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A Clinical Evaluation of Evidence-Based Maternity Care Using the Optimality Index

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The Optimality Index-US (*OI-US*) reflects the use of evidence-based practices in obstetrics. This paper's objective is to apply the *OI-US* to a "typical" nurse-midwifery service data set to demonstrate its use outside of a research context. The *OI-US* score for the sample practice was 80%. The *OI-US* can be used by obstetric and gynecologic nurse clinicians to demonstrate the relationship of various care practices to optimal outcomes. *JOGNN, 35,* 786-793; 2006. DOI: 10.1111/J.1552-6909.2006.00107.x

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The goal of maternity nursing practice in the United States has always been the promotion of optimal birth outcomes for childbearing women, their newborns, and their families. While there is wide variation in care practices, there is consensus that the biomedical focus is on the physical health of the mother and her newborn. There is less congruence regarding what should be done by nurses to optimize the process of giving birth. The care practices of nurse clinicians have varied greatly, depending on the birth environment, the health condition of the mother and her fetus prior to birth, the multidimensional aspects of the labor process, the type and outcome of the birth, and the health of the newborn.

Variations in care practices for childbearing women and their newborns may contribute to significant health disparities in the United States. On an international level, the United States ranks 25th when compared to other developed countries in infant mortality and 21st in maternal mortality [Centers for Disease Control (CDC), 1999], while countries that either have universal health care coverage or use midwives as the primary childbirth health care providers have the lowest rates, suggesting that models of care do have an effect on biomedical health outcomes.

Models of care during childbearing are ideally rooted in the scientific literature that links quality of care with evidence to support that care. However, the outcomes typically measured in maternity care are limited to morbidity and mortality outcomes for women and their newborns and do not encompass the full range of birth experiences or focus on optimal wellness of both mother and infant. The ability to measure care practices that promote optimal wellness has been hampered by a lack of appropriate measurement instruments.

Robust measures of perinatal care outcomes need to include the wide range of wellness-focused practices that are supported by the highest level of scientific evidence as well as biomedical outcomes. The *Optimality Index-US* (*OI-US*) is a measurement tool that helps to fill that gap (Murphy & Fullerton, 2001). The tool and its historic use in research are fully detailed in a companion article in this clinical series (Murphy & Fullerton, 2006). The purpose of this article is to describe the value of using the *OI-US* in maternity and neonatal care practices and to provide an example of how the tool can be used to explore the relationship of various care practices to optimal outcomes. For example, is fetal monitoring used routinely, or is its use consistent with its evidence-based recommendations in risk-based circumstances? A nurse-midwifery practice based in a tertiary care environment was used as a prototype to demonstrate how the *OI-US* can be used in practice.

Literature Review

The Importance of Evidence-Based Care

Linking care practices with scientific evidence is not a new concept. In fact, since the later 1990s, there has been an increase in calls for evidence-based care to become the standard for obstetric and perinatal health care professionals (American College of Nurse-Midwives (ACNM), 1998; Association of Women's Health, Obstetric and Neonatal Nurses, 2005; Grimes, 1995).

The demand to link care practices during childbirth to scientific evidence also has moved into the consumer arena. The Maternity Center Association's (MCA, 2002) "Listening to Mothers" survey demonstrated that technology-intensive labor is the common experience for a majority of women in the United States, despite a lack of evidence supporting the value of technology in promoting the best health outcomes. A majority of survey participants reported having the following physically invasive interventions while giving birth: electronic fetal monitoring (93%), intravenous (IV) hydration (86%), epidural analgesia (63%), artificially ruptured membranes (55%), pitocin augmentation of labor (53%), bladder catheterization (52%), and suturing to repair an episiotomy or laceration (52%). Although such interventions are incongruent with evidence-based care without a specific indication based on a risk profile, the rates reported by the MCA survey far exceed those projected by the World Health Organization (WHO) as expected rates, based on risk profile alone (WHO, 1997).

