figure 1 graphically depicts P-FTR.

An early example of research using P-FTR identified the inability to locate many of the data elements in the medical record as a disadvantage^{3, 10}, which led to the selection of P-FTR for this study. Using standards to incorporate P-FTR elements into EHRs could reduce the number of missing data elements.

When tools such as P-FTR are used for retrospective medical record review at individual facilities, the facility’s auditors have knowledge of words and phrases nurses use to document the data elements in their specific care setting; but facility-specific documentation may not translate across settings. Therefore, standard definitions for P-FTR data elements were necessary and were identified previously, using consensus methods¹¹. Consensus, defined as 75% agreement by a panel of 29 expert perinatal nurses, was achieved for definitions of 76 distinct P-FTR elements¹¹. The study was conducted in 2011 and was reviewed and approved by the Institutional Review Board (IRB) at Vanderbilt University.

Standard Terminologies

Four terminologies recognized by the ANA as supporting nursing practice were selected for this study, the Clinical Care Classification (CCC)¹², clinical LOINC¹³, ICNP¹⁴ and SNOMED CT¹⁵. Terminology selection was based on published examples suggesting the usefulness of the terminologies for nursing practice or because the terminology was suggested for use by national health IT initiatives. Additionally, each of the four selected terminologies was available at no cost to the researcher, had a defined semantic structure, and provided mapping resources, such as specific browsers or concept dictionaries.

Since this study was conducted in 2011, additional recommendations have been published that clarify specific purposes for LOINC and SNOMED CT as tools to facilitate interoperability¹⁶. In particular, LOINC is recommended for coding of assessment related elements and SNOMED CT is recommended for clinical problems/findings and intervention related elements¹⁷. Using LOINC and SNOMED CT allows alignment with Health Level 7 (HL7) interoperability frameworks that are now required to be used for data exchange¹⁷. Therefore, although all results are reported, this paper places particular emphasis on P-FTR elements that are present (or missing) from LOINC and SNOMED CT.

METHODS

Mapping Process

Using Excel (Microsoft, Redmond, WA) software, the 76 distinct P-FTR elements were arranged in workbooks for each area of P-FTR focus: 1) Careful Monitoring (Surveillance)/ Identification of Problems (58 elements), 2) Interventions (13 elements), and 3) Activation of a Team Response (5 elements)³. The workbooks were organized with separate spreadsheets for each terminology (CCC, ICNP®, LOINC, and SNOMED-CT)³. Mapping was done solely by the investigator, utilizing whichever search strategy (manual or electronic) the particular terminology employed. Mapping of P-FTR elements using exact words or phrases was attempted; however, post-coordination for some concepts was necessary³. Post-coordination involves combining individual data elements in order to convey the desired meaning and it is a viable approach when individual concepts cannot convey the desired meaning/context¹⁸. When post-coordination was employed, the existing semantic structure of the terminology was maintained³.

Expert Panel Validation

Once mapping was complete, a five-member expert panel was convened and met virtually to validate the results. Experts were sought who understood both the clinical (perinatal) content as well as the standard terminologies in question. Because the panel members met virtually, internet access was required of each panel member. To facilitate engagement and discussion, panel members were required to have a webcam and a headset with microphone; these were provided to panel members upon request at no charge. Expert panel sessions were conducted using a video conferencing option available to the investigator.

Panel members included: 1) a perinatal nurse who participated in the initial phase of this research (the standard definition development) and also had prior experience working with a perinatal electronic system vendor, 2) a senior health IT consultant with clinical experience in perinatal nursing, 3) a nursing terminology scientist, 4) the author of P-FTR, and 5) a clinical informatics consultant with expertise both as a perinatal nurse and with standard terminologies. Once panel members consented to participate, and one week before virtual meetings, each expert panel member received electronic copies of the Excel workbooks containing P-FTR mapping results by e-mail. Due to busy schedules among the expert panel members, a single validation session was not possible. Two virtual expert panel sessions were held; each session included at least one perinatal nursing expert, one terminology expert, and the investigator. Each validation session lasted approximately two hours; each

expert attended only one session. During the validation sessions, panel members reviewed and discussed each list of data elements and the corresponding mapping results. Experts were specifically asked to validate the accuracy of the mapping for each terminology and whether mapping findings captured the intended context of the data elements, especially if post-coordination was necessary.

