Chapter 5. Future Research

It is clear from this report, that the literature about TOL and ERCD is significantly flawed.

- One of the highest priorities for future research should be the development of standardized reporting measures of disease severity and outcomes of delivery. For example, standardized reporting of disease/condition severity especially for conditions with devastating consequences such as uterine rupture, and precise definitions for important health outcomes, such as delineation between outcome and predictor such as fetal tracing findings and clinically significant uterine rupture, to enable identification of important for premonitory predictors.
- Studies also need to be consistent in the definition of their conceptual cohort. In comparing TOL to ERCD, it is important to ensure that the ERCD group would have been eligible for a TOL.
- Future studies of tools to predict likelihood of vaginal delivery need to be tested in populations with varying baseline risk and also add considerations for the consequences of prediction such as the likelihood of clinically significant uterine rupture from a false positive test.
- Patients make decisions by a complex process weighing social ramifications and values in parallel with probabilities of health risks. Therefore, future studies should focus on accurately measuring this important dimension of childbirth decisionmaking.
- Patients make decisions based on short and long-term consequences of their choices. Therefore, further research needs to focus on long-term health outcomes such as pelvic floor dysfunction, incontinence, or the long-term repercussions of neonatal conditions such as neurologic and respiratory conditions.
- In order to consider long-term consequences and quality of life, studies need to use appropriate long-term methods such as survival analysis and studies that use QALYs need to be able to delineate maternal and neonatal consequences separately and in present data in a meaningful way.
- Factor such as malpractice coverage, and insurance variation, limit patients' ability to choose. No data was available for this very real determinant. Future studies are needed to examine the impact of factors such as the malpractice crisis and malpractice reform on choices available and outcomes from TOL and ERCD.

Vaginal Delivery Rates

- Future studies of vaginal delivery rates in TOL, should evaluate the impact of labor management strategies such as induction of labor on likelihood of success.
- Studies examining the factors that may explain why vaginal delivery rates differ in some study populations are needed.

Predictive Tools

- Studies with the objective of creating a predictive tool should attempt to use a prospective study design, avoid workup or verification bias (i.e., try to incorporate all of those who are eligible for a TOL into the study, instead of only those who decide on that route of delivery), and specify the reproducibility and generalizability of the predictive tools by validating it in another distinct population.
- Although the avoidance of workup or verification bias might be difficult if not impossible to do, one can minimize this bias by maximizing the percentage of those eligible for a TOL that actually attempt a TOL.
- By weighting the contribution of each variable and adjusting for confounding distortion, the use of a point system based on Beta coefficients and logistic regression modeling might provide more accurate and precise estimates of the probability of vaginal delivery.
- To date, the two best scoring systems are by Flamm and Troyer. Each of these scoring systems could benefit from further validation studies (e.g., using a non-HMO study population with the Flamm scoring system, and using a prospectively designed validation study with the Troyer scoring system).

Maternal and Infant Health Outcomes

Future research should focus on conducting methodologically rigorous studies to provide direct evidence regarding the relative benefits and harms of trial of labor and ERCD. If randomized trials are not done, good-quality studies of TOL versus ERCD must pay attention to the following:

Population - Studies should be conducted in populations of women who are similar in every respect except choice of delivery route (comparability of groups).

Specificity of Intervention - Studies should pay close attention to and account for the importance of co-interventions such as use of oxytocin and other medical agents for augmentation or induction of labor.

Precise and Standard Outcome Measures Variations in reporting of important clinical outcomes were striking. Studies should consider the following factors in developing outcome measures:

- **Etiology** - Outcomes such as hysterectomy, infection, maternal mortality, perinatal mortality must pay specific attention to explicitly identifying the etiology. Lack of precision in this regard allows for both under and over- reporting of cases due to misclassification. Examples include whether hysterectomy was performed due to maternal hemorrhage secondary to clinically significant uterine rupture versus hemorrhage due to abruption, uterine rupture through the uterine fundus in a woman with a low transverse incision either due to trauma or other non-incisional causes, and perinatal death due to lethal anomaly versus intolerance or management of labor.

- **Standard Terminology** - In order to accurately measure outcomes, there must be a consistent terminology. Lack of this, prevents accurate and meaningful comparisons of risks for each delivery choice. Outcomes such as infection, hemorrhage, and uterine rupture were not consistently defined.

