

Guidelines for antenatal and preoperative care in cesarean delivery: Enhanced Recovery After Surgery Society recommendations (part 1)—2025 update



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BACKGROUND: Enhanced recovery after cesarean delivery protocols include evidence-based interventions designed to improve patient experience, pregnancy, and neonatal outcomes while reducing healthcare-related costs. This is the first update of the Enhanced Recovery After Surgery Society guidelines for antenatal and preoperative care before cesarean delivery after the original publication in 2018.

METHODS: Interventions were selected based on expert consensus using the Delphi method. An updated literature search was conducted in September 2024 using the Embase, PubMed, MEDLINE, EBSCO CINAHL (Cumulative Index of Nursing and Allied Health Literature), Scopus, and Web of Science databases. Targeted searches were performed by a medical librarian to identify relevant articles published since the 2018 Enhanced Recovery After Surgery Society guidelines publication, which evaluated each antenatal and preoperative enhanced recovery after cesarean delivery intervention, focusing on randomized clinical trials and large observational studies (≥ 800 patients) to maximize search feasibility and relevance. Following a review of the evidence, a consensus was reached regarding the quality of evidence and the strength of recommendation for each proposed intervention according to the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system.

RESULTS: The 6 recommended enhanced recovery after cesarean delivery interventions are (1) antenatal pathway patient education for scheduled caesarean delivery (evidence low to very low, recommendation strong); (2) multidisciplinary medical and surgical staff education regarding enhanced recovery after cesarean delivery support, intervention implementation, and measurement (evidence low, recommendation strong); (3) optimization of the medical care for pregnant patients with comorbid conditions, such as anemia, obesity, hypertension, prepregnancy and gestational diabetes, smoking (tobacco, cannabis, vaping), congenital heart disease, epilepsy, autoimmune disease, and asthma (evidence moderate, recommendation strong); (4) abdominal skin preparation with chlorhexidine gluconate impregnated cloth (evening before scheduled cesarean delivery) (evidence moderate; recommendation weak); (5) the duration of preoperative fasting based on the content intake (evidence low, recommendation weak); (6) the use of a preoperative, nonparticulate carbohydrate drink (evidence low-moderate, recommendation strong).

CONCLUSION: The first 3 recommendations are for use in the antenatal period (10–38 weeks of gestation), which allow for the optimization of patient comorbidities, whereas the remaining 3 recommendations are for preoperative interventions (skin preparation, preoperative fasting directives, and preoperative carbohydrate supplementation). Educational tools for cesarean delivery with well-designed shared decision-making focus on comorbidity management should be developed. These management tasks are viewed as routine care; however, the measurable success and impact have clinical variance. The enhanced recovery after cesarean delivery goal for patients who are undergoing a scheduled caesarean delivery is to maximize the quality of the pregnant patient's recovery and the fetal-neonatal outcome.

Key words: antenatal care, cesarean delivery, knowledge transfer, obstetrical intervention variance, pregnant patient comorbidity management, preoperative care, prevention, protocol adherence, quality, safety, scheduled, shared obstetrical decision-making, unscheduled

Introduction

Enhanced recovery after cesarean delivery (ERAC) was introduced in 2013 and has been incorporated into many scheduled surgical pathways.¹ The goal of the ERAC process is to reduce surgical process variability through the

implementation of evidence-based processes, thereby improving the patient experience and quality of maternal and neonatal outcomes, in addition to reducing surgery-related costs.^{2–8}

The ERAC guidelines for antenatal and preoperative care in cesarean

delivery presented in this article provide the best practice recommendations for the preoperative phase. A recent initiative led by the American Society of Anesthesiologists (ASA) included representatives from multidisciplinary professional society stakeholders across

the United States (American College of Obstetricians and Gynecologists [ACOG], Society of Maternal Fetal Medicine [SMFM], Society of OB /GYN Hospitalists [SOGH], Enhanced Recovery After Surgery [ERAS] Society, ASA, Society for Obstetric Anesthesia and Perinatology [SOAP], American Association of Nurse Anesthesiology [AANA], and Association of Women's Health, Obstetric and Neonatal Nurses [AWHONN]) and patient representatives.⁹ This led to recommendations on the ERAC interventions for the antenatal period, patient comorbidity optimization, and the preoperative phase, which forms the basis of this guideline update.

The ERAS quality improvement process has become widely used and accepted in many surgical fields. The process of identifying specific care elements or processes in the preoperative, intraoperative, and postoperative pathways has allowed certain clinical care elements to be used preferentially for quality improvement in research settings. The logistics of scheduled and unscheduled surgical procedures have an impact on preoperative processes and elements used in published ERAS processes.

The health of the patient (woman, pregnant person, or fetus) or their metabolic status at the time of surgery has an important impact on patient safety, recovery, and outcome.

Pregnancy management during preconception, antenatal care, and delivery planning can provide an opportunity to enhance the health status of pregnant patients before scheduled cesarean delivery. The ERAC focus is more complex, because there are 2 (or more) patients involved, a longer length of gestational opportunity (10-42 gestational weeks) for the provider/team to manage the pregnant patient and fetal health, and the added difficulty of not having direct peer-reviewed evidence that has shown a direct impact on the pregnant patient and fetal outcomes related to a cesarean delivery. The antenatal obstetrical vision for the best practice or optimized comorbidity care for the pregnant patient-fetal dyad can only provide evidenced-based management for the well-defined perinatal morbidity and mortality. The conditions and the optimized interventions and recommendations summarized in this guideline have the intent to minimize the pregnant patient's teratogenic comorbidity effects on the fetal "passenger" and to limit the evidence-based preterm birth risk based on the clinical conditions that are pre-existing or that develop in the pregnant patient or fetus.