RESULTS

Mapping Results

There were a total of 76 separate P-FTR concepts included for mapping. Tables 1–3 illustrate the individual concepts and the terminologies to which they could be mapped. In terms of the three P-FTR domains, Careful Monitoring (surveillance)/Timely Identification contained 58 concepts; of these, 25 concepts relate to maternal or fetal risk (Table 1.) and 33 relate to maternal-fetal assessment (Table 2.) Thirteen concepts related to interventions and five concepts were associated with mobilizing a team (Table 3.). 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).

Expert Panel Validation

Panel members validated 100% of concept mapping findings, without exception. Experts validated the mapping findings for individual data elements, as well as those which required post-coordination.

Results demonstrate that perinatal nursing process concepts are present in recommended standard terminologies. This study is one of the first to explore the usefulness of standard terminologies to support perinatal nursing care processes and outcomes.

DISCUSSION

Findings from this 2011 study contribute a specialty nursing perspective to current nursing standardization efforts and support standardization recommendations made by the Office of the National Coordinator (ONC)¹⁹. Since this study was completed, additional examples of how standard terminologies can be used for nursing have been published and nursing informatics experts are working to increase nursing content and nursing value sets in standard terminologies^{20, 2122}. Therefore, it is important to discuss these study findings in the context of the current state of health IT and standard terminologies for nursing, with particular emphasis on LOINC and SNOMED CT.

LOINC

Twenty-one P-FTR elements (28%) were present in LOINC; these elements included gestational age, fetal heart rate, multiple gestation and fetal growth (see Table 1). These same concepts are elements included in the documentation of an obstetric ultrasound. Given that LOINC originated as a terminology for diagnostic and laboratory testing, study findings are not surprising²³. Since this study was done in 2011, LOINC has been recommended as the optimal terminology for nursing assessment related concepts². Nurse informaticists are

working to include assessment scales such as those for assessment of pressure ulcer risk, patient falls, and newborn screening to LOINC¹³. The nursing management minimum data set (NMMDS) is now mapped to LOINC, supporting assessment of nursing elements related to cost and staffing²⁴. Recently -published literature demonstrates the feasibility of mapping nursing assessments from community settings²⁵ and from 59 military hospitals²⁶ to LOINC.

P-FTR contains more than 50 data elements (see Tables 1 and 2) related to maternal and fetal assessment, but only two elements, fetal heart rate and cervical dilatation, were present in LOINC. LOINC has a defined process for requesting the addition of new data elements and recommends grouping individual elements with a common purpose into panels. Examples of panels include grouping the various data elements tested in a complete metabolic profile, and the data elements included to assess pressure ulcer risk. For P-FTR, panels would be appropriate for the data elements describing fetal assessment, beginning with fetal heart rate (FHR) already present in LOINC, along with FHR accelerations, FHR decelerations, and FHR variability, along with the assessment method (EFM or auscultation) (see Table 2). Similarly, another panel would describe uterine assessment data elements such as contraction frequency, contraction length, contraction strength, and uterine resting tone, along with assessment method (tocodynamometer or palpation) (see Table 2). During labor, complete assessment by the nurse includes both fetal and uterine parameters but fetal assessment may occur separately from uterine assessment in some circumstances, so two panels are preferred. A third panel may be appropriate for labor assessment and would include contraction regularity, cervical effacement, cervical dilatation (present in LOINC) and cervical change (see Table 2).

SNOMED CT

Eighty-three percent (n-63) of P-FTR concepts were found in SNOMED CT, including the majority of concepts related to electronic fetal and maternal assessment (see Table 2), which were not present in the other three terminologies. Study findings illustrate that SNOMED CT contains the most data elements which map directly to data elements included in P-FTR. As a reference terminology, SNOMED CT provides significant granularity to the individual data elements.

