Appendix 1. Description of the Maryland Perinatal Quality Improvement Collaborative

The Maryland Perinatal Quality Improvement Collaborative (MPQC) is coordinated by the Maryland Patient Safety Center with financial support from the Maryland Department of Health. In June 2016, the MPQC began a collaborative to reduce the state's primary cesarean delivery rate by implementing the "Safe Reduction of Primary Cesarean Births" patient safety bundle. Among the 32 birthing hospitals across the state, 31 agreed to participate, submitting an agreement form signed by the hospital's chief executive.

The requirements for collaborative participation, as described in the agreement form, included "participation in collaborative events [meetings and conference calls], data collection, and sharing opportunities; effort toward implementation and commitment to the elements of the 'Safe Reduction of Primary Cesarean Births.'" These requirements, and associated resources and supports provided through the collaborative, are described in further detail below:

- **Effort towards implementation the elements of the bundle:** Participating hospitals committed to actively make progress on implementing practices included in the bundle. Hospitals were not instructed on how to organize these efforts at their hospital or which bundle practices they should implement first. Hospitals were provided with the two-page bundle document and the list of additional resources on the Council on Patient Safety in Women's Healthcare website.[1] The additional resources that hospitals could choose to utilize to support their implementation effort include the Council's "Implementing Quality Improvement Projects Toolkit"[2] and the California Maternal Quality Collaborative's "Toolkit to Support Vaginal Birth and Reduce Primary Cesareans" and corresponding implementation guide.[3]
- **Participate in collaborative meetings:** The collaborative held in-person meetings at the start of the collaborative (June 2016), after one year (July 2017), and at the close of the collaborative (November 2018). Each participating hospital was required to send at least one staff member. These meetings included expert presentations related to the collaborative topic, updates on progress across the collaborative, and opportunities for networking and information sharing between hospitals.
- **Participate in collaborative conference calls:** The collaborative convened 21 conference calls over 24 months and each hospital was required to have one staff member participate in every call. Calls took place monthly for the first six months and then every 2 to 3 months thereafter. During the calls, hospital staff had opportunities to ask questions to clarify bundle components, learn how other hospitals were implementing

[1] Available at: https://safehealthcareforeverywoman.org/patient-safety-bundles/safe-reduction-of-primary-cesarean-birth/

[2] A 30-page introduction to quality improvement methods available at: https://safehealthcareforeverywoman.org/wp-content/uploads/2017/12/Implementing-Quality-Improvement-Projects-Toolkit_V1-May-2016.pdf

[3] The toolkit is a detailed, 159-page document describing most clinical practices in the bundle. The implementation guide provides a recommended order for practice adoption. Both are available at: https://www.cmqcc.org/VBirthToolkit

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- **Data collection:** Hospitals were required to submit indicators recommended in the bundle to the AIM portal on a quarterly basis.[4] These indicators included 4 patient outcome measures (e.g., primary cesarean delivery rates), 3 process measures (e.g., provider training and bundle compliance rate), and 4 structure measures (e.g., presence of labor support policies and electronic health record integration). The collaborative staff at Maryland Patient Safety Center assisted hospital staff with accessing the portal and entering data when they experienced challenges. The data reported in this study were not a part of required reporting and were collected separately.
- **Sharing opportunities:** In addition to sharing information during meetings and conference calls, collaborative staff at the Maryland Patient Safety Center (MPSC) facilitated several other sharing channels. First, a listserv was maintained for sharing and answering questions in between scheduled meetings. Second, the MPSC staff sometimes collected and shared sample hospital policy documents or clinical tools from hospitals willing to share them.
- **Webinars:** The collaborative hosted 8 optional learning webinars with presentations from content experts. Six webinars addressed clinical topics (e.g., "Common Non-Medical Indications for Induction of Labor") and two addressed quality improvement topics (e.g., "Using Data to Monitor Change").
- **Site visits:** Eleven hospitals also received a site visit from the Director of Operations at the MPSC, at the request of the hospital. Site visits were made for a variety of reasons, including to assist hospital-based team leads with using the data portal, to participate in presentation of data to hospital providers and staff, and to review the collaborative goals and responsibilities with new team leads when there was turnover at a hospital.

[4] Indicator definitions are available in the file "AIM Data Collection Plan" on the AIM program website data page: https://safehealthcareforeverywoman.org/aim-data/

Appendix 2. Relevant Practices Assessed by Cesarean Bundle Domains and Components

AIM Cesarean Bundle Component	Relevant Practices Assessed in the Survey
Readiness	
Build a provider and maternity unit culture that values, promotes, and supports spontaneous onset and progress of labor and vaginal birth and understands the risks for current and future pregnancies of cesarean birth without medical indication.	Create a team of providers, staff and administrators to lead the effort and cultivate buy-in*
	Implement a policy to integrate doulas into the birth care team*
Optimize patient and family engagement in education, informed consent, and shared decision making about normal healthy labor and birth throughout the maternity care cycle.	Develop a program with positive messaging to women and their families about intended vaginal birth strategies for use throughout pregnancy and birth*
	Introduce principles of shared decision-making*
Adopt provider education and training techniques that develop knowledge and skills on approaches which maximize the likelihood of vaginal birth, including assessment of labor, methods to promote labor progress, labor support, pain management (both pharmacologic and non-pharmacologic), and shared decision making.	Develop a program for ongoing staff training on labor and support techniques including caring for women with regional anesthesia*
Recognition and Prevention	
Implement standardized admission criteria, triage management, education, and support for women presenting in spontaneous labor.	Standardized admission criteria for women presenting in labor
	Standardized triage management for women presenting in labor
	Implement protocols and support tools for women who present in latent labor to safely encourage early labor at home*
Offer standardized techniques of pain management and comfort measures that promote labor progress and prevent dysfunctional labor.	Offer standardized techniques of pain management
	Offer comfort measures to promote labor progress and prevent dysfunctional labor
	Implement policies and/or protocols to encourage movement in labor for low-risk women*
	Implement policies and/or protocols for intermittent monitoring for low-risk women*
Use standardized methods in the assessment of the fetal heart rate status, including interpretation, documentation using NICHD terminology, and encourage methods that promote freedom of movement.	Use standardized assessment, interpretation, and documentation of fetal heart rate status using NICHD terminology

