Women's and Children's Health Policy Center
Johns Hopkins University

Strengthen the Evidence for Maternal and Child Health Programs

National Performance Measure 2 Low-Risk Cesarean Deliveries Evidence Review

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Celia Karp

Yu-Hsuan Lai, MSPH

Cynthia Minkovitz, MD, MPP

Holly Grason, MA

Stephanie Garcia, MPH

Emily Payne

Donna Strobino, PhD

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EXECUTIVE SUMMARY

Reduction of low-risk primary cesarean deliveries is one of fifteen Maternal and Child Health National Performance Measures (NPMs) for the State Title V Block Grant Program. The goal of NPM 2 is to decrease the proportion of cesarean deliveries among low-risk first-time mothers. The purpose of this evidence review is to identify evidence-informed strategies for State Title V programs to consider for addressing NPM 2 Low-Risk Cesarean Deliveries.

Thirty-four peer-reviewed publications met study inclusion criteria and informed this review. These studies were categorized into eight groups: "Patient Only," "Provider Only: Labor Support," "Provider Only: Excluding Labor Support," "Hospital Only," "Patient + Provider," "Provider + Population-Based Systems," "Hospital + Population-Based Systems," and "Provider + Hospital + Population-Based Systems."

The studies with population-based system components included interventions implemented at the national, state, and/or community level(s). Examples of each type of intervention and its evidence rating are shown below:

Intervention Category	Example	Evidence Rating
Patient Only	Childbirth education classes	Emerging Evidence
Provider Only: Labor Support	Supportive care from trained doulas	Emerging Evidence
Provider Only: Excluding Labor Support	Active management of labor	Mixed Evidence
Hospital Only	Chart audit and feedback	Emerging Evidence
Patient + Provider	Childbirth education classes + Active management of labor	—
Provider + Population-Based Systems	Active management of labor + National guidelines	—
Hospital + Population-Based Systems	Chart audit and feedback + National guidelines	—
Provider + Hospital + Population-Based Systems	Active management of labor + Chart audit and feedback + National guidelines	—

— indicates insufficient number of studies to assign evidence rating

Four key findings emerged from the review:

1. Interventions implemented at the patient only (e.g., childbirth education classes) and hospital only (e.g., chart audit and feedback) levels appear most effective in decreasing the percentage of cesarean deliveries among low-risk first-time mothers (nulliparous women).

2. Labor support, which includes supportive care from trained doulas, also appears to be an effective provider-based intervention to reduce cesarean deliveries among low-risk first births.

3. The evidence of effectiveness for other provider-based interventions (e.g., active management of labor, administration of epidural analgesia) is less clear.

4. Adding population-based components in interventions occurring among hospitals, providers, or patients may support the effectiveness of those interventions, as compared to interventions implemented in those categories alone.

In this evidence review, interventions to reduce cesarean deliveries among low-risk first births were categorized along an evidence continuum from *Evidence Against* (least favorable) to *Scientifically Rigorous* (most favorable). *Emerging Evidence* was identified for interventions implemented at the hospital-only and patient-only levels, as well as the specific provider-only intervention of labor support. *Mixed Evidence* was found for the broader category of provider-only interventions excluding labor support. The remaining intervention categories, including "Patient + Provider," "Provider + Population-Based Systems," "Hospital + Population-Based Systems," and "Provider + Hospital + Population-Based Systems," were not assigned to the continuum due to the limited numbers of studies.

It appears that interventions that involve components at the hospital-only or patient-only levels, as well as the specific clinical practice of labor support, are most effective in decreasing the proportion of cesarean deliveries among low-risk nulliparous women. Most interventions with only hospital-based components included chart audit and feedback; organizational change(s), such as development and application of new assessment forms for induction of labor

or adoption of obstetrical morning rounds for all obstetric clinicians; and guideline change(s) and implementation, such as full-term elective induction policies and induction of labor guidelines. The evidence suggests that engaging hospital staff and providers in hospital-wide efforts dedicated to cesarean reduction may promote decreases in the percentage of cesarean deliveries among low-risk first births. Improved monitoring of patient-specific interventions and routine in-hospital reviews of obstetric care practices and outcomes may be needed to better understand the current status of strategies to reduce primary cesarean deliveries. Further evaluation is needed to understand how implementation of specific interventions affects the proportion of cesarean deliveries among low-risk first births.

ACKNOWLEDGMENTS

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INTRODUCTION*

Strengthen the Evidence Base for Maternal and Child Health (MCH) Programs is a Health Resources and Services Administration (HRSA)-funded initiative that aims to support states in their development of evidence-based or evidence-informed strategies to promote the health and well-being of MCH populations in the United States. This initiative, carried out through a partnership among Johns Hopkins Women's and Children's Health Policy Center, the Association of Maternal and Child Health Programs, and Welch Library at Johns Hopkins, was undertaken to facilitate the transformation of the MCH Title V Block Grant Program.

A goal of the Strengthen the Evidence project is to conduct reviews that provide evidence of the effectiveness of possible strategies to address the National Performance Measures (NPMs) selected for the 5-year cycle of the Title V MCH Services Block Grant, beginning in fiscal year 2016. States are charged to select eight NPMs and incorporate evidence-based or evidence-informed strategies in order to achieve improvement for each NPM selected.

BACKGROUND

Reduction of low-risk primary cesarean deliveries, NPM 2, is one of the fifteen MCH NPMs. Eleven states and jurisdictions selected NPM 2, including Colorado, Indiana, Kentucky, Maine, Marshall Islands, Maryland, Missouri, Montana, Virginia, West Virginia, and Wyoming.[1] The goal for NPM 2 is to decrease the proportion of cesarean deliveries among low-risk first births (singleton, vertex births to nulliparous women at 37+ weeks).[2]

Cesarean delivery is the most common major surgical procedure performed in the U.S.[3] According to a 2013 report on U.S. birth trends, the cesarean delivery rate rose nearly 60% between 1996 and 2009, with increases occurring among all women regardless of age, race,

* The language used in the Introduction section was crafted by the Strengthen the Evidence team and is consistent across all evidence reviews within this project.

ethnicity, or state of residence.[4] From 1996 to 2009, the rate of cesarean delivery increased by 50% or more in 34 states and by more than 70% in six states, and the proportion of cesarean deliveries to low-risk women with no prior cesarean also rose 44.4% nationally, from 18% to 26%.[5,6] In 2009, the total national cesarean delivery rate reached an all-time high of 32.9%.[3]

Despite the increased use of cesareans during this time, the cesarean delivery rate has steadily declined each year since 2011, resulting in about one-third of all births occurring via cesarean as of 2015.[7] The cesarean delivery rate among all low-risk women decreased to 25.7% in 2015. However, between 2009 and 2015 no change in cesarean delivery rate among low-risk women occurred in 12 states and the District of Columbia, and the rate increased in one state.[7]

Although cesarean delivery can be a life-saving procedure for a mother and her infant, it may also increase the risk of illness and death.[8,9] Low-risk pregnant women who deliver by cesarean delivery are subject to potentially avoidable risks of maternal and neonatal morbidity and mortality. Further, the probability of subsequent vaginal birth after cesarean (VBAC) is low (about 10%) and the risks of maternal morbidity and mortality are compounded with each subsequent cesarean.[1,7] These heightened and avoidable risks associated with cesarean births highlight the primacy of prevention for early elective cesareans.

Recognizing this problem, HHS established reduction of cesarean births, and specifically low-risk primary cesarean births, a national priority in 2000 by instituting it as a sub-objective of Healthy People 2010.[6] Despite acknowledgment of concern, in the Healthy People 2010's *Midcourse Review*, the cesarean birth rate for both primary and repeat cesareans had increased.[10] Although the reasons for the observed rise were unknown, it was suggested that the increase was associated with more conservative practice guidelines, legal pressures, and reports about the risks associated with VBAC.[10] Further, the report highlighted the emergence of hospital-level and

provider-based programs during the interim period which aimed to reduce the rate of cesarean delivery. The report emphasized the potential of these programs to reduce national cesarean birth rates. As a follow-up to this effort, HHS reinstated its commitment to decreasing national cesarean birth rates by reestablishing the low-risk cesarean delivery objective as part of Healthy People 2020.[11]

Accompanying the initiatives of HHS, several national organizations of clinicians and researchers established guidelines for targeted efforts to reduce cesarean deliveries. In 2007, the American College of Obstetricians and Gynecologists (ACOG) developed clinical practice guidelines to reduce non-medically-indicated cesarean delivery and labor induction prior to 39 weeks.[12] The guidelines highlighted the risks associated with cesarean delivery on maternal request and outlined recommendations for its appropriate use. In 2009, reduction of low-risk primary cesareans was included as one of The Joint Commission's National Quality Core Measures for hospitals. The term nulliparous, term, singleton, vertex (NTSV) was used to describe this low-risk population of births potentially amenable to targeted reduction efforts. In 2014, ACOG and the Society for Maternal-Fetal Medicine (SMFM) issued a joint obstetric care consensus statement providing clinical recommendations for safe prevention of primary cesarean delivery that focused on addressing each of the most common indications for primary cesarean.[13] The proposed clinical recommendations were hospital-based and clinician focused (e.g., fetal heart rate monitoring and labor support). The recommendations put forth in this consensus target primary cesarean delivery among all first-time mothers, regardless of the woman's risk status during pregnancy.

