SPECIAL ARTICLE

Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean

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The purpose of this article is to provide a summary of the Enhanced Recovery After Cesarean delivery (ERAC) protocol written by a Society for Obstetric Anesthesia and Perinatology (SOAP) committee and approved by the SOAP Board of Directors in May 2019. The goal of the consensus statement is to provide both practical and where available, evidence-based recommendations regarding ERAC. These recommendations focus on optimizing maternal recovery, maternal-infant bonding, and perioperative outcomes after cesarean delivery. They also incorporate management strategies for this patient cohort, including recommendations from existing guidelines issued by professional organizations such as the American College of Obstetricians and Gynecologists and the American Society of Anesthesiologists. This consensus statement focuses on anesthesia-related and perioperative components of an enhanced recovery pathway for cesarean delivery and provides the level of evidence for each recommendation. (Anesth Analg XXX;XXX:00–00)

GLOSSARY

5HT3 = 5 hydroxytryptamine receptor; **AAP** = American Academy of Pediatrics; **ACC** = American College of Cardiology; **ACCP** = American College of Clinical Pharmacy; **ACOG** = American College of Obstetricians and Gynecologists; **AHA** = American Heart Association; **APAP** = acetaminophen; **ASA** = American Society of Anesthesiologists; **D2** = dopamine receptor; **ERAC** = Enhanced Recovery After Cesarean Delivery; **ERAS** = Enhanced Recovery after Surgery; **Hb** = hemoglobin; **IONV** = intraoperative nausea and vomiting; **IT** = intrathecal; **IV** = intravenous; **NICE** = National Institute for Health and Care Excellence; **NSAID** = nonsteroidal anti-inflammatory drug; **OR** = operation room; **PACU** = postanesthesiacare unit; **POD** = postoperative day; **PONV** = postoperative nausea and vomiting; **PPH** = postpartum hemorrhage; **PRN** = pre re nata (as needed); **q6h** = every 6 hours; **QLB** = quadratus lumborum block; **QTc** = QT duration in electrocardiography; **SOAP** = Society for Obstetric Anesthesia and Perinatology; **TAP** = transversus abdominis plane block; **UNICEF** = United Nations International Children's Emergency Fund; **UTI** = urinary tract infection; **VTE** = venous thromboembolism; **WHO** = World Health Organization

The first Enhanced Recovery after Surgery (ERAS) pathways were developed in the 1990s–2000s and focused on recovery after colorectal surgery.[1,2] Today, numerous ERAS protocols exist for multiple surgery types.[3–6] Since 2012, the National Institute for Health and Care Excellence (NICE) guidelines from the United Kingdom encouraged institutions to implement ERAS protocols in their obstetric units.[7] The widespread adoption of ERAS lies in successful standardization of perioperative patient management. Care pathways have the potential to limit the variability in patient care and therefore improve outcomes such as postoperative pain and hospital length of stay, without compromising patient outcomes or satisfaction.[8–10] Currently, evidence exists supporting benefits of standardizing protocols on improving maternal and fetal outcomes.[11,12] The ERAS Society published 3 distinct guidelines for antenatal, intraoperative, and postoperative care for women undergoing cesarean delivery.[13–15] They provide a solid foundation from which clinicians can base their perioperative management of the patient undergoing elective cesarean delivery; however, they lack details

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regarding important peri- and intraoperative anesthesia-related areas of patient care.

This consensus statement focuses on anesthesia-related components of an enhanced recovery pathway for cesarean delivery and provides the level of evidence for each recommendation.

Improving Quality of Care

The Institute of Medicine defines health care quality as, "[t]he degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge."[16] Intuitively, the value of enhanced recovery protocols in obstetrics may be different from other surgical models. Women undergoing cesarean delivery are generally young and healthy, and therefore less likely to require preoperative optimization or have surgical complications. They are also expected to take care of their neonate and are therefore motivated to recover quickly. The traditional markers of successful implementation of ERAS may be different with Enhanced Recovery After Cesarean delivery (ERAC). For instance, reduction in maternal length of stay is influenced by multiple factors including neonatal health state and breastfeeding success, and this metric should therefore be taken in context with other measures when evaluating ERAC success. ERAC can increase the value of health care provided, by improving the global quality of care and optimizing quality of recovery after cesarean delivery.

The goal of this consensus statement is to improve maternal and neonatal outcomes with evidence-based, patient-centered care using a standardized approach that optimizes recovery from cesarean delivery. Central to this goal is a culture of critically examining and applying current knowledge through quality improvement and collaboration.

The Society for Obstetric Anesthesia and Perinatology ERAC Consensus Statement

The Society for Obstetric Anesthesia and Perinatology (SOAP) is a US based, international professional society exclusively dedicated to optimizing maternal and perinatal health outcomes. In October 2018, SOAP Board of Directors convened a committee to review best practices and existing literature on enhanced recovery after cesarean. A consensus committee was selected, with 6 members from 6 different academic centers across the United States. Weekly phone calls were performed for 10 months between January and October 2019. Assigned members collated information regarding potential pre-, intra-, and postoperative ERAC elements that were further evaluated and subsequently discussed. Additional interventions were added/amended based on committee feedback. Of note, when there was a paucity in obstetric-specific data, elements of the consensus statement were adapted from other successful enhanced recovery programs, such as colorectal or gynecological-oncological surgical specialties.[1,7–10,17–19]

Three additional consultants (A.S.H., R.L., P.S.) were invited to participate in the consensus decisions and to provide further input and a draft consensus statement was presented and approved by the SOAP Board of Directors in May 2019. The consensus statement incorporates the best available evidence on each element, with focus on the obstetric patients, and maternal and neonatal outcomes. These ERAC elements are consistent with current practice guidelines for obstetrics and obstetric anesthesia, including those issued by the American Society of Anesthesiologists (ASA) Committee on Obstetric Anesthesia and SOAP as well as the American College of Obstetricians and Gynecologists (ACOG).[20–24]

We present the elements that a perioperative scheduled cesarean delivery–specific enhanced recovery program should include. Specific outcomes that these recommendations are designed to improve are often interrelated (eg, the prevention of intraoperative nausea and vomiting [IONV], multimodal analgesia, and shivering control are all expected to improve mothers comfort during the cesarean delivery and their birthing experience) and include postoperative duration of hospital stay, postoperative opioid requirement, breastfeeding success rate, maternal-neonatal bonding, patient satisfaction, and care experience.