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Adopt protocols for timely identification of specific problems, such as herpes and breech presentation, for patients who can benefit from proactive intervention before labor to reduce the risk for cesarean birth.	--[1]
Response	
Have available an in-house maternity care provider or alternative coverage which guarantees timely and effective responses to labor problems.	Establish an in-house maternity care provider or alternative coverage for response to labor problems*[2]
Uphold standardized induction scheduling to ensure proper selection and preparation of women undergoing induction.	Uphold standardized induction scheduling
Utilize standardized evidence-based labor algorithms, policies, and techniques, which allow for prompt recognition and treatment of dystocia.	Implement standard criteria for diagnosis and treatment of labor dystocia, arrest disorders, and failed induction*
Adopt policies that outline standard responses to abnormal fetal heart rate patterns and uterine activity.	Adopt standard criteria for diagnosis and treatment of abnormal fetal heart rate patterns and uterine activity*
Make available special expertise and techniques to lessen the need for abdominal delivery, such as breech version, instrumented delivery, and twin delivery protocols.	Implement training/procedures for identification of breech position and breech version technique*[2]
	Conduct training in instrumented delivery*[2]
	Establish twin delivery protocols*[2]
Reporting/Systems Learning	
Track and report labor and cesarean measures in sufficient detail to: 1) compare to similar institutions, 2) conduct case review and system analysis to drive care improvement, and 3) assess individual provider performance.	Track provider level cesarean rates
	Provide feedback to each provider on his/her rates
	Share provider level rates with the department*
Track appropriate metrics and balancing measures, which assess maternal and newborn outcomes resulting from changes in labor management strategies to ensure safety.	Perform monthly case reviews to identify consistency with dystocia and induction guidelines*
	Establish a project communications plan*
	Integrate new tools or guidelines into the Electronic Health Record System*

Notes: *Denotes use of the explicit "steps" recommended in the Implementation Guide for the Toolkit to support Vaginal Births and Reduce Primary Cesarean released by the California Maternal Quality Care Collaborative (CMQCC) in April 2016. [1] Number of possible protocols was considered too large to assess adoption of any individual such protocols. Implementation of training/procedures for identification of breech position and breech version technique is assessed under Response. [2] Listed under Recognition and Prevention domain in the CMQCC Toolkit.

Appendix 3. Definitions of Implementation Strategies

Implementation Strategies	Definition Provided to Respondents in Survey
Use Evaluative and Iterative Strategies	
Conduct a readiness assessment	Assess various aspects of your hospital to determine its degree of readiness and identify potential barriers and facilitators for implementation
Conduct a local needs assessment	Same as strategy name
Identify early adopters of guidelines	Identify early adopters of the guidelines in the AIM bundle to learn from their experiences
Conduct cyclical small tests of change	Implement changes in a cyclical fashion using small tests of change before taking changes system wide
Purposely reexamine the implementation of the bundle	Monitor progress and adjust clinical practices and implementation strategies to continuously improve the quality of care
Develop a formal implementation blueprint	Develop a formal implementation blueprint specific to your hospital, that includes all goals and strategies for your implementation of the AIM bundle
Stage implementation scale up	Phase implementation efforts by starting with small pilots or demonstration projects and gradually move to a system wide roll out
Adapt and Tailor to Context	
Tailor AIM recommended strategies and interventions	Tailor the implementation strategies to address barriers and leverage facilitators that were identified through earlier data collection
Promote adaptability of bundle components	Identify the ways the bundle can be tailored to meet local needs and clarify which elements of the bundle must be maintained to preserve fidelity
Develop Stakeholder Interrelationships	
Conduct consensus discussions	Include providers and other stakeholders in your hospital in discussions that address whether the chosen problem is important and whether the clinical innovation to address it is appropriate
Identify and prepare champions	Identify and prepare champions, individuals who dedicate themselves to driving through the implementation
Inform opinion leaders	Inform providers in your hospital identified by colleagues as opinion leaders or "educationally influential" about the clinical innovation in the hopes that they will influence colleagues to adopt it
Involve executive boards	Involve existing governing structures in your hospital (e.g. boards of directors) in the implementation effort, including the review of data on implementation processes
Engage Consumers	
Involve patients and family members in bundle implementation efforts	Same as strategy name
Obtain and use patient and family member feedback	Develop strategies to increase patient and family feedback on the implementation effort

Notes: Strategies were selected from the Expert Recommendations for Implementing Change study. Three team members reviewed the definitions (2 clinicians and an implementation scientist).