Infant and maternal health constituencies alike, with strong support from the March of Dimes, emphasized elimination of early elective deliveries and improvement of quality maternal

health care as central to the national effort to reduce cesarean births.[14,15] In 2011, through collaboration with the California Maternal Quality Care Collaborative's (CMQCC) Early Elective Delivery Task Force and the California Department of Public Health, the March of Dimes established the *Early Elective Deliveries Toolkit*, with the objective of presenting best practices for prevention of deliveries before 39 weeks, regardless of parity.[16] To enhance dissemination efforts, CMQCC partnered with the National Quality Forum and created an implementation playbook for states to use in their efforts to reduce early elective cesareans.[14] Recommended strategies were described in relation to the specific determinants of barriers to reduction of early elective cesarean deliveries (e.g., absence of hard-stop policies). The Council on Patient Safety in Women's Health Care also offers a patient safety bundle for reducing primary cesarean births to help facilitate the standardization process across hospitals (https://safehealthcareforeverywoman.org/patient-safety-bundles/safe-reduction-of-primary-cesarean-birth).

The goal of NPM 2 is to decrease the proportion of cesarean deliveries among low-risk nulliparous women. To support states and jurisdictions in their strategies to achieve this goal, the current review focuses on synthesizing the evidence about interventions to reduce primary cesarean deliveries among low-risk women.

METHODS

Studies were identified for review by searching the PubMed, CINAHL Plus, and Cochrane Library online databases. Search strategies varied across databases due to differences in controlled vocabulary, indexing, and syntax. Table 1 presents detailed search strategies used for each database. The same three concepts of cesarean, intervention, and nulliparous were used to build each database-specific search strategy. A library specialist (informationist) was

consulted in selecting appropriate databases and ensuring adequacy of the search strategies. The following six inclusion criteria were used to determine eligibility of peer-reviewed articles:

1. The study was empirical and assessed strategies and/or interventions aimed at decreasing the proportion of cesarean deliveries among low-risk (singleton, vertex, full-term births; $\geq$ 37 weeks gestation) first-time mothers (nulliparous women).
2. The study described interventions and/or strategies that that fell under the purview of Title V, as determined by the authors and reviewers.
3. The study design was a randomized controlled trial, quasi-experimental study, or time trend analysis, and included an appropriate comparison group.
4. The study was conducted in the United States or in another high-resource country, which is a member of the Organization for Economic Cooperation and Development (OECD).
5. The study was published in English.
6. The study was published in a peer-reviewed journal.

The results of the search for each database were evaluated systematically for relevant studies. Duplicates were removed before beginning title screening. The title of each article was reviewed, and if it appeared related to NPM 2, the abstract was then screened. If the abstract did not indicate whether or not the study met the inclusion criteria or the abstract was not available, full-text of the article was reviewed. All articles remaining after title and abstract screening were retrieved for detailed full-text review to assess their eligibility for inclusion in the current review.

The lead author (CK) extracted relevant data pertaining to study characteristics (setting, sample, cesarean delivery rate, and design); intervention (components, description, study period); and results. The study team met regularly to review interim extractions and resolve items in question. Data about results was extracted about cesarean delivery rates only. Results described

in this review are focused on the potential of the intervention to reduce cesarean deliveries among low-risk nulliparous women. Although some studies included multiparous women, study information and results were extracted exclusively for nulliparous women.

This review categorized studies based on the level at which interventions were implemented and included patient, provider, hospital, and population-based systems levels. For the purpose of this report, providers are synonymous with clinicians responsible for labor and delivery, including physicians, certified nurse-midwives, and certified midwives. The population-based systems were defined as interventions implemented at the national, state, and/or community level(s). Eight categories were created: "Patient Only," "Provider Only: Labor Support," "Provider Only: Excluding Labor Support," "Hospital Only," "Patient + Provider," "Provider + Population-Based Systems," "Hospital + Population-Based Systems," and "Provider + Hospital + Population-Based Systems." The "Provider Only: Labor Support" category contains studies that assessed labor support as the only intervention. The "Provider Only: Excluding Labor Support" category contains studies that assessed other provider-based intervention(s), including studies that assessed labor support in conjunction with other provider-based intervention(s).

An evidence continuum assessed evidence-informed interventions aligned with criteria for each category of the continuum. The Robert Wood Johnson *What Works for Health* evidence ratings were adapted to create an evidence continuum tailored for the Strengthen the Evidence project.[17] Evidence rating categories included: *Evidence Against, Mixed Evidence, Emerging Evidence, Expert Opinion, Moderate Evidence,* and *Scientifically Rigorous.* Strategies that are characterized by *Emerging Evidence* or more favorable ratings are considered evidence-informed. Table 2 shows the detailed evidence rating criteria, which include both study type and

study results for each rating.

Interventions identified through evaluation of peer-reviewed literature were placed along the evidence continuum. Assignment to the continuum required that a specific intervention was evaluated in four or more peer-reviewed studies. Two project team members assigned ratings to each intervention category; ratings were compared and discrepancies were discussed by the full project team until a consensus was reached.

RESULTS

Search Results

Searches in the PubMed, CINAHL Plus, and Cochrane Library databases were performed on May 19, 2016. In total, the systematic review identified 4,098 records. The searches in PubMed, CINAHL Plus, and Cochrane Library yielded 2,601, 676, and 821 records, respectively. A total of 7 records were also identified through expert consultation.

Title and abstract screening was conducted for 3,273 records after 832 duplicated records were removed. During title and abstract review, 3,162 records were excluded. One hundred and eleven articles were assessed for full-text eligibility and 77 were excluded due to failure to meet all inclusion criteria. Reasons for study exclusion included: full-text article not in English; not an evaluation of an intervention; no baseline data or adequate comparison group; cesarean delivery rate not stratified by parity or specific to nulliparous women; and retrospective observational study of a clinical intervention that was not within the purview of Title V, such as manual rotation of the fetal occiput. Thirty-four records qualified for the current review. Figure 1 displays the flow chart for the study selection process.

Characteristics of Studies Reviewed

The 34 articles included in this review varied considerably in study setting, sample, and

design, type of intervention, study period, and the nature of the intervention that was implemented. Table 3 presents the detailed characteristics of the studies. Of the 34 studies, 17 were randomized controlled trials[21,23-25,27,31-34,37,41,43-44,47-50], three were time trend analysis designs[22,39,45], 12 were observational cohort studies (prospective and retrospective)[26,29-30,35-36,38,40,42,46,51-53], and two were quasi-experimental studies with two different study designs (pretest-posttest design with control group and pretest-posttest without control group)[20,28]. Twelve studies were conducted in the United States[20,24,26,32,34,38,40-41,43-44,47,53], four in Canada[33,36,39,51], one in the United States and Canada[37], 10 in European countries[21-23,28-30,35,42,48,50], two in the United Kingdom[46], four in Australia[25,27,31,52], and one in New Zealand[49]. The study populations/samples also varied across studies. Most studies concentrated on nulliparous women only[21-24,27-30,32-34,39-41,43-49,53], while the samples for 13 studies included both nulliparous and multiparous women. Studies examining mixed parity populations are noted in Table 3. Two studies, which focused on interventions for nulliparous women who planned to deliver vaginally, reported only emergency cesarean delivery rates[28-29].

Intervention Components

Table 4 shows a detailed description of the intervention(s) implemented in each study. It also describes the comparison group in each study, which varied across studies. Table 5 details the specific intervention components implemented in each study. While these intervention components identify the core components tested in each study, the intervention group received the core components in addition to standard care in the vast majority of the studies (n=18). Examples of hospital-based interventions include quality improvement and organizational change(s), such as development and application of new assessment forms for induction of labor, and adoption of obstetrical morning rounds for all obstetric clinicians. Population-based systems

interventions include state or national policies or guidelines and specified places of birth (e.g., birth centers). Examples of provider-level interventions include an expanded role of midwives for delivery, administration of epidural analgesia, active management of labor, and continuity of care. Examples of patient-level interventions include childbirth education classes, intensive counseling or therapy to reduce fear of childbirth, and psychoprophylaxis, defined as patterned breathing techniques and relaxation during labor to reduce pain.[21] The number of articles in each category varied: "Patient Only" (n=5); "Provider Only: Labor Support" (n=5); "Provider Only: Excluding Labor Support" (n=13); "Hospital Only" (n=4); "Patient + Provider" (n=1); "Provider + Population-Based Systems" (n=2); "Hospital + Population-Based Systems" (n=3); and "Provider + Hospital + Population-Based Systems" (n=1). Most studies included interventions at only one level (n=27).