The complete consensus statement is available online (www.soap.org), along with resources to assist with implementation, including sample patient handouts.[25]

What Is an ERAC Pathway?

ERAC is best conceptualized as a continuum of care, from preconception outreach, antepartum optimization, intrapartum care which includes the anesthetic management, and concluding with postpartum inpatient care and out-patient support. ERAC protocols aim to optimize patient outcomes by modifying the inflammation and metabolic changes associated with surgery by organizing multimodal evidence-based interventions into a specific care pathway. This consensus statement and recommendations presents 25 specific recommendations that the committee believes define an ERAC pathway (Tables 1–5). Although the consensus statement was developed for scheduled cesarean deliveries, many of the elements of the pathway can be successfully applied to nonscheduled cesarean deliveries.

Class of Recommendations and Level of Evidence

Tables 1–5 present specific recommendations on ERAC elements for preoperative, intraoperative,

Table 1. Preoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of recommendation	Level of evidence
(1) Limit fasting interval	• Solids up to 8 h before cesarean delivery • Clear fluids up to 2 h before cesarean delivery	Reduces aspiration risk while limiting hypovolemia, metabolic stress, and ketosis. • Data extrapolated from colorectal ERAS programs ASA guidelines state 6–8 h based on the type of food ingested: • A light meal or milk may be ingested for up to 6 h before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation and analgesia • Additional fasting time (8 or more hours) may be needed in cases of patient intake of fried foods, fatty foods, or meat	Class IIb	Level C-EO
(2) Nonparticulate liquid carbohydrate loading	• Nonparticulate carbohydrate drink up to 2 h before cesarean delivery (nondiabetic women only) • 45 g carbohydrate is recommended • Examples: Gatorade 32 oz (54 g carbohydrate) clear apple juice 16 oz (56 g carbohydrate)	• Reduces maternal hypoglycemia and metabolic stress • The benefit of complex carbohydrate (eg, maltodextrin) drinks for cesarean delivery is currently undefined, and fetal effects unknown • Can omit if mother is diabetic; follow institutional protocols for maternal diabetes/neonatal monitoring • Most data are extrapolated from colorectal ERAS programs • More data in cesarean population is needed specifically with respect to ideal type of carbohydrate, dose, and fetal-neonatal effects	Class IIb	Level C-EO
(3) Patient education	• Minimum: Handout or other standardized educational tool or interaction that includes precesarean delivery instructions, what to expect during cesarean delivery, and enhanced recovery information, provided at least 1 d before surgery • Example: SOAP videos available on www.SOAP.org • Ideal: Direct contact with patients with phone call/reminder or meeting before cesarean, to remind patient of ERAC goals	• The goal of ERAC patient education is to set expectations, and to engage/empower the patient to participate more completely in their care plan and recovery • Ideally, patient education takes place before the day of surgery • Preoperative discussion should include ERAC goals in addition to the routine preoperative evaluation • Patient education in general improves patient compliance with care pathways and improves outcomes in certain clinical settings; reduces patient anxiety and postoperative pain; supports patient empowerment	Class IIb	Level C-NR
(4) Lactation/breastfeeding preparation and education	• Minimum: Handout or other standardized tool or interaction that includes information on normal breastfeeding physiology, management of common lactation complications, and resources for breastfeeding support after discharge • Ideal: Structured prenatal classes with books, videos, and in-person lactation support in the hospital; referrals to breastfeeding support groups and/or lactation consultant after discharge	• Early breastfeeding improves newborn and maternal outcomes, including promoting emotional attachment, reduced infant infectious complications, and reduced risk for sudden infant death syndrome • Breastfeeding is a public health priority because it is risk protective for downstream adverse health outcomes such as breast cancer and hypertension • Every woman should be supported in her informed decision on infant feeding	Class IIa	Level B-R
(5) Hemoglobin optimization	All pregnant women should be screened for anemia per ACOG guidelines[21] • Women with iron-deficiency anemia should be treated with supplemental orally, per os (or if refractory anemia with IV) iron in addition to prenatal vitamins • Anemia other than iron-deficiency should be further evaluated	• Goal: Work with obstetric provider team during prenatal visits, to engage patient in understanding the importance of hemoglobin optimization; treat prenatal anemia appropriately • Antepartum anemia is a significant predictor of postpartum anemia, which is linked to depression and fatigue • Iron-deficiency anemia in pregnancy is linked to increased risk for low birth weight, preterm delivery, and perinatal mortality	Class IIa	Level B-R

The included 5 preoperative elements aim to reduce fasting periods, engage patients and providers in the care plan, and promote physical health optimization. The 2016 ACC and AHA Clinical Practice Guideline Recommendation Classification Systems were used to evaluate each of the elements, based on the best available evidence.[26]

Abbreviations: ACC, American College of Cardiology; ACOG, American College of Obstetricians and Gynecologists; AHA, American Heart Association; ASA, American Society of Anesthesiologists; ERAC, Enhanced Recovery After Cesarean Delivery; ERAS, Enhanced Recovery After Surgery; IV, intravenous; SOAP, Society for Obstetric Anesthesia and Perinatology.