Although non-ERAS cesarean delivery care has wide documented variance in healthcare, adherence to these revised ERAC recommendations aims to improve outcomes when compared with the

traditional surgical ERAS processes, which only start 30 to 60 minutes before scheduled delivery. Preoperative recommendations after multiple Delphi consensus rounds identified the following interventions: patient education, staff education, pregnant patient anemia and comorbidity optimization, antiseptic abdominal skin cleaning, limited preoperative fasting periods, and preoperative nonparticulate carbohydrate drinking.⁹

The focus of this document was to provide a revised evidence-based consensus summary for each antenatal, optimized maternal comorbidity, and preoperative intervention and recommendation. This is the first update of the ERAS Society ERAC guidelines, which were published in 2018.¹⁰

Methods

Guideline methodology and literature search

The guideline update proposal was approved by the ERAS Society Guidelines Committee in September 2024. The author group was based on international expertise in the area, and the guideline methodology followed that endorsed by the ERAS Society, as published previously.¹¹ A consensus ERAS cesarean delivery antenatal and preoperative topic list was determined.⁹ After the topics were agreed on, they were allocated to different group members according to expertise.

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The literature search (2017 to September 2024) was conducted using the Embase, PubMed MEDLINE, EBSCO CINAHL (Cumulative Index of Nursing and Allied Health Literature), Scopus, and Web of Science databases to search controlled vocabulary (medical subject headings) and key words that included “Cesarean Section,” “Cesarean Delivery,” “Cesarean Section Delivery,” and all antenatal and preoperative ERAS items, focusing on randomized clinical trials and large observational studies (≥800 patients) to maximize search feasibility and relevance. The reference lists of all eligible articles were cross-checked with those of other relevant studies.

Overall assessment of data by quality of evidence and strength of recommendations

As outlined in Table 1, the quality of the evidence and recommendations was evaluated according to the Grading of Recommendations, Assessment, Development, and Evaluation system,¹² as described in the previous ERAS Guidelines. Recommendations were based not only on the quality of evidence (high, moderate, low, and very low) but also on the balance between desirable and undesirable effects. In some cases, strong recommendations may be obtained from low-quality data, and vice versa. Briefly, the following recommendations are given: strong recommendations indicate that the panel is confident that the desirable effects of adherence to a recommendation outweigh the undesirable effects. Weak recommendations indicate that the desirable effects of adherence to a recommendation outweigh the undesirable effects; however, the panel is less confident.

The Core ERAC Team (P.S., G.N., A.B.C., G.A.M., and R.D.W.) reviewed the evidence in detail for each section and assigned both the recommendation and evidence levels. Discrepancies were resolved by the leading and senior authors.

Results

The ERAC process requires maternity provider and patient acceptance, along with health service implementation and sustainability support for more supportive evidence.^{2,13–21}

TABLE 1
Summary of the Grading of Recommendations, Assessment, Development and Evaluation System

Variable	Definition
Rating quality of evidence: evidence level	
High quality	Further research is unlikely to change confidence in the estimate of the effect.
Moderate	Further quality research is likely to have important impact on confidence in the estimate of the effect and may change the estimate.
Low quality	Further research is very likely to have an important impact on confidence in the estimate of the effect and likely to change the estimate.
Very low quality	Any estimate of the effect is very uncertain.
Rating strength of recommendations: recommendation strength	
Strong	When desirable effects of intervention clearly outweigh the undesirable effects or clearly do not.
Weak	When trade-offs are less certain: either because of low quality evidence or because evidence suggests desirable and undesirable effects are closely balanced.

Wilson. Enhanced recovery after cesarean delivery preoperative guidelines. Am J Obstet Gynecol 2026.

A 2024 Delphi review (Recommended Interventions for Enhanced Recovery After Cesarean Delivery in the United States) was used to determine the appropriate preoperative, intraoperative, and postoperative interventions.⁹

Although it adds rigor to the evidence using repetitive consensus, the Delphi process has eliminated certain traditional cornerstone interventions in surgical processes and care.

An appropriate surgical indication is a traditional expectation or requirement before a patient undergoes an increased-risk surgery owing to anesthesia and the surgical procedures. Cesarean delivery, without a medical or surgical indication, should not be considered unless there has been a comprehensive preadmission evaluation of the harms and benefits for both the pregnant patient and their baby.^{22–25} Information about the increased surgical risk in terms of short-term complications (injuries to the abdominal organs, postoperative infection, thrombosis, bleeding, and pain)^{26–29} and the known long-term effects (risk of uterine rupture and

placental complications in subsequent pregnancies)^{30–32} should be compared with the benefit and risk profile of vaginal delivery as part of preoperative counselling. Short-term outcomes for the infant should be considered.^{33–37}

Although there is increasing clinical consideration for and uptake of cesarean delivery at the request of the pregnant patient, for this ERAC guideline, an appropriate surgical indication (obstetrical, pregnant patient, fetal) for caesarean delivery is recommended.

The 6 recommended interventions for antenatal care, optimization of patient comorbidity health, and preadmission/preoperative interventions before cesarean delivery are summarized in Table 2,^{13–155} with consensus ratings of the quality of evidence and strength of recommendations. Medical comorbidity evidence, although strong for the patient’s clinical optimization opportunity, has not been directly evaluated against cesarean delivery; therefore, a decision was made to evaluate the group of conditions as an overall composite and individualized consideration for their

TABLE 2

ERAC—a summary of the antenatal, optimized care, and preoperative ERAC interventions with GRADE level of evidence and strength of recommendation

No.	ERAC recommended antenatal, optimized care, and preoperative interventions	ERAC item	GRADE quality of evidence (references)	GRADE strength of recommendation
	Optimized antenatal care or best practice	Health optimization for the pregnant patient with medical comorbidities is complex and requires individuality based on the patient's engagement, desire of care, and the gestational age status. The ultimate ERAS-CD goal is to increase the patient and provider awareness and communication, thereby allowing an opportunity for both the pregnant patient and their fetus to be in the best condition possible at the time of their CD.	2,13–41	
1	Patient education (culturally and language appropriate). Preadmission information, education, and counselling	- Good antenatal, team-based, clinical practice should include shared care, informing the patient about the clinical care opportunities, antenatal screening and diagnosis, and, ultimately, any procedures before, during, and after the scheduled CD. - The information should be adapted and considered for scheduled CD or when there is a potential for an unscheduled CD. - This recommendation is made based on patient needs, although high-quality evidence is lacking,	Very low	Strong
2	Medical and surgical multidisciplinary staff education	- The organizational health service and clinical providers require collaboration and fiscal support for the introduction of maternity quality improvement interventions and implementation strategies with the aim of improving pregnant patient and neonatal outcomes after a CD.	Moderate	Strong
3	Pregnant person comorbidities optimization	The opportunity to impact or modify the morbidity (or mortality) risk associated with the pregnant patient's comorbidity(ies) and the risk for a CD has limited evidence for a direct cause and effect on CDs. Opportunity for impact: medical, surgical, obstetrical, or family history; antenatal screening and diagnosis; pregnant person and fetal surveillance; preventive optimization of care. Multidisciplinary team-based care is required for the pregnant patient with significant comorbid conditions because these conditions have increasing obstetrical prevalence (anemia, obesity, chronic hypertension, diabetes, smoking, congenital heart disease, epilepsy, autoimmune disease [systemic lupus], and asthma). They are associated with complex antenatal adverse events and possible requirement for CD. Generic comorbidity optimization consensus: Quality of evidence: moderate for CD Strength of recommendation: strong for impact on CD	42–120	