The Listening to Mothers survey demonstrated that many care practices not supported as efficacious by the scientific literature are routinely used during perinatal care for healthy women (MCA, 2002). Consumer groups used findings like these to advocate for less technologic approaches to maternity care, joining the professional organizations in their call for greater congruence of care with less technologically oriented evidence-based practice and increased options for childbearing women (Coalition for Improving Maternity Services, 1996; Sakala, Gyte, Henderson, Neilson, & Horey, 2001).

Measuring Evidence-Eased Care

The complexity of assessing outcomes of the childbearing process for women and their families is discussed throughout the perinatal nursing literature (Albers, 2001; Kardong-Edgren, 2001; Kennedy & Lowe, 2001). While there is general agreement regarding the measurement of biomedical outcomes, such as low birthweight, prematurity, Apgar scores, and route of delivery, there has been less consensus regarding an assessment of the quality of care practices and linkage to quantifiable outcomes underlying evidence-based care. Instead, philosophical debates have emerged about the role of care practices and whether or not the actual practices, interventions, and processes of care, even if not evidence based, were as important as the outcomes of the care provided (Hannah, 1999).

The *OI-US* (Murphy & Fullerton, 2006) combines optimal processes of care that are grounded in scientific evidence with standard biomedical health outcomes. Optimality is conceptualized as the best possible outcome in a given context. The *OI-US* captures the complexity of the process of the childbearing experience, including maternal background characteristics, processes of care, and biomedical outcomes, in a single index. It is far more sensitive to smaller differences in perinatal outcomes than are biomedical measures of major problems, such as low birthweight, prematurity, and maternal or infant morbidity and mortality. This makes it a useful measure to distinguish differences in outcomes even among populations at low risk.

The *OI-US* score includes two parts: a *Perinatal Background Index* (*PBI*) (demographic, medical, and obstetric history factors) and a combined measure of antepartum, intrapartum, neonatal, and postpartum care practices and health outcomes, the *Optimality Index* (*OI*) (Murphy & Fullerton, 2006). The total *OI-US* comprises 54 items (*PBI* = 14 items, *OI* = 40 items). Each item is coded as either "optimal" or "not optimal." Each optimal item receives a score of 1, and then the items are summed for a total score. The score is then presented as a proportion of items coded as optimal out of the total number of possible items. It serves as a global assessment of the "optimality" of processes and outcomes of maternity care.

Value of Measuring Optimality in Nursing Practice

Why should the *OI-US* be of interest to obstetric and neonatal nurses? First, the instrument is rooted in evidence-based practice congruent with the goal of professional nursing organizations to promote the use of evidence to guide clinical practice and health policy. Second, many of the care practices that contribute to optimal outcomes are within the nursing domain and can be implemented during nursing management of perinatal care. Thus, the *OI-US* reflects many best practice aspects that are usually absent from other indexes or measures of perinatal care outcomes. The *OI-US* provides nurses with the means to demonstrate the contribution of nursing care in positively influencing health outcomes of childbearing women and their newborns.

The *OI-US* was used to evaluate the match between actual practices and evidence-based optimal care, using data gathered "in the trenches" of the clinical setting.

The *OI-US* was used to analyze a typical hospital-based nurse-midwifery service data set to evaluate the applicability of the *OI-US* in a tertiary care setting outside of a research context. The *OI-US* was used to evaluate the match between actual practices and evidence-based optimal care, using data gathered "in the trenches" of the clinical setting. If the *OI-US* can be used to evaluate care practices with routinely collected data from a clinical nurse-midwifery service, nurses may be able to apply it within other clinical arenas.