Table 2. Intraoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of recommendation	Level of evidence
(1) Prevent spinal anesthesia–induced hypotension	• Maintain blood pressure at baseline • Optimally managed with prophylactic vasopressor infusion, for example, phenylephrine (or norepinephrine) infusion	• Spinal anesthesia–associated hypotension is primarily an afterload-driven problem • Goal is to prevent intraoperative nausea/vomiting after spinal anesthesia and maintain uteroplacental perfusion • Vasopressor regimen may need to be modified in women with preeclampsia as the degree of hypotension with spinal anesthesia may be less than that in nonpreeclamptics • Data are well supported in literature from the obstetric population	Class I	Level A
(2) Maintain normothermia	• Active warming: Example: • In-line IV fluid warmer • Forced air warming • Keep the OR temperature ideally >72°F or 23.0°C (Joint Commission guidance)	• Consider active warming starting preoperatively	Class I	Level C
(3) Optimal uterotonic administration	• Use lowest effective dose of uterotonic necessary to achieve adequate uterine tone and minimize side effects Sample: -Elective cesarean delivery: Bolus 1 IU oxytocin; start oxytocin infusion at 2.5–7.5 IU·h^{-1} (0.04–0.125 IU·min^{-1}) -and intrapartum cesarean delivery: 3 IU oxytocin over ≥30 s; start oxytocin infusion at 7.5–15 IU·h^{-1} (0.125–0.25 IU·min^{-1})[27]	• In the case of hemorrhage caused by uterine atony, transition from ERAC to institutional hemorrhage resuscitation protocol	Class II	Level A
(4) Antibiotic prophylaxis	• Antibiotic prophylaxis dosed before skin incision (do not wait until after cord clamping)	Follow ACOG guidelines[24]	Class I	Level A
(5) IONV/PONV prophylaxis	• Prophylactic vasopressor infusion (see above) to decrease hypotension-associated IONV • Address uterine exteriorization and abdominal saline irrigation with surgeon • Combination of at least 2 prophylactic IV antiemetics with different mechanisms of action. Examples: ◦ 5HT$_3$ antagonist (eg, ondansetron 4 mg) ◦ Glucocorticoid (eg, dexamethasone 4 mg) ◦ D2 receptors antagonist (eg, metoclopramide 10 mg)	• IONV/PONV is a major stressor for the mother and should be avoided, bearing in mind the different etiologies • Limiting/avoid uterine exteriorization which is associated with IONV and delayed bowel function recovery • Abdominal saline irrigation may worsen IONV and PONV • Dexamethasone is effective for PONV and not IONV due to delayed onset of action • Metoclopramide is effective for IONV but not PONV	Class I IONV/PONV prophylaxis Class IIa uterine exteriorization	Level B Level C-LD
(6) Initiate multimodal analgesia	Neuraxial long-acting opioid Example: • IT morphine 50–150 μg or • Epidural morphine 1–3 mg Nonopioid analgesia started in OR unless contraindicated: 1. Ketorolac 15–30 mg IV after peritoneum closed 2. APAP IV after delivery or orally, per os before or after delivery Consider local anesthetic wound infiltration or regional blocks such as TAP or QLB if neuraxial morphine is not administered	• Use neuraxial doses consistent with SOAP Center of Excellence criteria Link: bit.ly/2Ii8GBe • Nonopioid analgesia is ideally started before the onset of pain • Rectal APAP may be an alternative but has lower bioavailability • The role of wound infiltration and other regional blocks for postcesarean pain should be considered in select cases, for example, in women who could not receive neuraxial morphine, or other multimodal analgesia regimen components, or patients at risk for severe pain	Class I Data to support preemptive analgesia in cesarean delivery are limited	Level A

(*Continued*)

Table 2. Intraoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of recommendation	Level of evidence
(7) Promote breastfeeding and maternal-infant bonding	• Skin-to-skin contact should occur as soon as possible in the operating room as appropriate based on maternal/neonatal condition	• Skin-to-skin contact intraoperatively supports the "golden hour" of breastfeeding initiation within 1 h of birth • Supports a safe transition of the infant from intrauterine life to extrauterine life • Facilitates mother-infant bonding • May require additional nurse support intraoperatively (follow hospital guideline for safe positioning for the newborn during skin-to-skin contact) • Ideally responsibility of nonanesthesia care team member • Ways to facilitate skin-to-skin contact intraoperatively include moving electrocardiogram leads and electrodes to the patients back to clear space on the chest; moving equipment to allow nursing personnel space to safely accomplish skin-to-skin contact; maintain efforts to keep maternal/neonatal temperature (eg, forced air warmer, warmed blankets)	Class IIa	Level C

The included 9 (Tables 2, 3) intraoperative elements aim to prevent spinal anesthesia–induced hypotension and IONV, initiate multimodal analgesia, support breastfeeding and maternal-infant bonding, and optimize fluid management and fetal outcomes. The 2016 ACC and AHA Clinical Practice Guideline Recommendation Classification Systems were used to evaluate each of the elements, based on the best available evidence.[26]

Abbreviations: 5HT3, 5 hydroxytryptamine receptor; ACC, American College of Cardiology; ACOG, American College of Obstetricians and Gynecologists; AHA, American Heart Association; APAP, acetaminophen; D2, dopamine receptor; ERAC, Enhanced Recovery After Cesarean Delivery; IONV, intraoperative nausea and vomiting; IT, intrathecal; IV, intravenous; OR, operation room; PONV, postoperative nausea and vomiting; QLB, quadratus lumborum block; SOAP, Society for Obstetric Anesthesia and Perinatology; TAP, transversus abdominis plane block.

Table 3. Intraoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of recommendation	Level of evidence
(8) Intravenous fluid optimization	• Limit intravenous fluids to <3 L for routine cases	• In the case of hemorrhage, transition from ERAC to institutional hemorrhage resuscitation protocol • Spinal anesthesia–associated hypotension in cesarean delivery should be primarily managed with vasopressors, instead of fluids • Ideal intravenous fluid parameters/goals in cesarean delivery are not well established	Class IIa	Level C
(9) Delayed umbilical cord clamping	ACOG recommends delay in umbilical cord clamping in vigorous term and preterm infants for at least 30–60 s after birth[28]	• Benefits: Term: improved iron stores, developmental benefits; preterm: improved transitional circulation, reduced need for transfusion, lower risk of necrotizing enterocolitis and intraventricular hemorrhage • Does not increase maternal risk for blood loss or transfusion • The ability to provide delayed cord clamping may vary among institutions and settings Delayed cord clamping should be deferred in certain situations (eg, maternal instability, fetal/neonatal need for immediate resuscitation)[28]	Class I	Level A

The included 9 (Tables 2, 3) intraoperative elements aim to prevent spinal anesthesia–induced hypotension and IONV, initiate multimodal analgesia, support breastfeeding and maternal-infant bonding, and optimize fluid management and fetal outcomes. The 2016 ACC and AHA Clinical Practice Guideline Recommendation Classification Systems were used to evaluate each of the elements, based on the best available evidence.[26]

Abbreviations: ACC, American College of Cardiology; ACOG, American College of Obstetricians and Gynecologists; AHA, American Heart Association; ERAC, Enhanced Recovery After Cesarean Delivery.

and postoperative time frames. A focused literature review related to enhanced maternal and neonatal recovery after cesarean delivery was conducted for each recommendation by 2 committee members (preoperative period: S.B., M.T.; intraoperative period: G.L., M.Z.; postoperative period: L.B., B.C.) and then reviewed by the full committee. The existing evidence and strength of recommendations were evaluated for each of the elements by assigned committee members and subsequently discussed by the entire committee, in cases of disagreement, the level was up or downgraded until consensus was achieved. The 2016 American College of Cardiology (ACC) and American Heart Association (AHA) Clinical Practice Guideline Recommendation Classification Systems[26] were used to evaluate each of the element's level of evidence.