Summary of Study Results

Study results are presented in detail in Table 6. Only comparisons of low-risk primary cesarean delivery rates, as described in the studies, are reported. Table 7 summarizes the overall study findings, and organizes the studies by the intervention levels described above. The summary results presented in Table 7 for low-risk primary cesarean delivery rates illustrate a mix of favorable, unfavorable, and non-significant findings. Most results yielded non-significant (53%) or favorable (44%) results, with only one study reporting unfavorable results.

"Hospital Only" and "Patient Only" interventions appeared to be effective in decreasing cesarean deliveries among low-risk nulliparous women. The majority of interventions focused at these levels reported favorable outcomes. Chart audit and feedback, guideline change(s) and implementation, and organizational change were components of three of the four "Hospital Only" strategies, suggesting these types of interventions may be important for reducing the rate

of primary cesarean deliveries. Among the "Patient Only" strategies, three of the five included intensive therapy or counseling to alleviate patient fears of childbirth, indicating that interventions to address and manage fear of childbirth may be important to reduce the rate of primary cesarean deliveries, particularly among low-risk women. Overall, it appears that targeted interventions at both the "Hospital Only" and "Patient Only" levels may be effective strategies to reduce primary cesarean deliveries among this subset of the birthing population.

The results of studies of "Provider Only: Labor Support" suggest that this strategy may be effective in reducing cesarean births among primiparous women. Of the five studies, two indicated favorable results[41,44] and three non-significant results[24,33,37]. The effectiveness of interventions in the "Provider Only: Excluding Labor Support" category is less clear. The 13 studies within this category included a variety of strategies, making it difficult to draw conclusions.

Although no studies qualified for inclusion at a "Population-Based Systems Only" level, the majority of results from six studies of hospital-based and patient-focused interventions[22,35-36,39,42,53] with at least one "Population-Based Systems" intervention component were favorable. This finding suggests that aligning hospital-based and patient-focused interventions with national policies and state and community programs may be important for implementing effective primary cesarean reduction interventions.

Evidence Rating & Evidence Continuum

Assignments of evidence ratings were based on results for cesarean delivery rates reported in 34 studies (Table 7). Studies categorized as "Patient + Provider" (n=1); "Provider + Population-Based Systems" (n=2); "Hospital + Population-Based Systems" (n=3); and "Provider + Hospital + Population-Based Systems" (n=1) were not assigned evidence ratings, nor placed

on the evidence continuum, because there were fewer than four studies in each category.

Based on the evidence rating criteria, shown in Table 2, *Mixed Evidence* was identified for the intervention category "Provider Only: Excluding Labor Support." *Emerging Evidence* was identified for the categories of "Patient Only," "Provider Only: Labor Support," and "Hospital Only." Figure 2 displays the evidence continuum with evidence-informed strategies plotted along the continuum.

IMPLICATIONS

Nearly twenty percent of states and jurisdictions selected the Low-Risk Cesarean Delivery NPM as a programmatic focus of the current 5-year cycle of Title V MCH Services Block Grant. The purpose of this review was to provide information about evidence-based and evidence-informed strategies to reduce cesarean deliveries among low-risk first births.

Interventions that involve components at the "Hospital Only" or "Patient Only" levels, as well as labor support, appear most effective in decreasing the proportion of cesarean deliveries among low-risk nulliparous women. Most interventions with only hospital-based components included chart audit and feedback, organizational change(s), such as development and application of new assessment forms for induction of labor, and adoption of obstetrical morning rounds for all obstetric clinicians; and guideline change and implementation, such as full-term elective induction policies and induction of labor guidelines. These findings suggest that engaging hospital staff and providers in hospital-wide efforts dedicated to cesarean reduction may promote decreases in cesarean deliveries among low-risk first births. Improved monitoring of patient-specific interventions and routine in-hospital reviews of obstetric care practices and outcomes is needed to better understand the current status of strategies to reduce primary cesarean deliveries. Further evaluation is needed to understand how implementation of specific

interventions affects the proportion of cesarean deliveries among low-risk first births. Moreover, although clinical interventions implemented by clinicians within hospitals, like those recommended by ACOG and SMFM[13] (e.g., standardized fetal heart rate monitoring and manual rotation of the fetal occiput), were excluded from this review, our omission of these clinical interventions does not negate their importance. Many states support perinatal quality collaboratives, and Title V may play a key role in supporting evidence-based clinical interventions through dissemination of clinical guidelines. The specific clinical interventions which may be addressed in the perinatal collaboratives or guidelines were beyond the purpose of this evidence review.

The major strength of this evidence review related to NPM 2 is that it focuses exclusively on interventions and strategies aimed at reducing primary cesarean deliveries among low-risk nulliparous women. This population contributes most to the national primary cesarean delivery rate, and is most amenable to prevention efforts. There are, however, several limitations. First, only 34 studies met the strict inclusion criteria. Although multiple studies identified in early stages of the review provided insight into potential strategies, these studies were excluded due to the lack of focus on nulliparous women. For example, some studies support the use of reimbursement strategies,[†] but were not included in this review. The relatively small number of studies limits the conclusions that can be drawn regarding effective interventions. Second, 12 of the 34 studies (35%) were observational cohort studies (retrospective and prospective), which lack the rigor of randomized trials. Inferences from observational cohort studies must be made with caution. Although search results were screened and interpreted by one reviewer, a uniform protocol (as described in the methods) was followed, and any concerns that arose during this

[†] Keeler EB, Fok T. Equalizing physician fees had little effect on cesarean rates. *Med Care Res Rev.* 1996;53(4):465-471.

process were addressed by the study team.

While the results from interventions at the "Population-Based Systems" level were not ultimately included on the evidence continuum due to the limited number of studies, the majority (67%) of interventions with at least one "Population-Based Systems" component had favorable results. Population-level health accountability through national, state, and community levels may be important to the success of cesarean reduction interventions, despite the lack of a sufficient number of studies for analysis.

In 2012 a systematic review of 95 studies by the Agency for Healthcare Research and Quality (AHRQ) evaluated the effectiveness of strategies to reduce cesarean delivery among low-risk nulliparas.[18] This review found no single approach was uniformly successful and identified several other strategies that were not supported by the literature, including modifications of pain management approaches and fetal pulse oximetry. The authors noted that evidence of benefit was only found for doulas as a form of labor support, but cautioned interpretation of these findings due to poor quality of trials included.

A 2011 Cochrane Review of 16 studies by Khunpradit et al. focused on non-clinical interventions to reduce cesarean deliveries.[19] Similar to evaluations by others, the authors identified two broad target audiences for interventions: pregnant women and health professionals. Among the patient-focused interventions, nurse-led relaxation training programs for women with a fear/anxiety of childbirth and birth preparation sessions were shown to be effective at reducing cesarean deliveries among low-risk women. Of the provider-focused interventions, guideline implementation with mandatory second opinion; mandatory second opinion and peer review feedback; and guideline implementation with support from local opinion leaders were found to be effective in decreasing cesarean birth rates.

As discussed by ACOG and SMFM's obstetric care consensus and AHRQ's 2014 systematic review, labor support and increased access to nonmedical interventions before and during labor may reduce cesarean delivery rates, regardless of a woman's risk status during pregnancy.[13,17] Although these recommendations did not target nulliparous women, these interventions, as applied to nulliparous women, are further supported by the emerging evidence found in this review. Additionally, the emerging evidence for patient-focused interventions, especially for those with fear of childbirth, is supported by Khunpradit et al.'s 2011 Cochrane Review for all women[18] and by the findings of this review tailored to nulliparous women.

FIGURES & TABLES

Figure 1. Flow Chart of the Review Process and Results.