Wilson. Enhanced recovery after cesarean delivery preoperative guidelines. Am J Obstet Gynecol 2026.

(continued)

TABLE 2**ERAC—a summary of the antenatal, optimized care, and preoperative ERAC interventions with GRADE level of evidence and strength of recommendation***(continued)*

3 (Cont'd)	ERAC recommended antenatal, optimized care, and preoperative interventions	ERAC item	GRADE quality of evidence (references)	GRADE strength of recommendation
	Anemia during pregnancy has a prevalence of 12%	- Screening: there is insufficient evidence for screening and supplementation for iron deficiency, in the presence or absence of anemia, during pregnancy to improve maternal and fetal health outcomes. - Surgical consideration: Maternal iron deficiency anemia should be identified and treated before scheduled surgeries. Intravenous iron may be more effective than oral iron, although optimal dosing regimens are still under investigation.	High	Strong
	Maternal obesity (BMI >30 kg/m ²)	- The risk for morbidity and mortality increases as the pregnant person's BMI increases. - Medical care: before conception or during pregnancy, people with obesity should have access to evidenced-informed interventions (medical nutrition therapy; physical activity; psychological interventions; pharmacotherapy; surgery) aimed at healthy weight gain in pregnancy. - Surgical consideration: preoperative multidisciplinary surgical planning is recommended ahead of delivery.	Moderate	Strong
	Chronic hypertension	- Untreated or inadequate treatment of chronic hypertension will increase the risk for superimposed preeclampsia, intrauterine fetal growth restriction, and preterm birth. - Screening: USPSTF (2021) recommends screening for hypertension in adults 18-years or older with office and outside office blood pressure measurements. - Medical care: USPSTF (2021): recommends the use of low-dose aspirin (81 mg/d) as preventive medication for preeclampsia after 12 weeks of gestation for pregnant persons who are identified to have an increased risk for preeclampsia (dosing range 81-162 mg/d with PM oral administration) USPSTF (2024): during pregnancy, recommends treating chronic hypertension at a threshold of mild-range blood pressure of 140/90 mm Hg because it is found to be a cost-effective strategy. - Chronic hypertension should be treated with the most well-studied antihypertensive agents in pregnancy (labetalol, nifedipine, hydralazine, or methyldopa), with a target blood pressure of less than 140/90 mm Hg.	Moderate	Strong

Wilson. Enhanced recovery after cesarean delivery preoperative guidelines. *Am J Obstet Gynecol* 2026.*(continued)*

TABLE 2

ERAC—a summary of the antenatal, optimized care, and preoperative ERAC interventions with GRADE level of evidence and strength of recommendation

(continued)

3 (Cont'd)	ERAC recommended antenatal, optimized care, and preoperative interventions	ERAC item	GRADE quality of evidence (references)	GRADE strength of recommendation
	Prepregnancy or gestational diabetes impacts approximately 10% of US pregnancies	- Glycemic management of diabetes mellitus in pregnancy has gestational age complexity with significant metabolic and physiological changes. The pregnancy-related glycemic targets are required to be much tighter than in nonpregnant persons because of significant adverse perinatal and neonatal consequences. - Screening:USPSTF (2021): recommend screening persons with overweight and obesity for prediabetes and type 2 diabetes in adults aged 35–70 y. USPSTF (2021): concludes with moderate certainty that there is a moderate benefit to screening for gestational diabetes at 24 weeks of gestation or later to improve pregnant persons and fetal outcomes. - Medical care:Tight glycemic control among pregnant people with preexisting or gestational diabetes should be prioritized. Medical management strategies that include both lifestyle and/or medication options are effective at achieving optimal glycemic control and reducing perinatal risks.	Moderate	Strong
	Smoking (tobacco, cannabis; vaping)	- Inhaled smoke exposure (tobacco, cannabis, vaping) increases the risks for pregnancy and postoperative complications. The pregnant person's co-use of nicotine and cannabis is associated with increased pregnant person and neonatal morbidity and neonatal death when compared with use of either substance alone. - Smoking cessation or reduction should be encouraged as early as possible and supported throughout pregnancy. USPSTF (2021): Behavioral smoking cessation counseling during pregnancy was associated with fewer adverse neonatal outcomes and was cost effective.	High	Strong
	Increasing medical comorbidity prevalence conditions	Comorbidities in pregnancy are common and have increasing prevalence (congenital heart disease, maternal epilepsy, maternal auto-immune disease (systemic lupus), and asthma). The conditions and their medications for care are associated with fetal teratogenic effects, complex pregnant person antenatal effects, and an increased possibility for caesarean delivery. - Medical and surgical consideration: multidisciplinary team-based care is recommended and can modify the morbidity and mortality risks for pregnant person and fetal-neonates but the direct impact on caesarean delivery is unknown.	Moderate	Strong
	Pre-admission and preoperative focused interventions	The 3 focused interventions are preoperatively time-specific and may required re-interpretation or re-dosing due to common elective surgery delay issues.	121–155	
4	Preoperative skin antisepsis	- Preadmission: the use of 2% chlorhexidine gluconate cloths or soaps for preoperative showering or bathing (evening or morning or both) before the scheduled CD is a reasonable intervention to undertake because there is no or minimal risk associated with the variable preventive results related to surgical site infections	Moderate	Weak

Wilson. Enhanced recovery after cesarean delivery preoperative guidelines. Am J Obstet Gynecol 2026.