Evaluation Methods

Data Source

This evaluation study was a secondary analysis of an archived version of the clinical database maintained by a nurse-midwifery service in a university-based tertiary care setting. The nurse-midwifery service data collection tool was modeled after the ACNM's minimum clinical data set for antepartum, intrapartum, neonatal, and postpartum care (Greener, 1991). Data forms were completed by the Certified Nurse Midwives (CNMs) who attended the woman in labor. Data were recorded for all women admitted to the service, even if their risk status changed and they were comanaged with or transferred to physician care. Completed data forms were entered into a customized D-Base data program. The first author (L.K.L.) is a member of the midwifery practice that conducted the data collection.

The database contained information on 4,788 women who were clients of the nurse-midwifery service from 1987 to 1999. The clients were demographically diverse and were admitted to the midwifery service only if they were at low to moderate risk at the start of pregnancy. The database contained information about patient demographics and risk factors, as well as prenatal, intrapartum, postpartum, and neonatal interventions and outcomes. No contact was made with any patients, and no comparisons were made between the data in the database and the medical record. Any identifying information was removed from the database. The specific demographic data for this study were thus censored in compliance with Health Insurance Portability and Accountability (HIPAA) requirements protecting identifying information from disclosure for research purposes.

An *OI-US* score was created for each case in the database. To prepare the data set for analysis using the *OI-US*, the items that were regularly collected with the clinical data tool were compared to the items contained in the *OI-US*. In addition, 116 pages of narrative comments on risk factors were compiled from the database.

Managing Missing Data

In data collection for research, missing data are less common because the data are often collected directly from the events being studied, using instruments developed for that purpose. In this instance, the data were collected for clinical record keeping prior to the development of the *OI-US*. In addition, the data collection process was part of the routine work of a number of midwives doing clinical practice with the group, and forms were not always fully completed. Thirty-seven of the 54 *OI-US* items were found to be regularly collected within the nurse-midwifery clinical database. The list of items not available for use in the analysis out of the 54 items of the *OI-US* is provided in Table 1. This moderately high proportion of missing data is a realistic test of the utility of the index when it is applied retrospectively to group practice service databases.

While as can be seen in Table 2 not all items related to the perinatal background were recorded routinely, it is unlikely that the women had any of the health conditions listed as significant risk factors on the *PBI* section of the *OI-US* because each had been screened at the time of client intake into the midwifery practice. An additional exclusion criterion for the nurse-midwifery practice was current illicit drug use. Therefore, based on the CNM practice entry criteria, it was assumed that none of the complications noted above were present in the clients who were cared for by the nurse-midwives.

The *OI-US* takes missing items into account because it is scored as the percentage of available items demonstrating optimal care outcomes, rather than summing scores on all items regardless of the availability of data. The denominator

TABLE 1
***The 17 Items Not Available for Analysis Out of 54 Items of the* OI-US**

Alcohol
Pre-pregnancy body mass index
Birth interval <18 months
Previous cesarean delivery
Previous low birthweight
History of antepartum complications
Nonstress test, contraction stress test, or biophysical profile
Antepartum prescription medication
Presence of a support person
Nondirected pushing
Nonsupine pushing
Third- and fourth-degree extensions
Third-stage medications
Skin-to-skin contact
Transfusions
Prescription for medications postpartum
NICU admission

Note. OI-US = Optimality Index-US.

TABLE 2
Items Available for Analysis for Each Section of the OI-US

	Section of OI-US				
		OI *Items = 40*			
	PBI	*Antepartum*	*Intrapartum*	*Postpartum*	*Newborn*
Total # items	14	7	23	2	8
# Items available	8	5	16	1	9
# Items not available	6	2	7	1	1

Note. OI-US = Optimality Index-US; OI = Optimality Index; PBI = Perinatal Background Index.

can be adjusted to reflect the total number of items on which the analysis will be conducted. For this evaluation, 37 items were used as the baseline for optimality scoring. The proportion of missing data within each of the 37 items used in this test of the *OI-US* was calculated and is listed in Table 2. The effect of this kind of adjustment on content and construct validity of the tool is more fully detailed in a companion article in this series (Murphy & Fullerton, 2006).