Table 4. Postoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of Recommendation	Level of Evidence
(1) Early oral intake	• Ice chips and/or water within 60 min postcesarean admission to PACU • Heparin/saline lock the IV early once oxytocin infusion complete, tolerating fluids, and urine output adequate • Advance to regular diet ideally within 4 h postcesarean, as tolerated	Early oral intake leads to: • Accelerated return of bowel function • Reduced hospital length of stay • No increased rates of complication • No increased risk of postoperative nausea or vomiting • Reduced postoperative catabolism • Improved insulin sensitivity • Reduced surgical stress response	Class IIb For cesarean delivery	Level C-EO
(2) Early mobilization	• Ambulate only after adequate return of motor function Examples: 0–8 h postoperatively: • Sit on edge of bed • Out of bed to chair • Ambulation as tolerated 8–24 h postoperatively: • Ambulation as tolerated • Walk: 1–2 times (or more) in hall 24–48 h postoperatively: • Walk: 3–4 times (or more) in hall • Out of bed for 8 h	Early mobilization decreases: • Insulin resistance • Muscle atrophy • Hypoxia • Venous thromboembolism • Length of stay • Remove barriers to early mobilization: • IV poles • Urinary catheters • Poor pain control • Sedation • PONV • Dizziness • Slow block regression	Class I	Level B-NR
(3) Promotion of resting periods	• Optimize sleep and rest • Encourage clustered interventions (eg, vital signs assessments in coordination with analgesic administration; timing of oral analgesics contemporaneously) Appropriate use of postoperative monitoring (see SOAP neuraxial morphine monitoring consensus statement[29])	• Fatigue potentially impacts cognitive function, depression, pain, maternal-infant bonding, and risk of respiratory depression	Class IIb	Level C-EO
(4) Early urinary catheter removal	• Urinary catheter removed by 6–12 h postpartum • Construct protocols to establish criteria for appropriate removal and to manage postcatheter removal urinary retention	Benefits include: • Improved ambulation • Reduced length of stay • Lower rates of symptomatic UTI Earlier catheter removal may be associated with higher rates of urinary retention and need for recatheterization Dose of neuraxial local anesthetic and opioid can impact catheter removal time	Class IIb	Level C-EO
(5) Venous thromboembolism prophylaxis	Follow institutional practices as per ACOG and ACCP guidelines[30–33]	• Cesarean delivery approximately doubles the risk of venous thromboembolism compared to vaginal delivery, but in otherwise healthy patients the absolute risk is low • ACOG recommends mechanical thromboembolism prophylaxis for all women not already receiving pharmacologic thromboprophylaxis[33]	Class I	Level A
(6) Facilitate early discharge	• Standardize discharge planning and coordinate care starting preoperatively • Establish patient-oriented goals early • Personalize/patient-centered opioid prescribing at discharge • Use metrics to monitor patient progress in meeting early discharge criteria	• Discharge planning on POD 1 should ideally include pediatric, lactation, and contraceptive planning	Class IIb	Level C-EO
(7) Anemia remediation	• Screen and treat anemia	• Hb check on POD 1 or 2 should be considered in patients with severe intraoperative bleeding	Class I	Level A

(*Continued*)

Table 4. Postoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of Recommendation	Level of Evidence
(8) Breastfeeding support	• Robust lactation support per institutional guideline	• Should start immediately after birth by offering skin-to-skin care and continued throughout hospitalization • Support of the "golden hour" to help women initiate breastfeeding within 1 h of birth • Initial skin-to-skin contact should continue uninterrupted until the completion of the first breastfeeding • In the case of formula fed infants, initial skin-to-skin contact should continue as uninterrupted as possible for at least 1 h • After the initial period of skin-to-skin contact, mothers should be encouraged to continue this type of care as much as possible during the hospital stay • Provide lactation consulting and educational material (10 steps to successful breastfeeding as documented in the Joint Statement by UNICEF and WHO: Baby Friendly Hospital Initiative[34])	Class I	Level A

The included 11 postoperative elements (Tables 4, 5) aim to minimize postcesarean metabolic stress by early feeding, promote early mobilization, remove physical early mobilization barriers, facilitate hospital discharge, control glycemic levels, promote early return of bowel function and utilize multimodal analgesia. The 2016 ACC and AHA Clinical Practice Guideline Recommendation Classification Systems were used to evaluate each of the elements, based on the best available evidence.[26]

Abbreviations: ACC, American College of Cardiology; ACCP, American College of Clinical Pharmacy; ACOG, American College of Obstetricians and Gynecologists; AHA, American Heart Association; ERAC, Enhanced Recovery After Cesarean Delivery; Hb, hemoglobin; IV, intravenous; POD, postoperative day; PONV, postoperative nausea and vomiting; SOAP, Society for Obstetric Anesthesia and Perinatology; UNICEF, United Nations International Children's Emergency Fund; UTI, urinary tract infection; WHO, World Health Organization.

PREOPERATIVE ERAC RECOMMENDATIONS

A total of 5 preoperative ERAC elements were identified (Table 1): (1) limited fasting intervals; (2) nonparticulate liquid carbohydrate loading; (3) patient education; (4) lactation/breastfeeding education; (5) hemoglobin optimization.

Limit Fasting Interval (Class IIb, Level C-EO, Low-Grade Level of Evidence)

Oral intake up to the limits of the ASA guidelines is encouraged.[35] Limiting preoperative fasting interval is a key component of all ERAS pathways, because it limits metabolic stress and ketosis.[36] Curtailing these metabolic demands enables improved recovery quality and reduced length of stay after colorectal surgery.[37] The data supporting the recommendations for limiting preoperative fasting period was derived from nonobstetric populations (Table 1).