(continued)

TABLE 2

ERAC—a summary of the antenatal, optimized care, and preoperative ERAC interventions with GRADE level of evidence and strength of recommendation

(continued)

No.	ERAC recommended antenatal, optimized care, and preoperative interventions	ERAC item	GRADE quality of evidence (references)	GRADE strength of recommendation
5	Preoperative fasting	There is insufficient evidence on the relationship between fasting times for clear fluids or solid foods and the risk for pulmonary aspiration. - Preoperative fasting should be minimized irrespective of the type of anesthesia because recommendations are based on widely accepted clinical practice and professional society guidelines. - Pregnant patients should be encouraged to drink clear fluids, such as water, pulp-free juice, carbohydrate drink, and black coffee or tea without milk, up to 2 h before surgery. - A light meal up to 6 h before surgery is permissible. - After a large meal, meat, or food with a high fat content fasting, the time should be extended to 8 h	Low Low Low	Strong Strong Strong
6	Preoperative carbohydrate supplementation	- Nonparticulate carbohydrate drink (such as Gatorade or apple juice) should be provided 2 h before an elective CD. This intervention has not been shown to have clear clinically significant benefits but seems safe. It is a reasonable option based on benefits from other surgical cohorts and should be offered to women without diabetes.	Low to moderate	Weak

BMI, body mass index; CD, cesarean delivery; ERAC, enhanced recovery after surgery; ERAS, Enhanced Recovery after Surgery; GRADE, Grading of Recommendations, Assessment, Development and Evaluation; PM, evening dosing; USPSTF, U.S. Preventive Services Task Force.

Wilson. *Enhanced recovery after cesarean delivery preoperative guidelines*. Am J Obstet Gynecol 2026.

quality of evidence and strength of recommendation. Evidence to support the nonrandomized controlled trial (RCT)—based processes for recommendations for interventions 1 to 3 is provided.^{38–46} In addition, the ability to implement interventions to provide high-risk comorbidity care will differ between urban and rural sites/providers. The increasing use of evidence for remote multisite or provider collaborative care is clinically effective and fiscally feasible.^{47–52}

Antenatal care pathway

1 and 2—Patient education (culturally and language appropriate) and staff education Appropriate antenatal care should include the preparation of pregnant patients and their partners for delivery, including the possibility of either vaginal or surgical delivery. Balanced information should be provided for both the short- and long-term potential risks and benefits of all delivery modes. Although this information can be communicated in multiple ways, a systematic review and meta-analysis of RCTs found that the provision of presurgical information via educational videos was associated with a statistically significant reduction in patient anxiety (weighted mean difference, -3.10 ; 95% confidence interval [CI], -4.48 to -1.73).⁵³ RCT results focused on the implementation of a decision aid among patients with a history of cesarean delivery found that the use of the decision aid was not substantially associated with decision quality regarding the mode of delivery, nor with clinical outcomes.⁵⁴

Discussions about the mode of delivery should occur early enough in pregnancy to permit adequate time for referral to an obstetrician if cesarean delivery is being considered.⁵⁵ A co-design workshop that involved health-care providers and patients recommended initiating this discussion at the 16-week appointment and finalizing the birth plan by 28 weeks (while still providing opportunities for patients to request changes up to the time of delivery).⁵⁵ In all cases, a shared decision-making framework should be used to ensure that patients make decisions that

are concordant with their personal values.

In the case of a scheduled cesarean delivery, documentation of preadmission information and the counselling process should include when the procedure will occur, the type of procedure, who provided the information, and a comment on how the information was accepted or understood by the patient. Care providers should adapt their communication to the required situation, such as planned primary cesarean delivery or a trial of labor after cesarean delivery. When the need for neonatal care of the newborn infant is identified and time allows, the pregnant patient and their partner should have the option to meet a neonatologist or pediatrician and visit the neonatal unit before a cesarean delivery is performed. Qualitative data from postpartum patients who had undergone a cesarean delivery in a setting that had implemented the ERAS cesarean delivery pathway generally reported feeling informed about what they could expect before, during, and after their surgery. However, there was a need for improvement with regards to patient-provider communication, indicating the need for regular review of communication strategies to ensure that all patients felt adequately prepared for delivery.⁵⁶

In an unscheduled cesarean delivery, the informed consent process demands instructive and reassuring provider behavior with clear and essential information presented by the care team to the patient or partner. In an unscheduled situation, a short description of the indications for cesarean delivery, the recommended type of anesthesia, and surgical information related to the procedure and its urgency are important. Additional counselling may be required after the procedure to ensure that the patient is prepared for postpartum recovery.

Recommendation: patient and staff

Although high-quality evidence is lacking, good antenatal, team-based clinical practice should include shared care, informing the patient about clinical care opportunities, antenatal screening or diagnosis, and, ultimately,

any procedures before, during, and after an anticipated cesarean delivery. The information should be adapted to determine whether a cesarean delivery is scheduled or to understand the potential for an unscheduled surgery. Organizational and administrative health services and maternity providers of the clinical processes require collaboration and fiscal support for the introduction of maternity quality improvement interventions and implementation strategies for the anticipated outcome benefits of improved pregnant patient and neonatal outcomes after cesarean delivery.

Quality of evidence: low

Strength of recommendation: strong

3 Optimization of patient comorbidity

Education and counselling of pregnant patients with comorbidities that potentially impact obstetrical and fetal care are important. Team-based care support may be required, which will depend on the expertise of the primary obstetrical-maternal fetal medicine provider and the hospital services available. Internal medicine subspecialists, including neonatologists, anesthesiologists, and nursing support, are also important. For the comorbid conditions listed below, adverse pregnancy-related outcomes are common and affect management and delivery planning. These summaries can assist in patient education, pregnancy counselling, and informed consent. A patient's understanding of pregnancy and the added medical comorbid risk is important, because the patient may need to accept new provider expertise in their care.