- **Separating prevention/prediction strategies from outcomes**- As long as potentially important predictors of events such as prolonged fetal bradycardia as a predictor for clinically significant uterine rupture are included in the definition of uterine rupture, their true value as a predictor rather than a confounder will remain unknown.

Uterine Rupture

- Future studies need to use standard terminology for uterine rupture. Motivated by this need, we convened a conference call of national experts including representatives from the American College of Obstetricians and Gynecologists, American Academy of Family Physicians, Centers for Disease Control and Prevention, National Institutes of Health, and investigators from major VBAC studies to begin terminology discussions. The group proposed terminology based on anatomic findings. The term complete uterine rupture of a cesarean scar would be used to indicate a separation of all layers of the uterine wall including serosa. Incomplete rupture of a cesarean scar would be used to indicate a defect that did not extend through the entire thickness of the uterine wall (e.g. serosa intact). This latter term would include what are often referred to as uterine windows. Details are provided in Appendix G.
- Studies should be explicit in reporting uterine rupture related health outcomes. Inconsistencies in reporting health outcomes such as perinatal death, maternal death, and hysterectomy attributable to uterine rupture, limits our ability to fully appreciate the significance of this condition.
- Every effort should be made in future research studies to separate important predictors from the definition of uterine rupture. Failure to do so limits the ability to determine the value of factors such as fetal bradycardia as a predictor of risk.
- Fetal bradycardia should be further explored as an important predictor of uterine rupture by use of a control group and reporting all instances of fetal bradycardia that occur in patients undergoing a TOL and the frequency of finding uterine rupture for this signal.

Health Status

- Attention to development of a tool focused on maternal health that includes a woman's ability to care for her infant.
- Measurement of maternal and infant health status that measures these outcomes longitudinally over time.
- Documentation of delivery process (e.g., TOL followed by repeat CD, VBAC, or ERCD) as it relates to health status.

Patient Satisfaction

- Measurement and comparison of satisfaction as it relates to all delivery processes (TOL followed by repeat CD, VBAC, repeat CD).
- Ascertainment of the level of information provided to the patient and the level of involvement in decisionmaking. A future trial could test the effect on patient satisfaction and/or other psychosocial outcomes of the use of various approaches to providing information and involving the women in decisions. Intervention patients in these trials might receive packets that include videos, pamphlets, access to a computerized decision aid, etc., covering the risks, benefits, and realities of recovery from either TOL or ERCD. Intervention patients would also be given many opportunities to become involved in the decisionmaking.

Cost and Health Care Resources

Ascertainment of true cost data. Data on costs (rather than charges) is sparse in the literature relating to these two alternatives. The costs of labor and delivery and of the surgical processes are poorly understood. Detailed time-in-motion studies would help to estimate these costs. The costs of specific health outcomes (as adverse events) are also poorly understood. This is especially true for outcomes that might have long-term societal costs such as special education and lost productivity for severe adverse neonatal outcomes, and lost productivity for maternal deaths. Economic evaluations need to estimate these costs in a better way and to include these long-term costs in models. Once costs are available, economic evaluations need to assume a societal perspective, use QALYs as a summary outcome measure, allow for two or more pregnancies after an initial CD, and include all adverse outcomes and associated long-term costs of these outcomes.

Individual Factors

- First of all, there is a need for studies to consider certain factors such as maternal race, spontaneous and induced labor, oxytocin use, and nonclinical factors (i.e., the nonitalicized factors in the above table). Previous studies of these factors have demonstrated their influence on the outcome of TOL; however, the lack of adjustment for potential confounders makes the interpretation of these associations less valid.
- Second, there is the question of which study design best addresses this issue. Although database studies easily allow for large sample sizes (and hence the power to detect differences), they are often limited by the lack of individual patient data and thus the ability to control for confounding. While retrospective cohorts usually allow for the adjustment of confounders using individual patient data, they are limited by the availability and validity of previously collected data. Overall, it appears that the prospective cohort design allows the best opportunity to address the issue of predictive factors. Although expensive and time-consuming, this design allows one to collect the information desired, in a manner that improves the validity of the results.