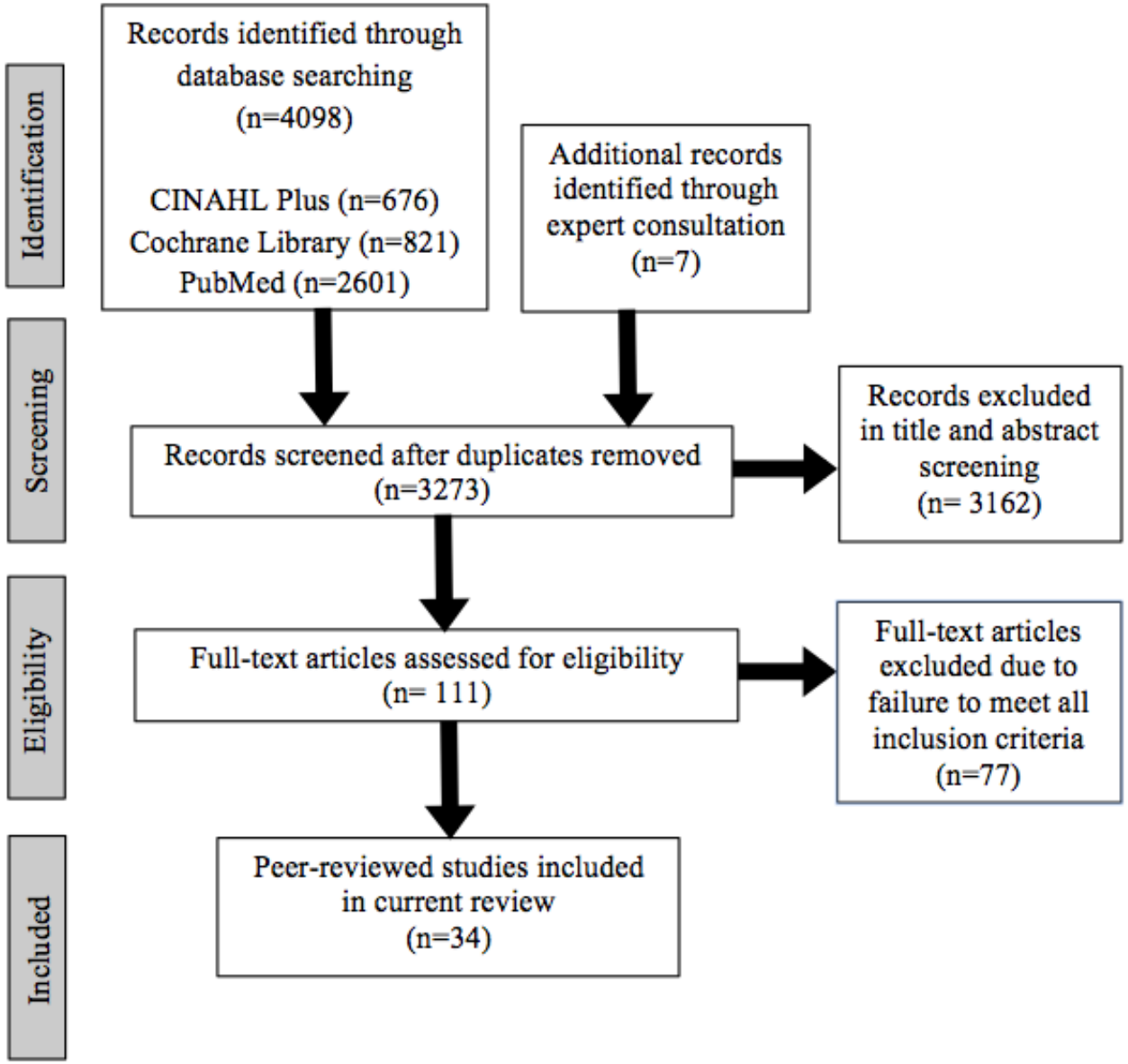

Figure 2. Evidence Continuum.

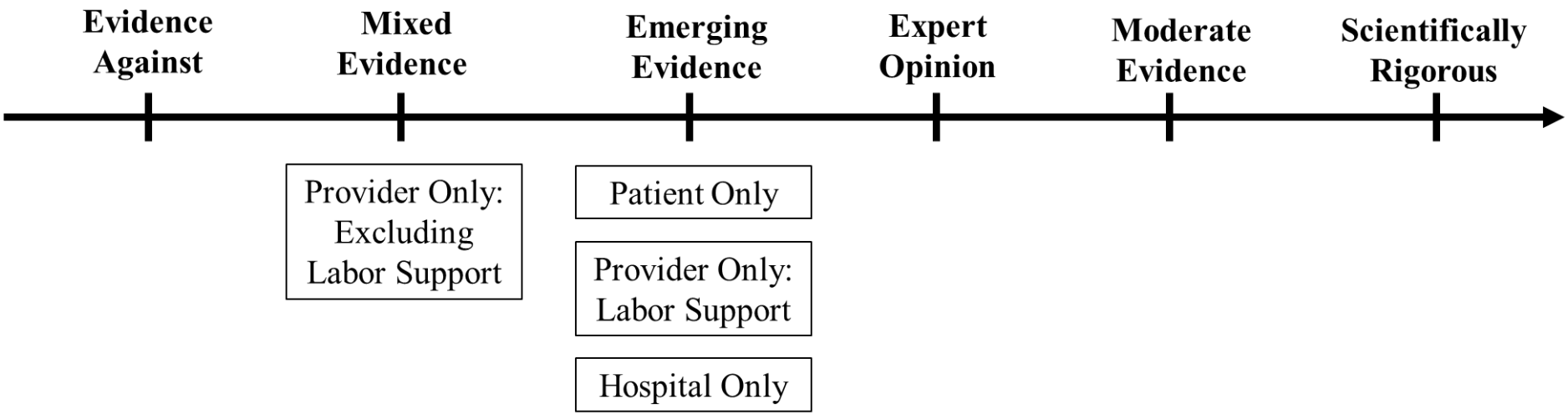

Table 1. Detailed Search Strategy.

Database	Search Strategies
PubMed	"Cesarean Section"[Mesh:NoExp] OR c-section*[tiab] OR abdominal deliv*[tiab] OR cesarean*[tiab] OR caesarean*[tiab] OR surgical birth*[tiab]
	"Guidelines as Topic"[Mesh] OR "Guideline" [Publication Type] OR "Guideline Adherence"[Mesh] OR guideline*[tiab] OR policy[tiab] OR policies[tiab] OR adherence[tiab] OR best practice*[tiab] OR "Evidence-Based Practice"[Mesh] OR "evidence based"[tiab] OR "evidence-based"[tiab] OR intervention*[tiab] OR strategy[tiab] OR strategies[tiab] OR "Outcome Assessment (Health Care)"[Mesh] OR "Patient Outcome Assessment"[Mesh] OR "Treatment Outcome"[Mesh] OR outcome*[tiab]
	"Parity"[Mesh] OR parity[tiab] OR nullipar*[tiab] OR primapar*[tiab] OR first birth*[tiab] OR first born*[tiab]
	#1 AND #2 AND #3
CINAHL Plus	(MH "Cesarean Section") OR (MH "Cesarean Section, Elective") OR TI("c-section*" OR "abdominal deliv*" OR "cesarean*" OR "caesarean*" OR "surgical birth*") OR AB("c-section*" OR "abdominal deliv*" OR "cesarean*" OR "caesarean*" OR "surgical birth*")
	(MH "Early Intervention+") OR (MH "Medical Practice, Evidence-Based") OR (MH "Nursing Practice, Evidence-Based+") OR (MH "Guideline Adherence") OR (MH "Hospital Policies+") OR (MH "Organizational Policies+") OR (MH "Health Policy+") OR (MH "Practice Guidelines") OR (MH "Outcomes (Health Care)+") OR (MH "Treatment Outcomes+") OR TI (intervention* OR strategy OR strategies OR "evidence based*" OR "evidence-based" OR "best practice*" OR adherence* OR policy OR policies OR guideline* OR outcome*) OR AB (intervention* OR strategy OR strategies OR "evidence based*" OR "best practice*" OR adherence* OR policy OR policies OR guideline* OR outcome*)
	(MH "Parity") OR TI("parity" OR "nullipar*" OR "primapar*" OR "first birth*" OR "first born*") OR AB("parity" OR "nullipar*" OR "primapar*" OR "first birth*" OR "first born*")
	S1 AND S2 AND S3
Cochrane Library	#1 MeSH descriptor: [Cesarean Section] this term only
	#2 C-Section*:ti,ab,kw or "C Section":ti,ab,kw or "C Sections":ti,ab,kw or Abdominal deliv*:ti,ab,kw or Cesarean*:ti,ab,kw or Caesarean*:ti,ab,kw or Cesarean Section*:ti,ab,kw or Caesarean Section*:ti,ab,kw or surgical birth*:ti,ab,kw (Word variations have been searched)
	#3 #1 or #2
	#4 MeSH descriptor: [Maternal Health Services] this term only
	#5 MeSH descriptor: [Program Evaluation] explode all trees
	#6 MeSH descriptor: [Guidelines as Topic] explode all trees
	#7 MeSH descriptor: [Outcome and Process Assessment (Health Care)] explode all trees
	#8 MeSH descriptor: [Treatment Outcome] explode all trees
	#9 MeSH descriptor: [Outcome Assessment (Health Care)] explode all trees
	#10 MeSH descriptor: [Patient Outcome Assessment] explode all trees
	#11 intervention*:ti,ab,kw or evaluation*:ti,ab,kw or effectiveness*:ti,ab,kw or "best practice":ti,ab,kw or "best practices":ti,ab,kw or "evidence-based medicine":ti,ab,kw or "evidence based":ti,ab,kw or "evidence-based":ti,ab,kw or strategy:ti,ab,kw or strategies:ti,ab,kw or outcome*:ti,ab,kw
	#12 #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11
	#13 MeSH descriptor: [Parity] explode all trees
	#14 parity:ti,ab,kw or nullipar*:ti,ab,kw or primapar*:ti,ab,kw or first birth*:ti,ab,kw or first born*:ti,ab,kw
	#15 #13 or #14
	#16 #3 and #12 and #15

Table 2. Evidence Rating Criteria.