Common combinations of pregestational clinical diagnoses, in general, do not increase the risk for common pregnancy-related complications more than when a single clinical diagnosis is present. This evidence is supportive given that patients who are entering pregnancy with multiple comorbidities are becoming more prevalent.⁵⁷

Although a comprehensive assessment of each comorbidity optimization is beyond the scope of this review, key information from the medical literature is highlighted below. Preoperative medical

optimization of modifiable clinical factors is an important goal for improving perioperative and postoperative outcomes. Evidence supports targeting pregnant patients' comorbidities (anemia, obesity, chronic hypertension, diabetes, smoking status, congenital heart disease, epilepsy, autoimmune diseases, and asthma) as potential factors that can be improved before delivery. Optimization of a pregnant patient with comorbidities can provide evidence and recommendations for patient benefit; however, there is no direct evidence that optimization of these selected conditions affects the likelihood or risk of cesarean delivery.

Maternal anemia

Anemia during pregnancy has been identified in 12% of pregnant patients in high-income countries and may affect up to 50% of pregnant patient in low- and middle-income countries and is associated with increases in patient morbidity and mortality, with notable racial and ethnic disparities.^{58–60} Furthermore, preoperative anemia has been shown to increase the perioperative morbidity and mortality rates, and postpartum anemia itself can affect recovery.^{61,62} Propensity score analysis of a large, international, cross-sectional cohort revealed that severe anemia (hemoglobin <7 g/dL) was associated with increased odds of patient death (adjusted odds ratio [aOR], 1.86; 95% CI, 1.39–2.49), but aside from preceding death, the exact timing of when the anemia laboratory results were obtained was not reported.⁶³ The most common cause of pregnant patient anemia is iron deficiency, however, a workup for other potential causes is recommended.⁶⁴ Iron deficiency should be identified and corrected ahead of any scheduled surgery. Oral iron supplementation is the preferred initial treatment for patients who can tolerate it. Recent RCTs and reviews have shown that every other day dosing of oral iron supplementation may be as effective as daily or more frequent dosing with fewer side effects, although more data are needed to establish the optimal dosing regimens.^{64,65} One RCT randomized pregnant patients to receive

oral iron supplementation or a single 1000 mg dose of low molecular-weight iron dextran intravenously (IV) and found significant reductions in maternal anemia at delivery in the IV iron-treated group (<11 g/dL: 40% vs 85%; $P=.039$; <10 g/dL: 10% vs 54%; $P=.029$ ⁶⁶). Owing to its efficacy and emerging safety profile, other studies have suggested that treatment with IV iron may be more likely than oral iron to reduce adverse patient outcomes.^{60,67–71}

Obesity

Obesity before and during pregnancy has important health- and pregnancy-associated risks.^{72–75} A systematic review that included 22 reviews demonstrated that pregnant patient obesity (body mass index [BMI] >30 kg/m²) substantially increased the incidence of gestational diabetes mellitus (GDM), hypertensive disorders, mental health conditions, cesarean delivery, and surgical site infections, as well as fetal complications; these complication rates increased as the BMI increased.⁷⁶ Several RCTs have shown that lifestyle interventions, particularly those related to behavior counseling, dietary intake, physical activity, psychological interventions, and pharmacotherapy can reduce excess gestational weight gain in pregnancy among pregnant patients with obesity, however, the interventions studied are heterogeneous, can be intensive, and some results are mixed.^{77–83} Optimizing gestational weight gain can help at the time of cesarean delivery, because surgical complexity in the presence of obesity necessitates directed delivery planning to optimize the surgical approach. This can include (1) identifying an appropriate operating room table with a lift device and adequately sized wheelchair or gurney; (2) planning the location of the abdominal incision based on body weight distribution, location of the uterus, and fetal lie, which can be assisted by a preoperative ultrasound (with a preference for transverse skin incisions when able to do so)^{82–88}; (3) preoperative cleansing with chlorhexidine wash, no shaving; (4) intraoperative considerations, including managing the pannus with a retraction device, adequately dosing antibiotic prophylaxis, minimizing manual

extraction of placenta, and closing the subcutaneous layer; (5) postoperative monitoring for wound infections and thromboprophylaxis.^{75,89}

Chronic hypertension

Chronic hypertension is common in the general population, which subsequently impacts the prevalence during pregnancy.^{90–92} Despite new guidelines that use lower values to define stage 1 hypertension outside of pregnancy and emerging evidence regarding these values in pregnancy,^{93,94} chronic hypertension during pregnancy is traditionally considered a systolic blood pressure of ≥ 140 mm Hg, a diastolic blood pressure of >90 mm Hg, or both on at least 2 determinations at least 4 hours apart before pregnancy or during pregnancy before 20 weeks of gestation.⁹⁵ Chronic hypertension, particularly when not well controlled, increases the incidence of preeclampsia, cesarean delivery, preterm birth, placental abruption, and fetal complications, such as fetal growth restriction and stillbirth.^{95,96} The goal of treatment is to prevent severe hypertension and superimposed preeclampsia, which can lead to severe end-organ dysfunction that affects intraoperative and postoperative care; with adequate treatment of mild to moderate hypertension in pregnancy, the progression to severe hypertension can be reduced by as much as 50%.^{97,98} A recent RCT of treatment for mild chronic hypertension before 23 weeks' gestation showed an 18% reduction in the risk for the composite outcome (severe preeclampsia, medically indicated preterm birth before 35 weeks' gestation, placental abruption, or fetal or neonatal death) without increases in small for gestational age babies by targeting a blood pressure of $<140/90$ mm Hg.⁹⁹ Given the available evidence, patients with chronic hypertension who become pregnant should be maintained on or transitioned to the most well-studied antihypertensive agents in pregnancy (labetalol, nifedipine, hydralazine, or methyldopa) with a target blood pressure of $<140/90$.¹⁰⁰