- Third and perhaps most important, there is an overwhelming lack of adjustment for confounding in the literature. Evaluation of the fair-to-good-quality studies showed that certain factors had a significant influence over the outcome of a TOL; these factors include but are not limited to: prior VD, order of prior VD (especially vaginal delivery after prior CD), cervical dilation, cervical effacement, and Bishop's score. This finding only strengthens the importance of considering these other factors when conducting research and making clinical decisions.

Patient Preferences

- Develop an instrument to measure a women's preferences for birth. The instrument should include preferences related to both risk and social motives.
- It remains unclear if VBAC education increases the proportion of women who choose TOL. Future studies of education should include education before next pregnancy, perhaps at the postnatal visit of patients with first CD.

Health Care Resources

- Future research on units of health care resources should address more than LOS. Other important units of resources include time spent in labor and delivery and time spent in steps in the surgical process. Resources associated with serious adverse events also need to be estimated (e.g., special education after severe neonatal outcomes).
- Research involving units of health care resources (e.g., LOS) should either compare TOL and ERCD at similar baseline risk or perform careful adjustment for baseline risk factors and other confounding variables. Otherwise comparisons of these resources suffer potential biases.
- If more detailed economic evaluations are conducted (i.e., that go beyond the total patient charge), the units of health care resources should be identified as part of that study. Further, the trade-offs between all the other economic outcomes (beyond LOS) will require full economic analyses to compare difference units of resources appropriately.

Implications for Legal, Health Care System, and Provider Characteristics

Across legal or legislative factors, guidelines, provider characteristics, hospital characteristics, and types of insurance or payments, there are several general future research needs. Research needs specific to one of these are presented after the general needs.

- Studies must either focus on a relatively homogeneous low-risk patient to compare across providers or to adjust analyses carefully for baseline risk and other potential confounding variables, to make sure comparisons among levels of characteristics are valid.
- Studies also need to include as many potential predictors and potential confounders as possible. While this review has separated these health care system characteristics for ease

of discussion, proper evaluation should include all of these. That is, a hospital characteristic might be a potential confounder for insurance type.

- Complete evaluation of all of these health care system characteristics in a single set of analyses will require consortium level research. That is, only if large, complete data sets are assembled from multiple sources (including hospitals, insurers, and physicians) will research to address all of these diverse characteristics be possible.
- For future research on the impact of legal and legislative characteristics on the choice of mode of delivery, studies need to be long term, collect adequate data on potential confounders, and estimate any underlying time trend independent of the intervention.
- Guidelines, especially as championed by an opinion leader, have been demonstrated to effectively modify provider behavior (e.g., to increase rates of VBAC). Other approaches (e.g., peer review and audit) have not demonstrated a clear impact on changing VABC rates. Further research into alternative systems of rewards (e.g., bonus payments for a successful VBAC in patients who meet guidelines) and or punishments (e.g., including VBAC rate as a quality index) might also warrant additional research.
- Studies looking at provider characteristics need to adjust for baseline differences in risk and other potential confounding variables.
- Also, for provider (and hospital) characteristics, the analysis must match the sampling design. Specifically, patients are attended by physicians and deliver at specific hospitals. The clustered nature of this relationship (patient nested and clinician nested within one or two hospitals) needs to be reflected in the statistical analyses employed.
- With respect to hospital characteristics, future studies need to make definitions of different characteristics as clear as possible. This is especially important, as some hospital characteristics are potentially confounded with one another. For example, hospitals that have high levels of care, have NICUs, are teaching hospitals, and have large numbers of deliveries might be the same small set of hospitals. That is, particular hospital characteristics might occur as groups and not as independent factors.
- A relationship between insurance type and rates of VBAC has not been demonstrated. However, to the extent that VBAC rate is becoming a quality measure, additional research on this particular association might not be warranted. If rate of VBAC becomes a widely used quality measure, there will likely be no association with type of insurance.
- Malpractice insurance premiums may also influence the decision on mode of delivery for women with prior CD. Increasing rates of malpractice insurance might lead some providers either to not provide any delivery services or to choose a mode of delivery perceived to be less risky for mother and/or child. Careful evaluations of rates of VBAC and ERCD across time (before and after changes in premiums) and across geographic regions (one or more in which changes in premiums were large and one or more in which changes in premiums were small) would allow appropriate comparisons to be made. That is, the changes in rates in the geographic region(s) in which the premiums were high could be compared with rates in the region(s) in which premiums were low. Inclusion of potential confounders including patient-level risk factors would need to be included in any such study.