The *OI-US* takes missing items into account because it is scored as the percentage of available items demonstrating optimal care outcomes.

Data Analysis

Descriptive statistics were calculated for each case in the database, using the 37 items available for inclusion in the analysis. For the sample as a whole, optimality (% of items scored as optimal) was calculated for each index item and for the total score. In addition, optimality scores were examined within various subgroups based on types of interventions.

Results

Of the 4,788 records in the data set, complete antepartum, intrapartum, postpartum, and newborn information was available for 3,425 cases. Clients with significant missing data included those who received antepartum or intrapartum care in another environment or moved or transferred care to another practice or provider.

Table 3 lists the items included in the analysis, how data were obtained, and the percentages scored as optimal. The average *PBI* score for the sample was 88.8%. This score was obtained based on an analysis of 8 available items of the 14 that comprise the *PBI*. This indicates that the clients cared for by the nurse-midwives were primarily at low risk. The total *OI-US* score, comprising the 37 available items including the *PBI*, was 80% (N = 3,425, range 54%-97.3%, standard deviation 8.3) for this nurse-midwifery practice. Table 4 provides a description of the two cases at the extremes of the range of the *OI-US* score.

To determine whether the *OI-US* score would differ as expected between groups who did and did not have intrapartum interventions, the sample was divided according to known "extreme" groups' criteria using the selected interventions of epidural analgesia and fetal monitoring. When women were grouped by whether or not they had an epidural during their labor experience, the *OI-US* mean scores were 71.1% in the group with epidurals (N = 723) and 82.4% in the group without epidurals (N = 2,701, mean difference 11.2%).

When the groups were split by the type of monitoring during labor, those who had electronic fetal monitoring (N = 2,316) had a mean *OI-US* score of 76.7%, compared to the mean *OI-US* score of 86.9% when auscultation or intermittent monitoring was performed (mean difference 10.3%).

Discussion

The *OI-US* has potential as a useful instrument to assess care practices outside of the original research context in which it was developed. Although comparison scores are not yet available from other obstetric units, the average *OI-US* score in this clinical population was relatively high, congruent with evidence-based care for a population at low risk. In other words, the *OI-US* score is expected to be higher or more optimal with populations at low risk because the scientific evidence supports minimal intervention for women without preexisting risk factors.

TABLE 3
Items Analyzed, Data Source, and Percentage of Optimal Outcomes (N = 3,425)

Perinatal Background and OI Items	*Item in Tool*	*Item Coded From Data*	*% Optimal*	*% Not Optimal*	*% Missing*
Marital status	X		78.0	20.8	1.2
Ethnic minority	X		83.5	15.1	1.4
Smoking		X	60.5	5.9	33.6
Drug use		X[a]	100		
Age		X	3.4	87.0	9.5
Major chronic disease		X[a]	100		
Previous preemie		X[b]	97.0	3.0	
Previous IUFD		X[a]	100		
Preeclampsia	X		95.8	4.2	
Anemia		X	39.1	0.3	60.6
Other AP complication	X		87.6	12.4	
First-trimester care		X	73.6	17.1	9.3
Amniocentesis	X		90.7	9.3	
ROM <24		X	61.4	6.9	31.7
Amniotic fluid	X		57.8	16.4	25.8
Induction or augment	X		69.9	30.1	
Pain med in labor	X		68.5	31.5	
Epidural	X		82.8	17.2	
Auscultation/intermit	X		25.0	50.5	24.5
Fetal distress	X		95.4	4.6	
Place as planned		X[b]	99.7	0.3	
Cephalic presentation	X		74.8	2.2	23.1
Instrumental birth	X		75.3	3.6	21.2
Cesarean	X		90.4	9.6	
Episiotomy	X		83.5	16.5	
First/second degree and sutured	X		59.0	41.0	
Placental retention	X		95.1	4.9	
Postpartum hemorrhage	X		84.8	15.2	
Other IP complication	X		92.2	7.8	
Estimate of gestational age		X	66.6	23.5	9.9
Birthweight		X	58.8	31.3	9.9
Five-min Apgar		X	74.0	16.1	9.9
Congenital anomaly	X		99.5	0.5	
Other baby complications	X		93.4	6.6	
Breastfeeding (plans to)	X		80.6	9.7	9.7
Perinatal death		X	99.8	0.2	
Postpartum fever or complication	X		94.7	5.3	