Diabetes

For pregnant patients with preexisting diabetes or GDM, optimal glycemic control ahead of delivery reduces the

risks for perinatal complications, such as hypertensive disorders and stillbirth, and postoperative complications, such as surgical site infections.^{101–108} Glycemic targets in pregnancy are similar for pre-existing diabetes and GDM with general goals of <95 mg/dL fasting, <140 mg/dL 1 hour postprandial, and <120 mg/dL 2 hours postprandial.^{105,107} Hemoglobin A1C levels can be used secondarily, however, physiological changes in red cell turnover during gestation may necessitate more frequent surveillance.¹⁰⁵ The appropriate treatment for diabetes in pregnancy should include lifestyle and dietary changes, followed by medical management with insulin (preferred) or oral agents if needed. Several RCTs and meta-analyses have shown that active diabetes treatment is feasible and effective in pregnancy and reduces the rate of complications, especially if started early.^{109–113} In addition, the safety of administering a routine oral carbohydrate drink ahead of a scheduled cesarean delivery in pregnant patients with GDM was demonstrated in a recent RCT in which lower rates of intraoperative hypoglycemia were noted among patients exposed to the intervention without differences in neonatal hypoglycemia.^{114–116}

Smoking

The health consequences of tobacco smoke exposure during pregnancy have been well established.^{117–120} A recent review of 64 studies on smoking in pregnant patients demonstrated significant dose-responsive increases in several perinatal complications, including hypertensive disorders, preterm birth, and low birth weight.¹¹⁷ Active smoking, including e-cigarettes, has also been associated with significant increases in wound complications, such as dehiscence following cesarean delivery.^{120,121} RCTs have shown that interventions to promote smoking cessation in pregnancy can be effective.^{122–124} One RCT that compared bupropion with placebo for smoking cessation did not identify reductions in smoking with the intervention, although financial incentives and multidisciplinary care approaches have been shown to be successful.^{125–129}

Cardiac disease.

Up to 4% of all pregnancies are complicated by pregnant patients with cardiac disease and cardiac disease is currently the largest indirect cause of pregnant patient death in the western world. Pregnancy-induced physiological adaptations are a serious burden for patients with cardiovascular diseases, especially in the late stages of pregnancy and in the peripartum period. The specific risk for pregnancy complications depends on many factors and can be accurately predicted using the modified World Health Organization classification. Patients at moderate or high risk should be managed by a multidisciplinary team of experts from preconception to the postpartum period.¹³⁰

Epilepsy

Pregnant patients with epilepsy and their fetuses require early gestational age team-based care and fetal teratogenic risk counselling, although preconception consultation is optimal. The mean (standard deviation) age at delivery for pregnant patients with epilepsy was 29.9 (5.3) years.¹³¹ The rate of severe composite morbidity and mortality was also higher among pregnant patients with epilepsy than among those without epilepsy (36.9 vs 25.4 per 1000 deliveries). Pregnant patients with epilepsy also have a substantially higher risk for death (0.23 deaths per 1000 deliveries) than pregnant patients without epilepsy (0.05 deaths per 1000 deliveries) with an aOR of 3.86 (95% CI, 1.48–8.10). Particularly, pregnant patients with epilepsy have increased odds of developing severe preeclampsia, an embolism, disseminated intravascular coagulation or shock, cerebrovascular events, and severe mental health conditions. Fetuses and infants of pregnant patients with epilepsy have elevated odds of mortality (aOR, 1.20; 95% CI, 1.05–1.38) and severe neonatal morbidity (aOR, 1.48; 95% CI, 1.40–1.56). In analyses restricted to women or pregnant persons with epilepsy, pregnant patients exposed to antiseizure medication (ASM), when compared with those who were not exposed, had higher odds of severe morbidity (aOR, 1.24; 95% CI, 1.10–1.48) and their neonates had

increased odds of mortality and severe morbidity (aOR, 1.37; 95% CI, 1.23–1.52). This multinational study showed that pregnant patients with epilepsy were at a considerably higher risk for severe patient and perinatal outcomes and an increased risk for death during pregnancy and the postpartum period. Epilepsy during pregnancy and the use of ASM have been associated with increased morbidity, perinatal mortality, and morbidity in patients with epilepsy.¹³¹

Pregnant patients with epilepsy should be informed about the care they can expect to receive during pregnancy, such as the need for ASM, continuation with medication or avoidance of abrupt medication withdrawal, risk for major congenital malformation, neurodevelopmental effects of antiseizure medication (sudden unexpected death in epilepsy), continued use of folic acid, obstetrical care, what to expect during pregnancy, safety and caring for baby, and breastfeeding. The exact nature of care will be individualized; however, in general, patients should have regular and planned reviews with an obstetrician and epilepsy specialist.¹³²

Autoimmune disease

Pregnant patients with autoimmune diseases require early gestational age counselling and team-based care. One review evaluated 32 of the 709 primary studies. The review reported an association between 12 autoimmune conditions and 16 adverse pregnancy outcomes. A higher risk for miscarriage was reported for pregnant patients with Sjögren's syndrome (risk ratio, 8.85; 95% CI, 3.10–25.26) and systemic lupus erythematosus (SLE) (OR, 4.90; 3.10–7.69). The incidence of preeclampsia has been reported to be higher in pregnant patients with type 1 diabetes mellitus (T1DM) (OR, 4.19; 3.08–5.71) and SLE (OR, 3.20; 2.54–4.20). Pregnant patients with autoimmune diseases had a higher risk for developing diabetes during pregnancy with inflammatory bowel disease (IBD) (OR, 2.96; 1.47–5.98). There was an increased risk for intrauterine growth restriction in pregnant patients with systemic sclerosis (OR, 3.20; 2.21–4.53) and celiac disease (OR, 1.71; 1.36–2.14). Low birth weight

babies were reported for pregnant patients with SLE or systemic sclerosis diagnoses (OR, 5.95; 4.54–7.80 and OR, 3.80; 2.16–6.56, respectively). T1DM in pregnant patients was associated with 32% lower odds of small for gestational age babies (OR, 0.68; 0.56–0.83). Preterm birth was associated with T1DM (OR, 4.36; 3.72–5.12) and SLE (OR, 2.79; 2.07–3.77). There was a higher risk for stillbirth in pregnant patients with T1DM (OR, 3.97; 3.44–4.58), IBD (OR, 1.57; 1.03–2.38), and celiac disease (OR, 1.57; 1.17–2.10). Pregnant patients with autoimmune conditions are at greater risk for developing adverse pregnancy outcomes.^{133,134}

Asthma in pregnancy with management, maternal comorbidities, and long-term health

Asthma is the most prevalent chronic disease during pregnancy. Symptoms can change during pregnancy, and exacerbations of asthma are common; therefore, regular review of asthma symptoms, provision of self-management education, and appropriate medication use are the foundations of management. Comorbidities, including obesity, GDM, hypertension, rhinitis, depression, and anxiety, are more prevalent among pregnant women with asthma than among those without asthma.¹³⁵

Composite pregnant patient comorbidity optimization recommendation

Multidisciplinary team-based care is or may be required for pregnant patients with significant comorbid conditions, because these conditions are associated with increasing obstetrical prevalence in the pregnant population (anemia, obesity, chronic hypertension, diabetes, smoking, congenital heart disease, epilepsy, autoimmune disease [eg, SLE], and asthma), complex antenatal adverse events, and higher rates of cesarean delivery care.