Evidence Rating	Evidence Criteria: Type	Evidence Criteria: Study Results
Scientifically Rigorous	• Peer-reviewed study results are drawn only from: o Randomized controlled trials, and/ or o Quasi-experimental studies with pre-post measures and control groups	• Preponderance of studies have statistically significant favorable findings
Moderate Evidence	• Peer-reviewed study results are drawn from a mix of: o Randomized controlled trials o Quasi-experimental studies with pre-post measures and control groups o Quasi-experimental studies with pre-post measures without control groups o Time trend analyses	• Preponderance of studies have statistically significant favorable findings
Expert Opinion	• Gray literature	• Experts deem the intervention as favorable based on scientific review
Emerging Evidence	• Peer-reviewed study results are drawn from a mix of: o Randomized controlled trials o Quasi-experimental studies with pre-post measures and control groups o Quasi-experimental studies with pre-post measures without control groups o Time trend analyses o Cohort studies	• Studies with a close-to-evenly distributed mix of statistically significant favorable and non-significant findings • Only cohort studies with preponderance of statistically significant favorable findings
	• Gray literature	• Experts deem the intervention as favorable
Mixed Evidence	• Peer-reviewed study results are drawn from a mix of: o Randomized controlled trials o Quasi-experimental studies with pre-post measures and control groups o Quasi-experimental studies with pre-post measures without control groups o Time trend analyses o Cohort studies	• Studies with a close-to-evenly distributed mix of statistically significant favorable, unfavorable, and non-significant findings
	• Gray literature	• Experts deem the intervention as having mixed evidence
Evidence Against	• Peer-reviewed study results are drawn from a mix of: o Randomized controlled trials o Quasi-experimental studies with pre-post measures and control groups o Quasi-experimental studies with pre-post measures without control groups o Time trend analyses o Cohort studies	• Preponderance of studies have statistically significant unfavorable or non-significant findings
	• Gray literature	• Experts deem the intervention as being ineffective or unfavorable

Table 3. Study Characteristics.[1]

Study	Country	Setting	Study Sample		Study Design
			Target Sample	Sample Size	
Altimier et al. (2011)	US	1 level-II maternity hospital in Ohio	Nulliparous women who gave birth between January 2005 to December 2007[2]	n=2,172	QE: pretest-posttest
Bergstrom et al. (2010)	Sweden	15 antenatal clinics	Nulliparous women with a planned vaginal delivery who gave birth after recruitment at antenatal clinics between October 2005 and January 2007	n=857	RCT
Blomberg (2016)	Sweden	1 public, medium-sized tertiary level obstetric unit	Nulliparous women who gave birth between January 2006 and October 2015	n=~900 (880-924) per year	Time trend analysis
Cammu et al. (1996)	Belgium	1 urban teaching hospital	Nulliparous women who gave birth after enrollment between January 1993 and March 1994	Total (n=306) Intervention (n=152) Control (n=154)	RCT
Campbell et al. (2006)	US	1 women's ambulatory care center at a tertiary hospital in New Jersey	Nulliparous women who gave birth after enrollment between 1998 and 2002	Total (n=586) Intervention (n=291) Control (n=295)	RCT
Davey et al. (2013)	Australia	1 large, tertiary maternity hospital	Nulliparous women with a planned vaginal delivery who gave birth after recruitment between September 2007 and June 2010[2]	n=1,532	RCT
Davis et al. (1994)	US	1 women's hospital in Illinois	Nulliparous women who gave birth between January 1987 and December 1990[2]	Total (n=4,827) Intervention (n=322) Control (n=4,505)	Retrospective cohort
Dickinson et al. (2002)	Australia	1 tertiary obstetric institution	Nulliparous women who gave birth between May 1997 and October 1999	Total (n=992) Intervention (n=499) Control (n=493)	RCT
Eide et al. (2009)	Norway	1 university hospital	Nulliparous women who gave birth between November 2001-May 2002 (intervention group) and October 2002 (control group) and did not express desire for epidural analgesia at admission to hospital[3]	Total (n=453) Intervention (n=252) Control (n=201)	QE: pretest-posttest non-equivalent control group
Eriksen et al. (2011)	Denmark	9 labor wards	Spontaneously laboring nulliparous women who gave birth after recruitment between May 2004 and July 2005[3]	Total (n=2,721) Intervention (n=588) Control (n=2,133)	Prospective cohort

Study	Country	Setting	Study Sample		Study Design
			Target Sample	Sample Size	
Eriksson et al. (2006)	Sweden	52 delivery units (all)	Nulliparous women who gave birth, excluding elective cesarean deliveries, between 1998 and 2000	n=94,217	Retrospective cohort
Fenwick et al. (2015)	Australia	3 antenatal clinics in three teaching hospitals	Nulliparous women with measured fear of childbirth who gave birth after recruitment between May 2012 and June 2013[2,4]	Total (n=104) Intervention (n=51) Control (n=53)	RCT
Frigoletto et al. (1995)	Massachusetts	1 women's hospital	Nulliparous women who gave birth between June 10, 1991 and October 17, 1993	Total (n=1,915) Intervention (n=1,009) Control (n=906)	RCT
Gagnon & Waghorn (1997)	Canada	1 university hospital	Nulliparous women who gave birth between January 17, 1993 and July 17, 1994	Total (n=413) Intervention (n=209) Control (n=204)	RCT
Gimovsky & Berghella (2016)	US	1 university hospital	Nulliparous women who gave birth between March 2004 and July 2015	Total (n=78) Intervention (n=41) Control (n=37)	RCT
Gottvall et al. (2011)	Sweden	1 large, public hospital	Nulliparous women admitted to the modified birth center between March 2004 to July 2008 who gave birth at either the modified birth center or in standard delivery ward[2]	Total (n=6,141) Intervention (n=1,263) Control (n=4,878)	Retrospective cohort
Harris et al. (2012)	Canada	1 women's hospital	Nulliparous women who gave birth between April 2004 to October 2010[2]	Total (n=1,660) Intervention (n=830) Control (n=830)	Retrospective cohort
Hodnett et al. (2002)	US & Canada	13 hospitals with annual CS rates of at least 15%	Nulliparous women who gave birth after enrollment between May 1999 to May 2001[2]	Total (n=3,395) Intervention (n=1,701) Control (n=1,694)	RCT
Hueston & Rudy (1993)	US	1 hospital in Kentucky	Random sample of nulliparous women who gave birth between 1990 and 1991[2]	Total (n=371) Intervention (n=185) Control (n=186)	Retrospective cohort
Iglesias et al. (1991)	Canada	1 small, rural hospital	Nulliparous women who gave birth between January 1985 and December 1989[2]	n=456	Time trend analysis
Iriye et al. (2013)	US	1 tertiary hospital in Nevada	Nulliparous women who gave birth between October 2006 and October 2011	Total (n=6,206) Intervention (n=2,654) Modified intervention (n=1,722) Control (n=1,830)	Retrospective cohort

Study	Country	Setting	Study Sample		Study Design
			Target Sample	Sample Size	
Kennell et al. (1991)	US	1 public, university hospital in Texas	Nulliparous women who gave birth during study period (dates not specified)	Total (n=616) Intervention (n=212) Observed (n=200) Control (n=204)	RCT
Le Ray et al. (2007)	France	138 maternity units	Nulliparous women who gave birth between June 2001 and May 2002[2]	Total (n=2,052) Intervention (n=69) Control (n=1,983)	Retrospective cohort
López-Zeno et al. (1992)	US	1 university hospital in Illinois	Nulliparous women who gave birth between February 5, 1990 and March 1, 1991	Total (n=705) Intervention (n=351) Control (n=354)	RCT
McGrath & Kennell (2008)	US	University Hospitals in Ohio	Nulliparous women who gave birth after enrollment in childbirth education classes between 1988 and 2002	Total (n=420) Intervention (n=224) Control (n=196)	RCT
Mousa & Mahmood (2000)	Scotland	1 private hospital	Nulliparous women who gave birth between January 1995 and November 1997 with scheduled induction of labor and for whom completed medical forms were available	Total (n=531) Pre-intervention (n=168) Post-intervention (n=164)	Time trend analysis
Robson et al. (1996)	England	1 private hospital	Nulliparous women who gave birth between 1984 and 1988 and between September 1989 and August 1992	Total (n=9,207) 1984-1988 (n=5,622) 1989-1992 (n=3,585)	Prospective cohort
Rogers et al. (1997)	US	1 public university hospital in New Mexico	Nulliparous women who gave birth from August 1992 and April 1996	Total (n=405) Intervention (n=200) Control (n=205)	RCT
Rouhe et al. (2012)	Finland	1 maternity unit	Nulliparous women with a measured fear of childbirth who gave birth after enrollment at antenatal clinics between October 2007 and August 2009[5]	Total (n=371) Intervention (n=131) Control (n=240)	RCT
Sadler et al. (2000)	New Zealand	1 women's hospital	Nulliparous women who gave birth after recruitment between June 1993 and August 1997	Total (n=651) Intervention (n=320) Control (n=331)	RCT
Saisto et al. (2001)	Finland	1 university hospital	Nulliparous women with a measured fear of childbirth who gave birth after enrollment between August 1996 and July 1999[2,6]	Total (n=90) Intervention (n=44) Control (n=46)	RCT
Stoll & Hall (2012)	Canada	Perinatal Services British Columbia data	Nulliparous women who gave birth after prenatal survey completion between May 2005 and July 2007[2]	Total (n=372) Intervention (n=311) Control (n=61)	Prospective cohort