SNOMED CT is the terminology required by the International Health Terminology Standards Development Organization (IHTSDO) to facilitate interoperability between Health IT systems, specifically for clinical problems². SNOMED CT is also suggested to be used in tandem with LOINC for sharing data across systems using HL7 models, LOINC for assessment related data elements (questions) and SNOMED CT for the corresponding values (answers)²⁷.

In keeping with these recommendations, assessment panels containing P-FTR data elements are appropriate for LOINC and were just described; the corresponding values associated with the assessment elements are present in SNOMED CT. For example, the data element *FHR variability* would be included in a fetal assessment panel in LOINC, but corresponding findings associated with variability (minimal, moderate, marked) would remain coded to SNOMED CT (see Table 2). Further, data elements associated with maternal and fetal risk,

from which frequency of maternal and fetal assessment is based, are present in SNOMED CT (see Table 1).

This study contributes perinatal specialty-specific problem elements, supporting the IHTSDO's emphasis on using SNOMED CT for nursing problems and adding to the existing nursing problem list already present in SNOMED CT²⁰. The interventions associated with P-FTR are also present in SNOMED CT. In some cases, post-coordination was necessary to capture the correct meaning of the element. For example, a common intervention when FHR findings are not normal is to reposition (turn) the woman to her side (lateral), with the left side recommended. In order to capture the intent of the element, the SNOMED CT code for lateral position was combined with right and left, along with a separate code for the procedure of repositioning (see Table 3). This post-coordination example illustrates that in some cases, several distinct (granular) data elements must be combined to illustrate a particular concept. Granularity has advantages in that each individual code may be queried separately but granularity may have disadvantages as well if individual elements are incorrectly associated or defined differently. An example from this study where definition became an issue was with the data element *reassuring* and its antonym, *non-reassuring* (see Table 3), words perinatal nurses may use to describe their impression of maternal or fetal status during labor. In SNOMED CT, *non-reassuring* was not present at all; reassuring was present but the definition was incorrect. In SNOMED CT, the current concept *reassuring* is a procedure, referring to the act of reassuring a patient or family member. For P-FTR, *reassuring* is a finding. Results from this study support other recently published evaluations of SNOMED CT, suggesting that further study is needed regarding definitions and structure²⁸, and highlighting the frequency of modeling errors in current SNOMED CT problem lists²⁹.

CCC

Only eleven discreet P-FTR concepts were found in CCC and of those, seven were intervention-related concepts (see Table 3); the other four were assessment findings (see Table 1). Since CCC is a terminology organized around the nursing process¹², the fact that discreet data elements were absent from CCC was not surprising. However, the CCC care component "safety" contains care concepts of "childbirth risk" and "labor risk"¹², which are applicable to the risk categories on which maternal and fetal assessment are organized in P-FTR. Therefore, as informatics researchers have suggested³⁰, the CCC may be valuable as an information model to which discreet P-FTR data elements may be organized into broader nursing care process domains. Such an approach has been successful in settings where CCC is deployed, allowing for the quantification of "basic nursing care".³¹ Findings from this study contribute nursing care concepts from the perinatal nursing specialty which could similarly be used to describe "specialty nursing care" in this domain.

ICNP

Twenty-six of the 76 P-FTR (34%) were present in the ICNP. Notably, most concepts related to electronic fetal heart monitoring (EFM) (see Table 2) were not present in ICNP, supporting the differences between nursing care processes for laboring women in the United States compared to other countries. EFM is a common intervention in U.S. hospitals for

maternal and fetal assessment in labor, whereas other countries outside the U.S. routinely assess women in labor using intermittent fetal heart rate auscultation and abdominal palpation.

Recent publications support the usefulness of ICNP to support perinatal nursing care processes internationally³² as well as generic nursing concepts.³³ Cross mapping work has also been done recently, correlating nursing concepts in ICNP to other terminologies, such as SNOMED CT.^{34,35, 36} As perinatal nursing care processes are mapped to standard terminologies, ICNP can be used in conjunction with other terminologies and can contribute coding of granular concepts as part of a broader nursing information model.³⁰ Mapping to ICNP when possible also permits data sharing and quantification of the nursing process outside the U.S. healthcare system.