Quality of evidence: moderate

Strength of recommendation: strong

Preoperative period focused interventions

Routine preoperative laboratory evaluations may reveal that many practices are used to try and limit the number of

evaluations and minimize healthcare costs while maintaining patient quality of care. Implementing comprehensive preoperative laboratory testing guidelines to focus surgical clinical practice can lead to substantial cost reductions by optimizing the use of preoperative tests. There is a need to stop routine testing and start ordering tests specific to the patient, disease, and patient's needs. Given the population's inadequate adherence to routine health check-ups, it may be possible to establish evidence-based, country-specific guidelines.¹³⁶

4 Pre-admission and early preoperative period

Antiseptic skin cleaning processes have been used in the pre-admission and early preoperative periods before various surgical procedures with most available evidence reported for orthopedic, gastrointestinal, and gynecologic surgeries.¹³⁷

The ACOG Practice Bulletin^{75,107} entitled Prevention of Infection After Gynecologic Procedures recommends certain pre-admission and preoperative preventive measures to reduce infectious morbidity by treating remote infections, advising patients to shower or bathe (full body) with soap (antimicrobial or non-antimicrobial) or an antiseptic agent at least the night before or the morning of the abdominal surgery, and to not shave the abdominal incision area; however, if hair removal is necessary, an electric clipper or razor should be used. In the preoperative period, serum blood glucose levels should be evaluated and controlled and perioperative hyperglycemia should be avoided.^{138–141}

A single-center, double-blind, placebo-controlled RCT (Study To Reduce Infection Prior to Elective Cesarean Deliveries [STRIPES]) evaluated the use of 2% chlorhexidine gluconate (CHG) cloths in the evening and morning before scheduled surgery to clean 6 anatomical body areas (neck, shoulders, and chest; armpits, arm, and hands; abdomen and groin; left leg and foot; right leg and foot; back and buttocks) and compared it with the use of placebo cloths in the same manner. The treatment group included 1356 patients and the placebo group included 674

patients with a postoperative observation period of 6 weeks. No significant difference was found in the surgical site infection rates between the 2 groups (treatment, 2.6%; placebo, 3.7%). Pre-admission use of CHG cloths did not reduce surgical site infections for scheduled cesarean delivery when added to the routine use of standard-of-care infection prophylaxis recommendations.¹⁴²

Although the Centers for Disease Control and Prevention and other major guidelines do not specifically recommend CHG, its use as a pre-admission shower or bath antiseptic choice is based on limited evidence suggesting increased preventive efficacy when compared with either soap or placebo.¹⁴³

Recommendation: Pre-admission or early preoperative CHG use by a woman or pregnant person before their scheduled cesarean delivery is as follows: the use of 2% CHG cloths or soaps for preoperative showering or bathing (evening, morning, or both) before scheduled cesarean delivery is a reasonable intervention because there is no or minimal risk associated with the variable preventive results related to surgical site infections.

Quality of evidence: moderate

Strength of recommendation: weak

5 Preoperative fasting

To reduce the risk for pulmonary aspiration, preoperative fasting involves not eating or drinking for a set amount of time before surgery. Prolonged preoperative fasting (traditionally described as nothing by mouth after midnight) is not recommended and may lead to hypovolemia, hypoglycemia, ketoacidosis, and decreased patient satisfaction.^{144,145}

Some variation exists between the North American and European professional society guidelines. The SOAP consensus statement and the ASA practice guidelines and Enhanced Recovery Canada state the minimum duration of fasting before scheduled cesarean delivery should be 2 hours for ingestion of clear fluids (including carbonated beverages and carbohydrate rich nutritional drinks), 6 hours after a light meal or milk, and 8 hours after a meal of fried foods, fatty foods, or meat.^{144–147} The

European Society of Anesthesiology guidelines are more liberal and state that for scheduled cesarean delivery, patients can consume clear liquids up to 2 hours before surgery (including tea or coffee with a modest amount of milk) and 6 hours for solid foods.¹⁴⁸ There are no randomized controlled studies that compared fasting times in patients who underwent cesarean delivery. Therefore, contemporary guidelines that provide guidance on preoperative fasting before cesarean delivery are based on non-obstetrical populations.^{144–151} A study revealed 3 key points that affect fasting times and that can be addressed. First, the actual admission time to the operating room may differ substantially from the planned admission time, particularly if elective operations are performed by the same staff and operating rooms that are used for emergency cases. To address this, either the scheduled operations should be performed separately from the emergency cases or the fasting instructions for the scheduled cases should be based on actual operating room admission times. Second, parturients scheduled for a cesarean delivery should be more explicitly informed to eat food hours before their arrival at the hospital, thus adhering closer to the recommended fasting times of 6 to 12 hours before the start of surgery. Third, although the pregnant patient is waiting for their operation, a nonparticulate CHO drink should be offered up to 2 hours before the realistic time of arrival in the operating room.¹⁵¹

Further considerations for patients who are awaiting a scheduled cesarean delivery surgery that is delayed because of emergency operations could include initiating re-dosing of clear fluids and carbohydrate drinks based on communication between the preoperative nursing staff, the attending obstetrician, and the on-call anesthesiologist.¹⁵¹

Preoperative fasting is used to minimize the risk for perioperative pulmonary aspiration. Standard fasting protocols may not be appropriate for pregnant women with conditions associated with delayed gastric emptying (eg, diabetes, obesity, gastroparesis, and the

use of glucagon-like-peptide-1 receptor agonists). A point-of-care gastric ultrasound may provide a noninvasive and reliable evaluation of gastric volumes.^{152–155}

Recommendation: There is insufficient evidence on the relationship between the fasting time for clear fluids or solid foods and the risk for pulmonary aspiration. Preoperative fasting should be minimized, irrespective of the type of anesthesia, because the recommendations are based on widely accepted clinical practice and professional societal guidelines.