Nonparticulate Liquid Carbohydrate Loading (Class IIb, Level C-EO, Low-Grade Level of Evidence)

In the obstetric population, a balance needs to be struck between the desire to limit preoperative fasting and selecting appropriate oral intake parameters to prevent aspiration in this high-risk population.[20,35] For example, particulate carbohydrate loading is not advisable, given the historical context of lethal aspiration pneumonitis/pneumonia hazards that are well described in this patient cohort.[38] Studies in nonlaboring women scheduled to undergo a cesarean delivery suggest that gastric emptying is not decreased compared to their nonpregnant counterpart.[39] Therefore, carbohydrate loading with nonparticulate liquids (eg, clear apple juice) up to 2 hours before scheduled cesarean delivery is recommended.

Patient Education (Class IIb, Level C-NR, Moderate-Grade Level of Evidence)

Patient education, information material, and clear communication are essential to enhanced recovery pathways, as patient empowerment for active participation in their health care is vital to improving health outcomes.[37,40–43] Malpractice claims, a potential surrogate for care quality, are lower among physicians who emphasize a positive communication style and orientate toward patient education in clinical encounters.[42] For obstetric patients, patient activation and prenatal engagement, both of which emphasize patient counseling and education, are associated with positive patient experience and improved obstetric outcomes.[44]

Lactation/Breastfeeding Education (Class IIa, Level B-R, Moderate-Grade Level of Evidence)

Lactation/breastfeeding education is an important element of postpartum recovery for breastfeeding mothers and their infants.[22,23,45–49] Numerous

Table 5. Postoperative ERAC Pathway Elements

Recommendation	Action	Comments	Strength of recommendation	Level of evidence
(9) Multimodal analgesia	Multimodal analgesia protocols include: • Low-dose long-acting neuraxial opioid such as morphine (see above) • Scheduled NSAID • Scheduled APAP • Local anesthetic techniques as indicated Example: • APAP 650–1000 mg orally, per os q6h scheduled • Ibuprofen 600 mg orally, per os q6h scheduled after IV ketorolac 15–30 mg was given after delivery in OR, or naproxen 500 mg orally, per os twice a day or other NSAID • Oxycodone 2.5–5 mg orally, per os q4h PRN pain • Preemptive or rescue supplemental regional blocks as indicated	Multimodal analgesia should be used to: • Reduce pain • Improve mobilization • Limit IV opioids in PACU • Limit opioids in hospital • Limit opioids at discharge Opioids are associated with nausea/vomiting, sedation, fatigue, ileus, constipation, misuse/addiction risk • Multimodal analgesia (including NSAID + APAP) decrease opioid use/side effects by 30% • See SOAP Center of Excellence criteria Link: bit.ly/2Ii8GBe • Expectation management[25] • Peripheral nerve blocks (TAP, QLB, continuous wound infiltration) available when neuraxial morphine cannot be given, or as a rescue technique when severe breakthrough pain despite the use of neuraxial morphine • TAP block does not provide significant improvement when given in addition to neuraxial morphine and scheduled NSAID/APAP • Gabapentinoids have not been shown to have significant benefit in routine cesarean; may be appropriate in select patients; use caution in patients on methadone or other QTc prolonging medications	Class I	Level B-NR
(10) Glycemic control	• Patient with diabetes ideally first case of day • Maintain normoglycemia (<180–200 mg/dL); check maternal/neonatal glucose per hospital protocol	• Hyperglycemia (>180–200 mg/dL) is associated with poor outcomes including infection and delayed wound healing • Data stems from nonobstetric populations	Class I	Level A
(11) Promotion of return of bowel function	• Minimization of opioid consumption • Consider chewing gum • Remove barriers to recovery • Encourage mobilization	• Availability of multiple PRN bowel medications, eg, Docusate (Colace, Purdue Pharma LP, Stamford, CT), Polyethylene glycol 3350 (Miralax, Bayer HealthCare LLC, Tarrytown, NY), Simethicone (Gas Relief, Equate TM, Perrigo Company PLC, Allegan, MI)	Class IIb	Level C-EO

The included 11 postoperative elements (Tables 4, 5) aim to minimize postcesarean metabolic stress by early feeding, promote early mobilization, remove physical early mobilization barriers, facilitate hospital discharge, control glycemic levels, promote early return of bowel function and utilize multimodal analgesia. The 2016 ACC and AHA Clinical Practice Guideline Recommendation Classification Systems were used to evaluate each of the elements, based on the best available evidence.[26]

Abbreviations: ACC, American College of Cardiology; AHA, American Heart Association; APAP, acetaminophen; ERAC, Enhanced Recovery After Cesarean Delivery; IV, intravenous; NSAID, nonsteroidal anti-inflammatory drug; OR, operation room; PACU, postanesthesia care unit; PRN, pre re nata (as needed); q6h, every 6 hours; QLB, quadratus lumborum block; QTc, QT duration in electrocardiography; SOAP, Society for Obstetric Anesthesia and Perinatology; TAP, transversus abdominis plane block.

professional organizations, including the World Health Organization (WHO) and American Academy of Pediatrics (AAP), recognize the many medical and neurodevelopmental advantages of breastfeeding, and consider infant nutrition to be a public health issue rather than a lifestyle choice.[45] The AAP recommends exclusive breastfeeding for 6 months and continued breastfeeding alongside solid food for 1 year or longer as desired by both mother and infant. Hospitals should therefore encourage and support the initiation and maintenance of breastfeeding.[45] The US Surgeon General, Centers for Disease Control and Prevention (CDC), and The Joint Commission have issued strategies to facilitate breastfeeding in the hospital and community settings, and highlight the potential for improved breastfeeding end points with the implementation of breastfeeding-friendly practices.[50–52]

Hemoglobin Optimization (Class IIa, Level B-R, Moderate-Grade Level of Evidence)

Many health benefits are associated with perinatal anemia prevention and treatment, including transfusion avoidance, improved cognition and mood, and quicker postpartum recovery.[21,53–57] One randomized controlled trial suggested that early prenatal iron supplementation improved postpartum depression screening scores,[56] although its effect on clinical diagnosis of depression was not assessed. For other surgeries, preoperative anemia optimization is recommended as part of a multimodal patient blood management approach.[54] Preoperative anemia optimization for cesarean delivery is particularly important given that: (1) pregnancy is associated with increased blood volume and dilutional anemia; (2) cesarean delivery is associated with blood loss that is higher than most abdominal surgeries; (3) prenatal anemia is a strong predictor of severe postpartum anemia[55]; (4) ACOG and CDC recommend screening, prevention, and treatment of anemia in pregnancy.[21,53]

In summary, preoperative ERAC element recommendations include patient education, minimizing preoperative fasting periods, and nonparticulate carbohydrate loading up to 2 hours before scheduled delivery, lactation/breastfeeding education, and hemoglobin optimization.