Study	Country	Setting	Study Sample		Study Design
			Target Sample	Sample Size	
Tracy et al. (2014)	Australia	1 large teaching hospital	Nulliparous women who gave birth between July 2009 and December 2010[2]	Total (n=1,406) Intervention (n=482) Control (n=674)	Retrospective cohort
Wilson-Leedy et al. (2016)	US	1 public university hospital in Pennsylvania	Nulliparous women who gave birth between September 13, 2013 and February 28, 2014 and between May 1, 2014, to September 28, 2014	Total (n=567) Pre-intervention (n=275) Post-intervention (n=292)	Retrospective cohort

[1] Abbreviations used in this table: QE (quasi-experimental study); RCT (randomized controlled trial)
[2] Total study sample includes nulliparous and multiparous women; analysis sample for this review includes only nulliparous women.
[3] Only emergency cesarean delivery rates reported.
[4] High fear scores defined as $\geq$ 66 on the Wijma Delivery Expectancy/Experience Questionnaire.
[5] High fear scores defined as $\geq$ 100 on the Wijma Delivery Expectancy/Experience Questionnaire.
[6] Fear of childbirth defined as five or more affirmative answers to specific fear of childbirth screening questionnaire or request for cesarean delivery.

Table 4. Intervention Description.

Study	Comparison Group	Intervention	Study Period
Altimier et al. (2011)	N/A	• Chart audit and feedback, guideline development and implementation to reduce early elective deliveries, and safety and quality improvement intervention initiated by hospital and Institute for Healthcare Improvement o 2005: reviewed literature on elective inductions and hospital's own induction rates and associated outcomes o 2006: established induction of labor bundle for practice decisions, monitored compliance rates and informed consent for oxytocin use, developed and implemented practice guidelines for inductions, Interdisciplinary Perinatal Practice Committee conducted monthly reviews of inductions not meeting established criteria, and peer reviews with physicians performed o 2005-2007: retrospective chart audit of induction and elective induction rates in all deliveries Jan 2005 to Dec 2007	2005-2007
Bergstrom et al. (2010)	Standard maternity care with no psychoprophylaxis use	Standard maternity care supplemented with use of psychoprophylaxis (patterned breathing techniques and relaxation)	Oct 2005-Feb 2007
Blomberg (2016)	N/A	• Implementation of a "nine-item list" of obstetric-unit organizational and cultural changes o Nine items: monitoring of obstetric results, recruitment of a midwife coordinator, risk classification of women, introduction of three different midwife competence levels, improved teamwork, obstetrical morning round, fetal monitoring skills, obstetrical skills training, and public promotion (outreach efforts advertising monthly lectures given by midwives to promote the benefits of vaginal birth) o Nine items introduced at different times from 2006-2015 and were developed in response to feedback and outcomes	2006-2015
Cammu et al. (1996)	Standard maternity care with no routine amniotomy and more selective use of oxytocin	Active management of labor (AMOL), including early amniotomy and early oxytocin administration	Jan 1993-Mar 1994
Campbell et al. (2006)	Standard maternity care with no doula support during labor	Specialized maternity care with doula support during labor; participating women identified a female friend/family member to act as their doulas and identified doulas received two two-hour lay doula trainings	1998-2002
Davey et al. (2013)	• Control 1: antenatal care in the community with a general practitioner and intrapartum care with midwives and medical staff • Control 2: antenatal care from midwives and obstetric trainees and intrapartum care from midwives and medical staff	Antenatal and intrapartum care from known midwife	Sep 2007-Jun 2010
Davis et al. (1994)	Standard maternity care from physicians	Specialized maternity care from certified nurse-midwives	Jan 1987-Dec 1990
Dickinson et al. (2002)	Standard maternity care with spinal-epidural analgesia administered upon presentation for delivery	Specialized maternity care with continuous midwifery support and women were encouraged to avoid epidurals	May 1997-Oct 1999
Eide et al.	Standard maternity care in conventional delivery	Specialized maternity care; delivery in midwife-led wards, no induction/ augmentation	Nov 2001- Oct

Study	Comparison Group	Intervention	Study Period
(2009)	wards with care from both midwives and obstetricians	of labor or epidural use	2002
Eriksen et al. (2011)	Standard maternity care with no supplemental administration of epidural analgesia	Standard maternity care supplemented with administration of epidural analgesia during labor	May 2004-Jul 2005
Eriksson et al. (2006)	N/A	• Analysis of institutional frequency of epidural block use into five groups vs. proportion of non-elective CS o Hospital levels stratified by level: III, IIa, IIb, and I	1998-2000
Fenwick et al. (2015)	Standard maternity care with a hospital midwife to women with a measured fear of childbirth[1]	Specialized maternity care; telephone psychoeducation, based on the 'Promoting Resilience in Mothers' Emotions' counseling intervention, provided by a midwife at between 24-34 weeks gestation to women with a measured fear of childbirth[1]	May 2010-June 2013
Frigoletto et al. (1995)	Standard care, including oxytocin and periodic dose increases, two-to-one patient-to-nurse ratio until late stage of labor	AMOL, including strict criteria for the diagnosis of labor, early amniotomy, and treatment with high-dose oxytocin; one-to-one nursing, and customized birth classes	Jun 1991-Oct 1993
Gagnon & Waghorn (1997)	Standard maternity care with nurses attending to 2-3 laboring women at any given time	Specialized maternity care with one-to-one nursing support among specially trained nurses	Jan 1993-Jul 1994
Gimovsky & Berghella (2016)	Standard maternity care with delivery after reaching prolonged second stage of labor	"Extended care", including continuation of second stage of labor for at least one additional hour post-prolonged second stage criteria (i.e. after three hours in the second stage of labor with an epidural or two hours without an epidural)	Mar 2014-Jul 2015
Gottvall et al. (2011)	Standard maternity care with different midwives providing antenatal and intrapartum care, midwives as birth attendants and obstetricians present at delivery ward 24/7, medical technology visible, clinical hospital environment, large scale birth center	Specialized maternity modified birth center care with comprehensive care from early pregnancy through postnatal discharge, including continuity of care with same team of midwives who serve as birth attendants with obstetricians on-call, medical technology concealed in birthing room, small scale birth center	Mar 2004-Jul 2008
Harris et al. (2012)	Standard maternity care via community-based family physician, obstetricians, and midwives	Specialized team-based, shared maternity care from midwives, family physicians, nurses and doulas at South Community Birth Program; midwives and physicians remunerated at same rate; free-of-charge visits with midwife/physician for exams, lab tests, genetic counseling, and prenatal care group; comprehensive doula support; postpartum home visits and breastfeeding support by practitioner and lactation consultant; weekly drop-ins available for up to six months post-partum	Apr 2004-Oct 2010
Hodnett et al. (2002)	Standard maternity care by a nurse who had not received specialized labor support training; no time minimum or special care guidelines assigned to the usual care nurses	Specialized maternity care from specially trained nurses who provided continuous support for at least 80% of time from women's randomization upon admission through delivery	May 1999-May 2001
Hueston & Rudy (1993)	Standard maternity care; patients managed by a family physician or family practice resident	Specialized maternity care; patients managed by nurse midwives or nurse midwives-nurse midwife student pairs	1990-1991
Iglesias et al. (1991)	N/A	• Program to reduce CS rate, identify reasons for potential CS rate reduction, and identify reasons for changes in maternal and neonatal morbidity and mortality o Implementation of National Consensus Conference on Aspects of Cesarean Birth (NCCACB) guidelines with adoption of new VBAC protocol and dystocia management o New dystocia management practices included: ▪ Waiting for labor to be established beyond the latent phase (3cm dilation) and	Jan 1985-Dec 1989