Missing Data Elements

Some P-FTR data elements were missing all together and at least one, the data element *reassuring*, was not in the correct context for P-FTR. One missing element, *tachysystole*, the presence of more than five uterine contractions in a 10 minute period, averaged over 30 minutes, replaces a similar data element “hyperstimulation”, which was present in SNOMED CT but is no longer recommended for use to describe uterine activity³⁷. This difference is an example of the need for specialty expertise and updating of terminologies as evidence warrants. A request will be made to add the term tachysystole, and its definition, to SNOMED CT as a finding.

Each terminology has procedures for requesting data elements. Given current recommendations for emphasis on the use of SNOMED CT and LOINC, requests to add missing P-FTR elements will be made.

LIMITATIONS

There are notable limitations in this study. One limitation is that only four ANA recognized terminologies were included in this analysis. The four terminologies included in this study were selected based on previously published examples of their usefulness for nursing. Since the study was conducted, recommendations for the use of SNOMED CT and LOINC have been published so results from this study contribute specialty perspective to existing work underway with both terminologies. Other terminologies may be useful to describe perinatal nursing and should be considered in further work.

Another limitation is that this study mapped only 76 data elements, based on one process measurement tool. However, limits were necessary in order to sharpen the research focus and to provide a foundation for the data modeling necessary for incorporating P-FTR into EHRs. Future work should focus on other perinatal nursing data elements, such as those included in perinatal nursing care quality measurement³⁸, maternal early warning systems³⁹, or triage in labor and delivery settings⁴⁰, among others.

RECOMMENDATIONS

Perinatal nursing care process concepts contained within P-FTR are present in standard terminologies, many in LOINC and SNOMED CT. Using standard terminologies facilitates semantic interoperability, and models based on standards and incorporated into EHRs can promote real-time decision making by capturing and organizing information without compromising the nurse's workflow.

Study findings support the feasibility for an information model containing mapped P-FTR elements to be created and tested in an electronic documentation system. Prior examples of research regarding the suitability of standard nursing terminologies, notably LOINC^{23, 41, 42}, ICNP^{43, 44}, and SNOMED-CT to support nursing documentation⁴⁵ or conduct clinical research⁴⁶, represent instances from nursing specialties are noted; other examples are included elsewhere in this paper. This study represents a first example of mapping concepts used by perinatal nurses to recommended terminologies. Current recommendations for the use of SNOMED CT to code clinical problems, and using LOINC for assessments, suggest that problem-and assessment- related concepts in P-FTR should focus on SNOMED CT and LOINC. Findings from this study and other research suggest that the CCC could provide a framework upon which a model for P-FTR could be developed, using more than one terminology.³⁰ ICNP may be valuable for cross-mapping across terminologies for data sharing outside the U.S.

Initial testing should first assess whether P-FTR elements can reliably be retrieved through EHR queries. One can hypothesize that electronic retrieval will provide more complete audit results, but such a hypothesis must be tested. Once reliability is assured, queries of each P-FTR domain, such as 1) careful monitoring/surveillance and timely identification of problems, 2) appropriate intervention, and 3) activation of a team response, can be tested in at least two ways. First, in the case of an unfavorable outcome, to determine if "failure to rescue" existed by querying the current, rather than the closed medical record. Such a query would provide assessment of process successes, or failures, nearer to real time and could speed process improvement. Second, testing the correlation of perinatal nursing interventions included in P-FTR to corresponding patient outcomes would be possible. The fact that P-FTR interventions are coded individually allows them to be individually correlated to outcomes, quantitatively supporting (or perhaps refuting) current evidence. Further, P-FTR elements could be associated with nursing practice variables, such as specialty certification, years of experience, or educational preparation. The testing of such associations would be specific to perinatal nursing and supplement recent work that explores the correlation of nursing variables to inpatient mortality and failure to rescue in surgical patients⁴⁷.