INTRAOPERATIVE ERAC RECOMMENDATIONS

A total of 9 intraoperative ERAC elements were identified (Tables 2, 3): (1) prevention of spinal-induced hypotension; (2) maintenance of normothermia; (3) optimized uterotonic administration; (4) antibiotic prophylaxis; (5) IONV and postoperative nausea and vomiting (PONV) prophylaxis; (6) multimodal analgesia initiation; (7) promotion of breastfeeding and maternal-infant bonding; (8) intravenous fluid optimization, and (9) delayed umbilical cord clamping.

Spinal Anesthesia–Induced Hypotension Prevention (Class I, Level A, High-Grade Level of Evidence)

Preventing spinal-induced hypotension is an important strategy to enhance maternal and neonatal outcomes in cesarean delivery.[38] Fetal perfusion is dependent on uteroplacental blood flow, which lacks autoregulation, making it directly dependent on uterine perfusion pressure and inversely proportional to uterine vascular resistance. Current evidence supports the routine use of prophylactic phenylephrine infusion started immediately after injection of spinal anesthesia medications.[38,58] A crystalloid fluid coload (1 L administered immediately and rapidly after spinal injection) is preferable to a preload, and in combination with vasopressors significantly reduces the incidence of spinal-induced hypotension.[58] Spinal-induced hypotension during cesarean delivery should be managed with vasopressors agents having primarily direct alpha activity (eg, phenylephrine or norepinephrine), while fluids should remain a complementary intervention. Since IONV during cesarean delivery is commonly the result of spinal-induced hypotension, the above-recommended management techniques can be effective at reducing the incidence of IONV during cesarean delivery. Among women randomized to receive a prophylactic phenylephrine infusion compared to intermittent bolus regimens, the umbilical artery pH and base excess improved and incidence of maternal IONV was lower.[58]

Normothermia Maintenance (Class I, Level C, Low-Grade Level of Evidence)

Maintaining normothermia confers multiple perioperative maternal-neonatal benefits including reduced surgical site infection risk, shorter hospital length of stay (as shown in nonobstetric surgical settings), and improved neonatal umbilical artery pH and Apgar scores.[59–64] One meta-analysis found that active warming for elective cesarean delivery significantly decreased the incidence of hypothermia and perioperative shivering.[63] Preferred methods of facilitating maternal-neonatal warming in cesarean delivery include preoperative patient warming, and intraoperative fluid and forced air warming. A higher ambient operating room temperature set at 72°F (23.0 °C) is also recommended.[65]

Uterotonic Administration (Class II, Level A, High-Grade Level of Evidence)

Optimal uterotonic administration during cesarean delivery is important to prevent and treat uterine atony and associated postpartum hemorrhage (PPH).[66,67] However, appropriate dosing of these medications is important to avoid drug-related side effects. It is advisable to use the lowest effective dose of uterotonics needed to achieve adequate uterine tone to minimize side effects. Undesirable effects of uterotonic agents include flushing, nausea and vomiting, tachycardia, hypotension, delayed water retention, hyponatremia and seizures (oxytocin); bronchospasm (prostaglandins); hypertension (ergot alkaloids); and drug errors (a risk associated with any unnecessarily administered drug).[27,66] A suggested uterotonic dosing regimen can be found in Table 2. Large and rapidly administered oxytocin boluses should be avoided to minimize side effects. Intrapartum cesarean delivery oxytocin dosing requirements are several fold higher than for elective cases without prior oxytocin exposure.[68]

Antibiotic Prophylaxis (Class I, Level A, High-Grade Level of Evidence)

Appropriate antibiotic prophylaxis is critical for prevention of surgical site infection. ACOG guidelines

consider cefazolin 2 g as a first-line antibiotic, with the addition of azithromycin in appropriate cesarean deliveries (such as in the presence of ruptured membranes).[24,69] Prophylactic antibiotics should be administered before incision, rather than after cord clamping. Preincision administration improves the prophylaxis effectiveness while the risks to fetus do not appear to be increased.[24]

IONV/PONV Prophylaxis (Class I, Level B, Moderate-Grade Level of Evidence)

Adding lipophilic opioids such as fentanyl or sufentanil to spinal anesthesia with local anesthetics enhances intraoperative anesthesia,[70] reduces the total required dose of local anesthetic and thereby decreases spinal hypotension, reduces intraoperative pain and need for rescue analgesics, and decreases IONV.[38,71] PONV prophylaxis elements for cesarean delivery include the use of at least 2 antiemetic agents, for example, ondansetron and dexamethasone.[72–74] Metoclopramide is effective for IONV prevention, while dexamethasone's pharmacological profile make it a better option for PONV prophylaxis.[75] Evidence supports the avoidance of intraabdominal saline irrigation, which does not reduce the incidence of infectious complications but does increase the incidence of IONV and PONV.[76,77]

Avoiding uterine exteriorization has also been suggested as a strategy to reduce IONV,[78] intra- and postoperative pain, and time-to-return of bowel function following cesarean delivery; however, evidence regarding its effectiveness in preventing IONV is conflicting. The committee favored avoiding uterine exteriorization because studies with IONV as the primary outcome after uterine exteriorization suggested benefits with not externalizing the uterus.[78–84]

Multimodal Analgesia (Class I, Level A, High-Grade Level of Evidence)

Initiating multimodal analgesia includes administration of intrathecal morphine (50–150 µg) or epidural morphine (1–3 mg); nonopioid analgesia, for example, nonsteroidal anti-inflammatory drugs and acetaminophen (started in the operating room unless contraindicated); and supplemental local anesthetic wound infiltration or truncal blocks in select cases (if unable to receive the above-recommended drugs).[20,38,85,86] An emphasis on regular scheduled nonopioid analgesia begun before the onset of pain (ie, immediately after delivery of fetus and not on first pain request) should be central in these multimodal analgesic regimens.