Note. OI = Optimality Index; IUFD = intrauterine fetal death; AP = antepartum; ROM = rupture of membranes; IP = intrapartum.

[a]Represents criteria for risking out of midwifery care in this practice.

[b]Coded from narrative comments.

TABLE 4
Case Examples of Extreme Differences in OI-US *Scores*

	OI-US = *54%*	OI-US = *97.3%*
Pregnancy	G2P1	G1P0
	History of herpes	Married, Caucasian
	Had amniocentesis	11 prenatal visits
	12 prenatal visits	29 pounds weight gain
	Developed preeclampsia	Nonsmoker
		No antepartum complications
Intrapartum	Medical induction of labor	Normal labor progress
	Ruptured membranes >24 hr	No medications used in labor
	Medication use in labor	No prolonged rupture of membranes
	Meconium-stained fluid	Clear fluid
	Epidural for pain relief	Auscultation of fetal heart tones
	Internal monitoring	Spontaneous vaginal birth
	Physician consultation during care	Intact perineum, no suturing needed
	Identified fetal distress	Estimated blood loss >400 cc
	Prolonged second stage	CNM care only
	Mid-forceps birth with episiotomy and lacerations requiring suturing	
Neonatal/postpartum	2920 AGA infant, Apgars 5/9	AGA infant, Apgars 9/9
	Breastfeeding	Breastfeeding
	No baby complications	No baby complications
	No postpartum complications	No postpartum complications

Note. CNM = certified nurse midwife.

The higher score is also congruent with the application of the midwifery model of care, which includes individualized care for childbearing women and selection of care practices based on the evidence about their efficacy in the appropriate context (ACNM, 2004). High-optimality scores among clients of the nurse-midwifery service demonstrate that within this practice, there was an ability to apply the midwifery model of care for childbearing women at low risk. The use of the *OI-US* provided an effective evaluation of the degree of evidence-based midwifery practice in this setting.

This test of the *OI-US* also demonstrated the influence of one intervention on others, as seen in the comparison of women who did and did not have epidurals. The difference in average scores is larger than would be accounted for by the epidural alone. This example demonstrates the potential cascade effect of interventions, when one leads to another or requires another, regardless of a change in risk status. When an epidural is in place, an IV is required, continuous electronic fetal monitoring is used, and there is a greater possibility that the route of birth will be affected. While many women may desire the use of an epidural for pain relief, the need for additive interventions to assure the safe use of this technology means that women also will potentially experience additional risks related to those interventions. Therefore, the *OI-US* score would be decreased when an epidural is used, regardless of the presence of risk factors.

The *OI-US* should not be used as means of benchmarking the quality of maternity care practice (Collins-Fulea, Mohr, & Tillet, 2005). The *OI-US* captures what is an optimal outcome according to the current scientific evidence for care practices and health outcomes, but it does not identify when additional intervention is appropriate and warranted due to changes in risk status. For example, if a woman arrives in the labor and delivery unit with ruptured membranes and meconium-stained fluid, fetal monitoring is an appropriate assessment to determine fetal well-being. During this process, if non-reassuring fetal heart tones are noted, an IV may be considered, and continuous fetal monitoring with an internal fetal scalp electrode may be deemed necessary. In this instance, while the care may be considered appropriate in the presence of these changing risk factors, the *OI* score would be lower because it does not capture the changing risk status described above but is scored based on whether the individual

care practice (e.g., type of fetal monitoring) is congruent with the evidence base for the practice.