Of course, the goal of incorporating tools like P-FTR into electronic systems is research related to the potential benefits of real-time process assessment. Decision-support tools to alert the perinatal nurse that "timely identification" is needed and/or "appropriate intervention" is necessary, thereby reducing the potential for "failure to rescue," should be developed and tested. No decision support tool should disrupt the nurse's workflow, increase documentation burden, or decrease time with the patient; all these variables should be tested.

Real-time use of tools like P-FTR could modify the tool's purpose from a process measurement tool to a process validation tool. If interventions included in P-FTR were consistently quantified and correlated with outcomes, and the interventions could be attributed to a particular nurse as well as a particular patient, tools like P-FTR become competency assessment tools.

The combination of tools like P-FTR incorporated into electronic systems, and ongoing nursing informatics research could increase the visibility of and validate the perinatal nurse's practice, highlighting the perinatal nurse's distinct contribution to maternal and infant outcomes. This study was a first step toward quantifying some perinatal nursing activities with the overall goal to measure the relationship between perinatal nursing care and outcomes for women and newborns. This paper describes a process that can be replicated by others and offers suggestions for subsequent steps.

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Figure 1.

Perinatal Failure to Rescue (P-FTR) Process Measurement

Adapted by the author from Simpson KR. Failure to rescue: Implications for evaluating quality of care during labor and birth. *J Perinat Neonatal Nurs.* Jan-Mar 2005;19(1):24-34; quiz 35-26.

Table 1

Risk Assessment/Surveillance Elements

	Concept Name	Value	SNOMED-CT	LOINC	ICNP	CCC
High-Risk Maternal & Fetal Concepts	Induction of labor	Yes	X		X	
	Augmentation of Labor	Yes	X			
	Gestational age	<37 wks	X	X		
	Previous cesarean section	Yes	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	Yes		X		
	Fetal Growth	IUGR	X	X		
	Fetal Growth	SGA	X			
Maternal Complications	Hypertension	Yes	X	X	X	X
	Preeclampsia	Yes	X			
	Eclampsia	Yes	X			
	Diabetes	Yes	X	X		
	Vaginal bleeding	Yes	X		X	
	Cardiac Disorders	Yes	X		X	
	Complications	No (None)				
	Medical History	No (Neg)				
Low-Risk Maternal & Fetal Concepts	Prenatal Care	Yes	X			
	Gestational Age	>37–40 weeks	X	X		
	Temperature	Normal	X			
	Systolic BP	Normal	X			
	Diastolic BP	Normal	X			
	Fetal Growth	Normal	X	X		
	Gestation	Singelton		X		

Table 2

Monitoring/Surveillance Elements

	<i>Concept Name</i>	<i>Value</i>	<i>SNOMED-CT</i>	<i>LOINC</i>	<i>ICNP</i>	<i>CCC</i>
Fetal Heart Rate (FHR) Assessment Concepts	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)	Y/N	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				
Uterine Monitoring & Labor Elements	Category II	Y/N				
	Category III	Y/N				
	Impression	Reassuring	X			
	Impression	Non-reassuring				
	<i>Concept Name</i>	<i>Value</i>	<i>SNOMED-CT</i>	<i>LOINC</i>	<i>ICNP</i>	<i>CCC</i>
	Method	palpation	X ++		X ++	
	Method	toco	X			
	Method	IUPC	X			
	Contraction length	seconds	X		X ++	

recurrent may relate to any or all types of deceleration

++ = post-coordination required

Table 3

Intervention Elements

Concept Name	Value	SNOMED-CT	LOINC	ICNP	CCC
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
Amniotinfusion	milliliters/hour	X			
Modified pushing	Yes				
Team Mobilization/Transfer					
Concept Name	Value	SNOMED-CT	LOINC	ICNP	CCC
Provider notification	Y/N	X	X	X	X
Time notified	time	X	X	X	
Time arrived	time	X	X	X	

Ivory

	X					Y/N	Transfer/transport team notified
X ⁺⁺			X [*]			Y/N	Cesarean section called

* refers to emergency cesarean, not decision
++ post-coordination necessary

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