Breastfeeding and Maternal-Infant Bonding (Class IIa, Level C, Low-Grade Level of Evidence)

Skin-to-skin contact immediately after delivery improves breastfeeding success and promotes maternal-infant bonding.[47–49] The Association of Women's Health, Obstetric and Neonatal Nurses support skin-to-skin contact to promote lactation and breastfeeding.[49] One quality improvement project found that early skin-to-skin contact in the operating room during cesarean delivery was feasible and increased breastfeeding initiation behaviors.[47] These infants had lower rates of formula supplementation in the hospital. A meta-analysis, including 38 randomized controlled studies, showed that skin-to-skin contact promoted breastfeeding among healthy infants, and found potential physiologic benefits for infants in transitioning to extrauterine life.[48] Although a randomized trial did not find this physiologic benefit for infants, it did not report elevated risks associated with early skin-to-skin contact.[87]

Intravenous Fluid Optimization (Class IIa, Level C, Low-Grade Level of Evidence)

Goal-directed intraoperative fluid management is a mainstay of many ERAS pathways (Table 3). In colorectal surgery, the avoidance of both volume overload (that may affect anastomotic integrity) and under-resuscitation (that may cause end-organ hypoperfusion) are important.[37] As previously stated, prevention and treatment of spinal anesthesia–induced hypotension should focus on use of vasopressors in conjunction with judicious coadministration of fluids. Ideal fluid management parameters or goals in cesarean delivery have not been established. Expert consensus suggests limiting intravenous fluids to <3 L for routine cases. Avoidance of excessive volumes is important given the ubiquitous coadministration of oxytocin for active management of the third stage of labor, which increases postoperative intravascular fluid shifts and the risk of hyponatremia.[66,88] Early recognition and preparedness for PPH, a commonly preventable cause of serious maternal morbidity,[11] is of critical importance. In the setting of PPH, fluid and blood administration as part of hemorrhage protocols supersede ERAC fluid guidelines. Data supporting the recommendations for intraoperative fluid management were derived from nonobstetric surgical populations (Tables 2, 3).

Delayed Cord Clamping (Class I, Level A, High-Grade Level of Evidence)

Delayed umbilical cord clamping improves neonatal hemoglobin levels at birth and improves iron stores in term infants, which may have neurodevelopmental benefits.[89] Preterm infants benefit from delayed cord clamping by improved circulation, greater red cell volume, reduced transfusion risk, and decreased risk for necrotizing enterocolitis and cerebral hemorrhage. There may be a small increased risk for neonatal

jaundice associated with this technique, and therefore systems should be set up for monitoring and treating jaundice in these infants. Delayed cord clamping does not significantly increase perioperative blood loss or the incidence of maternal postoperative anemia.[28] ACOG currently recommends a delay in umbilical cord clamping in vigorous term and preterm infants for at least 30–60 seconds after birth.[89] Patient-physician judgments should determine whether delayed cord clamping is performed in setting of PPH or high-risk deliveries.

In summary, intraoperative ERAC element recommendations include (1) prevention of spinal-induced hypotension, (2) maintenance of normothermia, (3) optimization of uterotonic administration, (4) antibiotic prophylaxis, (5) IONV and PONV prophylaxis, (6) multimodal analgesia initiation, (7) promotion of breastfeeding and maternal-infant bonding, (8) intravenous fluid optimization, and (9) delayed cord clamping.

POSTOPERATIVE ERAC RECOMMENDATIONS

A total of 11 postoperative ERAC elements were identified (Tables 4, 5): (1) early oral intake, (2) early mobilization, (3) resting periods promotion, (4) early urinary catheter removal, (5) venous thromboembolism (VTE) prophylaxis, (6) early discharge facilitation, (7) anemia remediation, (8) breastfeeding support, (9) multimodal analgesia, (10) glycemic control, and (11) return of bowel function promotion.

Early Oral Intake (Class IIb, Level C-EO, Low-Grade Level of Evidence)

The goals of early oral intake are to accelerate return of bowel function and reduce postoperative catabolism. Early oral intake improves insulin sensitivity and mitigates the surgical stress response.[37,90–95] Early oral intake is not associated with increased rates of gastrointestinal complications or risk for PONV in the nonobstetric and obstetric population. A meta-analysis, including 11 studies found that early oral intake after cesarean delivery enhances the return of bowel function and does not increase the risk of postoperative complications.[90,92]

Early Mobilization (Class I, Level B-NR, Moderate-Grade Level of Evidence)

Early mobilization reduces insulin resistance, venous thromboembolic risk, and hospital length of stay.[96–99] Tables 4, 5 provide examples of time-based goals for ambulation postcesarean delivery.[100] For example, getting out of bed to a chair or ambulating within 8 hours as tolerated is a recommended goal. Barriers to early mobilization such as intravenous poles, urinary catheters, and poor pain control should be removed. Data supporting these recommendations were derived from nonobstetric populations (Tables 4, 5).

Resting Periods (Class IIb, Level C-EO, Low-Grade Level of Evidence)

Minimizing interruptions from visitors and health care providers encourage maternal resting periods. Maternal fatigue may negatively impact cognitive function, depression, mood, maternal-infant bonding, and increase the risk of respiratory depression.[101] Practices that support these goals include clustering interventions such as assessment of vital signs, scheduled analgesic administration, and patient-appropriate postoperative monitoring. The 2019 SOAP respiratory monitoring consensus statement outlines patient-centered monitoring options in more detail.[29]

Early Urinary Catheter Removal (Class IIb, Level C-EO, Low-Grade Level of Evidence)

Early urinary catheter removal is important to support early mobilization goals. Other benefits include facilitating ambulation, shortening length of hospital stay, and lowering rates of symptomatic urinary tract infections.[102–105] Neuraxial local anesthetics dose and particularly long-acting neuraxial opioids can increase the duration of detrusor muscle dysfunction and delay catheter removal times.[103] Early urinary catheter removal must be balanced against increased risk of recatheterization. Data supporting these recommendations were derived from nonobstetric surgical populations (Tables 4, 5).