Therefore, a caution is raised regarding interpretation of the *OI-US* results. It is a combined index of risk factors, care practices, and outcomes. The *OI-US* enables evaluation of all three domains at the completion of the care provided. It does not reflect when care practices such as epidurals and fetal monitoring are judged clinically to be necessary due to changing background risk factors and other clinical events. It only measures the change from what is optimal based on the evidence (e.g., intermittent fetal monitoring) compared to what is not optimal (e.g., continuous fetal monitoring).

Limitations of This Evaluation

This study was a retrospective analysis of data collected prior to 2000. Since that time, evidence has emerged to support the optimality of newer practices measured in the *OI*. For example, prior to 2000, clear evidence demonstrating that spontaneous pushing was preferable was not available, so while it was often the practice of the midwives to use this method, it was not often documented. This missed opportunity is a reminder of the importance of documenting nursing care practices and outcomes to develop the evidence base needed to promote practice changes.

Another consideration is that in this clinical data set, only 37 of the items out of a possible 54 were available for the analysis. While the *OI-US* can be scored using different numbers of items without diminishing the validity of the measure (Murphy & Fullerton, 2006), more comprehensive clinical practice records would have captured all elements of the *OI-US* and enabled a stronger evaluation. Chart reviews were a possible alternative data source instead of or in addition to the midwives' practice data set, but while most of the standard biomedical outcomes can be found in the medical record, most care practices are not. For example, the type of second-stage pushing method is not often documented, and the use of mother-baby skin-to-skin contact may not be recorded. To capture all of the items prospectively, the use of a comprehensive data collection tool should be considered. This evaluation demonstrated that it is possible to use the *OI-US* with a limited clinical data set and still obtain meaningful results, because the scoring can be done based on the number of items available, but additional research and evaluation is needed to determine the minimal number of items needed to maintain the validity of the instrument.

Applications of the *OI-US* by Maternity Care Nurse Clinicians

The *OI-US* does have the potential to be used within clinical practices as a means of assessing practice patterns and changes over time. By creating a "snapshot" view of the optimality of outcomes related to the childbearing experience, maternity nurses can determine whether changes in practice are enhancing outcomes or potentially moving outcomes away from evidence-based maternity care.

The *OI-US* can capture the impact over time of nursing practices as well as biomedical practices.

The relationship between certain care practices and certain outcomes can be explored. For example, a clinical unit could explore the question of whether adding the evidence-based practice of immediate skin-to-skin contact for the mother and newborn increases breastfeeding success and reduces the number of babies who may have to be evaluated for low blood sugar in the NICU nursery. The *OI* scores before and after the change in practice could be compared. The scores would increase if the practice were regularly used and the desired outcomes such as breastfeeding initiation and reduction in transfer to the NICU, both of which are included in the *OI-US*, were also achieved.

The *OI-US* can be used to detect practices that are often unique to nursing, thus allowing assessment of comprehensive care rather than merely medical obstetric outcomes. For example, assuring skin-to-skin contact for the mother and newborn is generally within the domain of the nurse. Supporting the use of spontaneous pushing is within the scope of maternity nursing practice. Thus, the *OI-US* can capture the impact over time of nursing practices as well as biomedical practices.

Much of the information needed for the *OI-US* instrument is already collected in general nursing practice, but the *OI-US* allows for an organizing framework that can then be used to compare outcomes after specific changes are implemented. Making nursing care practices visible within the medical record as well as in any data collection tool ascribes value and significance to those practices. When it becomes routine to document skin-to-skin contact as an outcome, this aspect of care gains greater attention and importance than other nondocumented aspects of care have not become important enough to be documented. Thus, the use of the *OI-US* can begin to create momentum toward further consideration and implementation of evidence-based perinatal care practices, for the benefit of women and their newborns.

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