Study	Comparison Group	Intervention	Study Period
		slow labor to progress to successful vaginal delivery; study modified to 4cm ▪ Augmenting a non-progressive labor with oxytocin	
Iriye et al. (2013)	• Oct 2006-Jan 2008: Traditional Model – no laborists o Traditional private practice care without dedicated in-house physician coverage; 52 obstetricians provided care, offered as-needed care for patients without designated obstetric providers on a rotating schedule	• Modified intervention o Feb 2008-Apr 2009: Community Laborist Model – continuous in-hospital laborist coverage by community staff ▪ Hospital contracted 45 community physicians to provide 24-hour coverage for obstetric emergencies and provide care for patients without designated providers due to lack of prenatal care or patients who presented at hospital where her designated obstetrician lacked admitting privileges • Intervention o Nov 2009-Oct 2011: Full-time Laborist– full-time laborists providing continuous in-hospital coverage ▪ Employment of 4 obstetricians dedicated to inpatient care, working 12-hour shifts for one week (84-hour work week)	Oct 2006-Oct 2011
Kennell et al. (1991)	• Control 1 (observed group): standard maternity care; observer recorded staff contacts, interactions, and procedures, but never interacted with patients • Control 2 (control group): standard maternity care; if admitted on days when doulas were already assigned to patients and if they met inclusion criteria, following delivery these patients were assigned to control group	Specialized maternity care; continuous labor support from bilingual Spanish-English doulas	Not Specified
Le Ray et al. (2007)	• Spontaneous onset of labor o Measured frequency of failure adhere to national consensus guidelines for elective induction; failure defined as any one of the following criteria: ▪ unripe cervix at moment of induction (Bishop score <5) ▪ method other than oxytocin used ▪ gestational age <38 weeks	Elective induction of labor based on French national consensus guidelines for elective induction	Jun 2001-May 2002
López-Zeno et al. (1992)	Standard care with timing of amniotomy, frequency of cervical examinations, and criteria for identifying adequate progress determined by attending obstetrician	AMOL, including amniotomy within one hour of labor diagnosis and oxytocin administration when cervical dilation rate had reached designated cut point	Feb 1990-Mar 1991
McGrath & Kennell	Standard maternity care from obstetricians and nurses	Specialized maternity care; doula support from admission through delivery	Oct 1988-Oct 1992

Study	Comparison Group	Intervention	Study Period
(2008)			
Mousa & Mahmood (2000)	N/A	• Intervention: comprehensive strategy to guide pre-induction cervical ripening practices o Jan 1996: development of new guidelines for induction of labor and implementation with input from local maternity units o Two prospective audit loops- Jan-Nov 1996 and Nov 1996-Nov 1997 o Retrospective review of pre-implementation inductions in 1995	Jan 1996-Nov1997
Robson et al. (1996)	N/A	• Medical audit of all deliveries from 1984 to 1989 o 1984-1989: Systematic and critical analysis of medical care, including procedures used for diagnosis and treatment, use of resources, and resulting outcomes and quality of life o 1989: Results of medical audit used to inform changes in labor ward practices, including strategies for labor management for cases of dystocia, which were then developed and introduced to practitioners o 1989-1992: Effect of these changes monitored prospectively	1984-1992
Rogers et al. (1997)	Standard maternity care with admission when patient had achieved guideline-level dilation and contractions, amniotomy and augmentation of labor with oxytocin performed at discretion of attending physician	AMOL, including strict diagnosis of labor, amniotomy performed within 2 hours of admission, augmentation of labor with oxytocin, and two-to-one nurse-to-patient ratio	Aug 1992-Apr 1996
Rouhe et al. (2012)	Standard maternity care by community nurses and referrals if necessary to women with a measured fear of childbirth[2]	Group psychoeducation therapy sessions, including six sessions during pregnancy and one session 6-8 weeks postpartum, to women with a measured fear of childbirth[2]	Oct 2007-Aug 2009
Sadler et al. (2000)	Standard maternity care; frequency of vaginal examinations, use of amniotomy, and initiation of oxytocin performed at discretion of attending physician	AMOL; women encouraged to have amniotomy at diagnosis of labor; cervical assessment performed every two hours; oxytocin augmentation initiated if progress was delayed	Jun 1993-Aug 1997
Saisto et al. (2001)	Standard maternity care supplemented with conventional therapy and standard information distribution to women with a measured fear of childbirth[3]	Intensive psychotherapy and four additional appointments with obstetrician/midwife before delivery to women with a measured fear of childbirth[3]	Aug1996-Jul 1999
Stoll & Hall (2012)	Standard maternity care; no attendance at childbirth education classes	Standard maternity care supplemented by attendance at childbirth education classes	May 2005-Jul 2007
Tracy et al. (2014)	• Control 1: standard care; midwife care in discrete wards or clinics, staff and trainee obstetrician care in public hospitals, and community-based general medical practitioner care • Control 2: private obstetrician care; fee-for-service private maternity care during pregnancy, labor, and delivery with management decisions made by private obstetricians	Maternity group practice care; caseload midwifery responsible for management of pregnancy, labor, delivery and postpartum care	Jul 2009-Dec 2010

Study	Comparison Group	Intervention	Study Period
Wilson-Leedy et al. (2016)	N/A	• Formal guidelines for labor management: o Pre-Apr 15, 2014 (pre-guideline implementation): no formal guidelines regarding labor management o Post-guideline ▪ Feb 28, 2014- guidelines for labor management published ▪ Apr 15, 2014- guidelines adopted as practice standard at the hospital, policy presented at departmental meetings, circulated to all faculty and residents via e-mail, included among nursing policies, and made available online	Sep 2013-Sep 2014

[1] High fear scores defined as $\geq$ 66 on the Wijma Delivery Expectancy/Experience Questionnaire.
[2] High fear of childbirth scores defined as $\geq$ 100 on the Wijma Delivery Expectancy/Experience Questionnaire.
[3] Fear of childbirth defined as five or more affirmative answers to specific fear of childbirth screening questionnaire or request for cesarean delivery.

Table 5. Intervention Components.

	Patient			Provider						Hospital						POPULATION-BASED SYSTEMS		
																Community	State	National
Study	Childbirth education classes	Intensive therapy	Psychoprophylaxis	Active management of labor	Continuity of care (caseload)	Labor support	Epidural analgesia	Midwifery	Prolonged second stage of labor	Chart audit and feedback	Elective induction policy	Guideline change and implementation	Organizational changes	Peer review	Quality improvement	Outreach	Place of birth	Policy/Guideline
PATIENT ONLY (n=5)																		
Bergstrom et al. (2010)			X															
Fenwick et al. (2015)		X																
Rouhe et al. (2012)		X																
Saisto et al. (2001)		X																
Stoll & Hall (2012)	X																	
PROVIDER ONLY: LABOR SUPPORT (n=5)																		
Campbell et al. (2006)						X												
Gagnon & Waghorn (1997)						X												
Hodnett et al. (2002)						X												
Kennell et al. (1991)						X												
McGrath & Kennell (2008)						X												
PROVIDER ONLY: EXCLUDING LABOR SUPPORT (n=13)																		
Cammu et al. (1996)				X														
Davey et al. (2013)					X													
Davis et al. (1994)								X										
Dickinson et al. (2002)					X		X	X										
Eide et al. (2009)								X										
Eriksen et al. (2011)							X											
Eriksson et al. (2006)							X											
Gimovsky & Berghella (2016)									X									
Hueston & Rudy (1993)								X										
López-Zeno et al. (1992)				X														
Rogers et al. (1997)				X														
Sadler et al. (2000)				X														
Tracy et al. (2014)					X	X												

	Patient			Provider						Hospital						POPULATION-BASED SYSTEMS		
																Community	State	National
Study	Childbirth education classes	Intensive therapy	Psychoprophylaxis	Active management of labor	Continuity of care (caseload)	Labor support	Epidural analgesia	Midwifery	Prolonged second stage of labor	Chart audit and feedback	Elective induction policy	Guideline change and implementation	Organizational changes	Peer review	Quality improvement	Outreach	Place of birth	Policy/Guideline
HOSPITAL ONLY (n=4)																		
Altimier et al. (2011)										X		X	X	X	X			
Iriye et al. (2013)													X					
Mousa & Mahmood (2000)										X	X	X						
Robson et al. (1996)										X		X	X		X			
PATIENT + PROVIDER (n=1)																		
Frigoletto et al. (1995)	X			X		X		X										
PROVIDER + POPULATION-BASED SYSTEMS (n=2)																		
Gottvall et al. (2011)					X	X											X	
Harris et al. (2012)						X											X	
HOSPITAL + POPULATION-BASED SYSTEMS (n=3)																		
Iglesias et al. (1991)												X	X		X			X
Le Ray et al. (2007)											X	X			X			X
Wilson-Leedy et al. (2016)												X						X
PROVIDER + HOSPITAL + POPULATION-BASED SYSTEMS (n=1)																		
Blomberg (2016)								X		X			X		X	X		

Table 6. Study Results.