VTE Prophylaxis (Class I, Level A, High-Grade Level of Evidence)

Modern VTE prophylaxis goals in cesarean delivery[96,106] include mechanical thromboprophylaxis for all women not already receiving pharmacologic thromboprophylaxis with low-molecular-weight heparin or unfractionated heparin (ACOG and American College of Chest Physicians, ACCP guidelines) unless contraindicated.[30–33,96,106]

Early Discharge (Class IIb, Level C-EO, Low-Grade Level of Evidence)

Facilitating early discharge ideally starts with establishing patient-oriented goals preoperatively, and encompasses elements such as neonatal care planning, lactation education, and contraception planning. Patient and support person education strategies in addition to patient self-empowerment for active participation in their health care are emphasized.[107]

Anemia Remediation (Class I, Level A, High-Grade Level of Evidence)

Anemia remediation includes early recognition and treatment of peripartum hemorrhage and management of postpartum anemia. Routinely checking postpartum laboratory tests in low-risk cohorts is not necessary, and routine hemoglobin checks on

postoperative day 1 or 2 should be reserved for patients with significant (eg, >1 L) intraoperative bleeding or preexisting anemia.[21,53–57] Although oral or intravenous formulations are acceptable for treatment of iron-deficiency anemia, 1 meta-analysis suggests intravenous formulations may offer increased efficacy (higher hemoglobin levels at 6 weeks postpartum compared to oral administration), without increased risk of side effects.[57] Recent reports describe the association between postpartum iron-deficiency anemia and postpartum anxiety and depression, emphasizing the importance of anemia remediation in preventing postpartum morbidity.[108–110] Of note, there is no evidence that liberal transfusion policies improves maternal outcomes and transfusion reactions are more common in pregnant and postpartum women compared to their nonpregnant peers.[111]

Breastfeeding Support (Class I, Level A, High-Grade Level of Evidence)

Lactation education and counseling should continue throughout the hospital stay in accordance with the Joint Statement by United Nations International Children's Emergency Fund (UNICEF) and WHO.[34]

Multimodal Analgesia (Class I, Level B-NR, Moderate-Grade Level of Evidence)

Multimodal analgesia in the postpartum period facilitates a reduction of pain, improves mobility, limits intravenous opioid requirement, and reduces in-hospital and discharge opioids use.[112–115] These goals are accomplished by low-dose long-acting neuraxial opioids such as morphine (see "Intraoperative" section), scheduled nonsteroidal anti-inflammatory drugs, and scheduled acetaminophen.[85,86,116–119] Local anesthetic techniques, including wound infiltration, transversus abdominis plane (TAP), and quadratus lumborum blocks (QLB) should also be leveraged when indicated (Table 3).

Glycemic Control (Class I, Level A, High-Grade Level of Evidence)

Avoidance of hyperglycemia (>180–200 mg/dL) is desirable because perioperative hyperglycemia increases risk for surgical site infection and delayed wound healing.[120–122] Strategies to maintain normoglycemia include scheduling patients with insulin-dependent diabetes early in the day and checking maternal-neonatal glucose parameters per institutional protocol. These recommendations were derived from nonobstetric populations (Tables 4, 5).

Return of Bowel Function (Class IIb, Level C-EO, Low-Grade Level of Evidence)

Promoting return of bowel function emphasizes the use of multiple pro re nata bowel medications such as docusate and simethicone, minimizing opioid use, providing adequate hydration and encouraging mobilization.[37 90] These recommendations were derived from nonobstetric populations (Tables 4, 5).

In summary, postoperative ERAC element recommendations include promotion of (1) early oral intake, (2) early mobilization, (3) resting periods, (4) early urinary catheter removal, (5) VTE prophylaxis, (6) facilitation of early discharge, (7) anemia remediation, (8) breastfeeding support, (9) multimodal analgesia, (10) glycemic control, and (11) early return of bowel function.

DISCUSSION

Considerations for enhanced recovery pathways for cesarean deliveries differ significantly from those proposed after other surgical procedures, in that unique and essential elements for both maternal and fetal/neonatal care goals, standards and outcomes are necessary. Importantly, ensuring women's ability to care for their newborn is crucial, which requires optimization of pain management and achievement of specific milestones by the time of hospital discharge. The overarching goal is to improve maternal outcomes without compromising measures of patient safety including maternal readmission and complication rates. While it is desirable to reduce postpartum depression, improve neonatal safety, reduce chronic pain, and maternal morbidity (eg, surgical site infection, acute kidney injury, and wound dehiscence), future research needs to evaluate ERAC effects on these rarer outcomes.

Implementation of ERAC pathways for obstetric patients requires highly functional relationships between hospital systems and local cultural factors to support each element. ERAC pathways improve maternal and infant outcomes, enhance the patient experience, and support a local culture of growth orientation and commitment to continuous improvement and high quality of clinical care. Inherent to enhanced recovery pathways is ongoing interdisciplinary quality improvement and auditing of processes and outcomes to continuously adapt and improve the individual ERAC protocols.

Due to relatively limited, high-quality evidence supporting enhanced recovery elements specific to obstetric populations, several recommendations presented here are based on low or very low-quality evidence or expert consensus. Strongest evidence (level 1 A) exists for intraoperative and postoperative recommendations, such as avoidance of spinal-induced hypotension to prevent IONV, implementation of multimodal analgesia and delayed cord clamping. Postoperative recommendations with strong evidence (level 1 A) are early mobilization, glycemic control, and use of multimodal analgesia.

There is minimal evidence of specific effects of individual elements of ERAC protocols; however, recommended elements proposed here have been evaluated together in different bundles and resulted in improved maternal and neonatal outcomes.[123]

A limitation of this consensus statement is that no obstetricians or nurses were invited to participate yet several recommendations primarily apply to obstetric providers and nurses. However, as perioperative specialists, it is the responsibility of obstetric anesthesiologists to promote and facilitate these important elements of an enhanced recovery program to all, rather than on a case-by-case basis, and ensure they are built into an ERAC pathway. There is no international consensus regarding which specific outcomes should be monitored in perioperative enhanced recovery pathway studies. Future research should therefore focus on providing high-quality data clarifying which pathway elements, or combinations thereof, best enhance recovery. More study is required to facilitate consensus among the various ERAC protocols that are utilized while considering the impact of local practices. Other areas of knowledge gaps include how to best initiate, support, and maintain ERAC system changes, and how to optimally involve and motivate patients to be part of and remain on enhanced recovery care pathways. ■

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