Women and pregnant women should be encouraged to drink clear fluids for up to 2 hours before surgery, such as water, pulp-free juice, carbohydrate preload, and black coffee or tea without milk.

Quality of evidence: low

Strength of recommendation: weak

Recommendation: A light meal up to 6 hours before surgery is permissible.

Quality of evidence: low

Strength of recommendation: weak

Recommendation: After a large meal, meat, or food with a high fat content, the preoperative fasting time should be extended to 8 hours.

Quality of evidence: low

Strength of recommendation: weak
6 Preoperative nonparticulate carbohydrate drink

Gastric emptying in a cohort of pregnant patients suggests that 400 mL of a nonparticulate CHO drink can be safely consumed up to 2 hours before elective surgery. This study showed that, before scheduled cesarean delivery, pregnant patients have similar gastric volumes after a standard overnight fast and for 2 hours after consuming 400 mL of a nonparticulate CHO drink. This finding suggests that using a nonparticulate CHO drink does not delay gastric emptying beyond 2 hours before the scheduled surgery and may be beneficial preoperatively.¹⁵⁶

Postoperative hyperglycemia is a well-established risk factor for postoperative complications.¹⁵⁷ A preoperative nonparticulate CHO drink (with 45 g of carbohydrates) is recommended as a strategy to reduce the insulin-resistant state caused by surgery, and therefore,

postoperative hyperglycemia.¹⁵⁸ The suggestions are 454 mL of clear apple juice (56 g carbohydrate), white cranberry juice, kiwistrawberry juice, and commercial preoperative carbohydrate drinks (50 g carbohydrate; antioxidants [zinc/selenium]).

The benefits of preoperative nonparticulate CHO drinks seem to be clear in cardiac surgery¹⁵⁹ and, to a lesser extent, in general abdominal surgery.^{160–163} There have been a number of single-center trials that reported on nonparticulate CHO drinks and cesarean deliveries. One small RCT reported reduced postoperative insulin resistance among patients who underwent scheduled cesarean delivery and who were treated with a preoperative nonparticulate CHO drink.¹⁶⁴ Two studies (1 RCT) evaluated postoperative maternal ketosis; 1 study found that ketosis was reduced in the nonparticulate CHO drink intervention group.^{165,166} Although postoperative nausea and vomiting is a commonly studied outcome, there was no consistent reported benefit of the nonparticulate CHO drink.^{159,167} Pregnant patient's anxiety before surgery was also a commonly studied outcome but, again, the consistent effects of nonparticulate CHO drinks on reducing anxiety was not observed.^{165,166,168,169} One additional RCT of 47 participants found improved "preoperative well-being", measured using visual analog scale scores, when 2 different preoperative nonparticulate CHO drinks and fasting were compared.¹⁷⁰ However, no effect was seen in overall recovery, measured using a validated structured questionnaire (Quality of Recovery-40). Two studies have evaluated breastfeeding outcomes. One study found that preoperative nonparticulate CHO drinks shortened the time to the expression of colostrum¹⁶⁷ and 1 found increased frequency and duration of breastfeeding¹⁷¹ associated with nonparticulate CHO drinks. Neonatal outcomes were not commonly studied, but 2 trials reported less neonatal hypoglycemia with preoperative nonparticulate CHO drinks, although the number of infants with hypoglycemia was small.^{114,172}

Overall, none of the studies was multicenter, and most were of poor quality with inadequate allocation concealment and a lack of adherence to intention-to-treat analyses. Most of the outcomes studied were not clinically significant, and only 1 study evaluated the effect of CHO loading on general recovery. None of the studies reported maternal aspiration complications.

Recommendation: A nonparticulate CHO drink administered 2 hours before scheduled cesarean delivery has not been shown to have clinically significant benefits, but the intervention seems safe. This is a reasonable option based on the reported benefits in other surgical cohorts. Further research is required to evaluate the potential benefits of neonatal hypoglycemia and its impact on breastfeeding outcomes.

Quality of evidence: moderate to high

Strength of recommendation: strong

Comment

ERAC is unique because it involves an extended timeline of care that exceeds the 30- to 60-minute preoperative time period of other specialty ERAS protocols with the obstetrical care mandate starting at 10 weeks of gestation, if not during the preconception period. This expanded time period has not allowed for directed research or evidence to be generated using the standard randomized trials to answer the clinical questions regarding antenatal care, the optimization of pregnant patients' comorbidity care, and the impact on the recovery of the postpartum person and the newborn after a cesarean delivery. ERAC interventions and evidence for antenatal care, the optimization of identified maternal comorbidities, and early preoperative interventions will contribute to and support more directed, surgically enhanced quality interventions and outcomes in parts 2 and 3. The 6 ERAC part 1 interventions outlined should be implemented for pregnant patients who are undergoing an appropriately indicated scheduled cesarean delivery in the absence of contraindications to optimize maternal experiences, satisfaction, and recovery following cesarean delivery. The overall

principle or goal of an obstetrical best practice process should be used for all antenatal care, thereby increasing the optimization for pregnant patients who require emergency or unscheduled caesarean delivery.

The Delphi process will continue to be used to further evaluate and define ERAC intervention processes and their impact on obstetrical care and outcomes among patients and newborns as new evidence and concepts emerge. Continuous measurement and evaluation of the outcomes and quality related to ERAC are required.^{16,173}

The final comment reemphasizes the need for preconception counseling, thereby allowing increased patient optimization of medical or surgical comorbidities before and throughout pregnancy using team-based multidisciplinary knowledge translation and care. Although the real outcome goal is to have a healthy postpartum patient and newborn, the ability to use risk prevention or clinical modifications based on personal, family, obstetrical, medical, and surgical factors is the first step toward better outcomes. ■

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