Study	Results
Altimier et al. (2011)	• Rate of CS among electively induced women at the level II hospital decreased from 37.4% (2005) to 31.5% (2006) to 25% (2007) o From 2005 to 2006, one year after hospital review was launched, there was a 5.9% decrease in CS ($p<0.05$)[2] o From 2006 to 2007, two years after hospital review was launched and supplemental changes to elective induction policies and practices were made, there was a 6.5% decrease in CS ($p<0.05$)[2]
Bergstrom et al. (2010)	• Rate of CS lower in psychoprophylaxis use group vs. control group[1] (11.7% vs. 17.3%; $p<0.05$)
Blomberg (2016)	• Rate of CS decreased from 20% (2006) to 10% (2014); $p<0.05$
Cammu et al. (1996)	• Rate of CS higher in AMOL group vs. control group (3.9% vs. 2.6%; $p>0.05$)[2]
Campbell et al. (2006)	• Rate of CS higher in doula vs. control group (18.9% vs. 17.9%, $p>0.05$)
Davey et al. (2013)	• Rate of CS lower in caseload midwifery group vs. standard care group (14.6% vs. 20.2%; OR=1.49, $p<0.05$), though this difference was not significant after adjustment for cervical dilatation of 5cm or more upon admission, maternal age, and maternal BMI (OR=1.41, $p>0.05$)
Davis et al. (1994)	• Rate of CS lower in CNM group vs. physician group (12.7% vs. 18.1%; $p<0.05$)
Dickinson et al. (2002)	• Rate of CS lower in CMS group vs. epidural group[1] (14.2% vs. 17.2%; $p>0.05$)
Eide et al. (2009)	• Rate of emergency CS higher in CDW group vs. MLW group[1] (7.0% vs. 6.3%; OR=1.1, 95% CI: 0.5–2.2)
Eriksen et al. (2011)	• Rate of emergency CS higher in epidural group vs. control group[1] (24.5% vs. 4.4%; $p<0.05$)
Eriksson et al. (2006)	• Hospitals with lowest proportions of CS (9.1%) were also those with the lowest (20-29%) and highest (60-64%) frequencies of epidural o Hospitals with 20-29% frequency epidural block at lower risk for CS than 40-49% frequency (OR=0.84; 95% CI: 0.77-0.93) o Hospitals with 60-64% frequency epidural block at lower risk for CS than 40-49% frequency (OR=0.85; 95% CI: 0.77-0.93) • Hospitals with 30-39%, 40-49%, and 50-59%, proportion of deliveries as CS varied between 10.3 and 10.6%; not statistically significant • CS rates vary in relationship to frequency of epidural block, but in no consistent linear fashion. Results do no suggest a linear relationship of percentage of epidural block with CS rates in any hospital, except level I where the numbers are too small to draw any conclusions.
Fenwick et al. (2015)	• Rate of CS lower in psycho-education group vs. control group[3] (35.3% vs. 47.0%; $p>0.05$)[2]
Frigoletto et al. (1995)	• Rate of CS among protocol-eligible women lower in AMOL group vs. control group (10.9% vs. 11.5%; $p>0.05$) after adjustment for epidural use and adoption of final protocol (three hours for second stage of labor with epidural); (OR=0.9, 95% CI: 0.4–1.9)
Gagnon & Waghorn (1997)	• Rate of CS lower in nursing support group vs. control group (13.9% vs. 16.2%; RR=0.86, 95% CI: 0.54–1.36)
Gimovsky & Berghella (2016)	• Rate of CS lower in extended care group vs. usual care group (19.5% vs. 43.2%; RR=0.45, 95% CI: 0.22–0.93)
Gottvall et al. (2011)	• Rate of CS lower in MBCC group vs. standard care group (18.9% vs. 25.6%; OR=0.61, 95% CI: 0.52–0.72); adjusted for maternal age, country of birth, education, income, smoking before pregnancy, elective cesarean section, and gestational age
Harris et al. (2012)	• Rate of CS lower in SCBP group vs. standard care group (24.1% vs. 32.4%; RR=0.81, 95% CI: 0.72–0.91)
Hodnett et al. (2002)	• Rate of CS higher in continuous labor support group vs. usual care group (19.7% vs. 19.5%; $p>0.05$)
Hueston & Rudy (1993)	• Rate of CS lower in nurse midwife group vs. family physician group (4.3% vs. 7.5%; $p=0.05$)
Iglesias et al. (1991)	• Rate of CS decreased from 23% (1985) to 12% (1989); $p>0.05$
Iriye et al. (2013)	• Rate of CS differed significantly between the three groups: no laborist care (39.2%), community physician laborist care (38.7%), and full-time laborists (33.2%); $p<0.05$
Kennell et al. (1991)	• Rate of CS lower in supported group vs. observed group (8% vs. 13%; $p<0.05$) • Rate of CS lower in supported group vs. control group (8% vs. 18%; $p<0.05$)
Le Ray et al. (2007)	• Rate of CS identical in elective induction group vs. spontaneous induction group (4.1% vs. 4.1%)
López-Zeno et al. (1992)	• Rate of CS lower in AMOL group vs. traditional management (10.5% vs. 14.1%; $p<0.05$)
McGrath & Kennell (2008)	• Rate of CS lower in doula group vs. control group (13.4% vs. 25.0%; $p<0.05$)

Study	Results
Mousa & Mahmood (2000)	• Rate of CS among induced women decreased from 18% (1995) to 16% (1996) to 16% (1997); (p>0.05)
Robson et al. (1996)	• Rate of CS decreased between pre-medical audit cycle (13.2%; 1984-1989) and post-medical audit cycle (9.6%; September 1989-August 1992); p<0.05
Rogers et al. (1997)	• Rate of CS lower in AMOL group vs. control (7.5% vs. 11.7%; p>0.05)
Rouhe et al. (2012)	• Rate of CS lower in psychoeducative group therapy for FC vs. control (22.9% vs. 32.5%; p=0.05) • Rate of CS among those who actually participated in intervention lower in psychoeducative group therapy for FC vs. control (23.3% vs. 38.7%; p<0.05)
Sadler et al. (2000)	• Rate of CS lower in AMOL group vs. routine care (9.4% vs. 9.7%; p>0.05)
Saisto et al. (2001)	• Rate of CS higher in intervention vs. control (43.1% vs. 41.3%; p>0.05)[2]
Stoll & Hall (2012)	• Rate of CS lower in childbirth education classes group vs. no classes (30.2% vs. 49.2%; p<0.05)
Tracy et al. (2014)	• Rate of CS lower in MGP group (15.4%) vs. standard hospital care (19.5%) vs. private obstetric care (17.6%); (p>0.05)
Wilson-Leedy et al. (2016)	• Rate of CS among induced women decreased before and after guideline implementation (26.9% vs. 18.8%; p<0.05)

*CS refers to "cesarean section".
[1]Rate of CS among women who planned to have vaginal deliveries.
[2]Statistical significance of this result was calculated by authors (CK & DS).
[3]Rate of CS obtained from emergency and elective CS rates presented.

Table 7. Summary of Study Results.[1]

Study	Rate of Cesarean Delivery Among Nulliparous Women
PATIENT ONLY	
Bergstrom et al. (2010)	+
Fenwick et al. (2015)	ns
Rouhe et al. (2012)^	+
Saisto et al. (2001)	ns
Stoll & Hall (2012)	+
PROVIDER ONLY: LABOR SUPPORT	
Campbell et al. (2006)	ns
Gagnon & Waghorn (1997)	ns
Hodnett et al. (2002)	ns
Kennell et al. (1991)	+
McGrath & Kennell (2008)	+
PROVIDER ONLY: EXCLUDING LABOR SUPPORT	
Cammu et al. (1996)	ns
Davey et al. (2013)	ns
Davis et al. (1994)	+
Dickinson et al. (2002)	ns
Eide et al. (2009)	ns*
Eriksen et al. (2011)	–*
Eriksson et al. (2006)	ns
Gimovsky & Berghella (2016)	+
Hueston & Rudy (1993)	ns
López-Zeno et al. (1992)	+
Rogers et al. (1997)	ns
Sadler et al. (2000)	ns
Tracy et al. (2014)	ns
HOSPITAL ONLY	
Altimier et al. (2011)	+
Iriye et al. (2013)	+
Mousa & Mahmood (2000)	ns
Robson et al. (1996)	+
PATIENT + PROVIDER	
Frigoletto et al. (1995)	ns
PROVIDER + POPULATION-BASED SYSTEMS	
Gottvall et al. (2011)	+
Harris et al. (2012)	+
HOSPITAL + POPULATION-BASED SYSTEMS	
Iglesias et al. (1991)	ns
Le Ray et al. (2007)	ns

Wilson-Leedy et al. (2016)	+
PROVIDER + HOSPITAL + POPULATION-BASED SYSTEMS	
Blomberg (2016)	+

[1] With regards to the symbols, "+" refers to a statistically significant favorable outcome on a p=0.05 level; "–"refers to a statistically significant unfavorable outcome on a p=0.05 level; "ns" refers to a non-significant outcome.
*Refers to rate of emergency cesarean delivery, as study did not present overall cesarean delivery rates including non-emergency cesareans.
^Results presented based on per-protocol analysis of participants.

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