Measuring enhanced recovery in obstetrics: a narrative review

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Enhanced recovery after cesarean delivery is a protocolized approach to perioperative care, with the aim to optimize maternal recovery after surgery. It is associated with improved maternal and neonatal outcomes, including decreased length of hospital stay, opioid consumption, pain scores, complications, increased maternal satisfaction, and increased breastfeeding success. However, the pace and enthusiasm of adoption of enhanced recovery after cesarean delivery internationally has not yet been matched with high-quality evidence demonstrating its benefit, and current studies provide low- to very low-quality evidence in support of enhanced recovery after cesarean delivery. This article provides a summary of current measures of enhanced recovery after cesarean delivery success, and optimal measures of inpatient and outpatient postpartum recovery. We summarize outcomes from 22 published enhanced recovery after cesarean delivery implementation studies and 2 meta-analyses. A variety of disparate metrics have been used to measure enhanced recovery after cesarean delivery success, including process measures (length of hospital stay, bundle compliance, preoperative fasting time, time to first mobilization, time to urinary catheter removal), maternal outcomes (patient-reported outcome measures, complications, opioid consumption, satisfaction), neonatal outcomes (breastfeeding success, Apgar scores, maternal—neonatal bonding), cost savings, and complication rates (maternal readmission rate, urinary recatheterization rate, neonatal readmission rate). A core outcome set for use in enhanced recovery after cesarean delivery studies has been developed through Delphi consensus, involving stakeholders including obstetricians, anesthesiologists, patients, and a midwife. Fifteen measures covering key aspects of enhanced recovery after cesarean delivery adoption are recommended for use in future enhanced recovery after cesarean delivery implementation studies. The use of these outcome measures could improve the quality of evidence surrounding enhanced recovery after cesarean delivery. Using evidence-based evaluation guidelines developed by the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) group, the Obstetric Quality of Recovery score (ObsQoR) was identified as the best patient-reported outcome measure for inpatient postpartum recovery. Advances in our understanding of postpartum recovery as a multidimensional and dynamic construct have opened new avenues for the identification of optimum patient-reported outcome measures in this context. The use of standardized measures such as these will facilitate pooling of data in future studies and improve overall levels of evidence surrounding enhanced recovery after cesarean delivery. Larger studies with optimal study designs, using recommended outcomes including patient-reported outcome measures, will reduce variation and improve data quality to help guide future recommendations.

Key words: enhanced recovery, enhanced recovery after cesarean delivery, enhanced recovery after surgery, patient-reported outcome measures, postpartum recovery

Introduction

Worldwide, approximately 140 million women give birth every year.[1] Cesarean delivery (CD) rates continue to rise globally, currently estimated at 21% of all deliveries. Rates are predicted to continue to increase over the coming decade, accounting for almost a third of all deliveries by 2030.[2] This will add to the growing burden on global surgical and anesthesia care services, and thus processes and systems that improve the quality and efficiency of CD have the potential to affect large numbers of patients.

Pioneered in the 1990s by Danish surgeon Henrik Kehlet as a fast-track pathway for colorectal surgery,

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enhanced recovery after surgery (ERAS) has become the gold-standard approach to perioperative care for planned surgery, now adapted for most surgical subspecialties.[1] By reducing surgery-related stress, this evidence-based, multimodal, and multidisciplinary protocol can improve postoperative outcomes and reduce length of hospital stay and costs.[2,3] ERAS protocols vary by specialty but have common themes. Enhanced recovery after cesarean delivery (ERAC) is supported by the Society for Obstetric Anesthesia and Perinatology (SOAP), the American College of Obstetricians and Gynecologists, and the ERAS Society, all of which have recently published ERAC guidelines.[4−8] The 25 interventions recommended by SOAP are: limiting the fasting interval; nonparticulate liquid carbohydrate loading; patient education; lactation/breastfeeding preparation and education; hemoglobin optimization; preventing spinal anesthesia−induced hypotension; maintaining normothermia; optimal uterotonic administration; antibiotic prophylaxis; inititating multimodal analgesia; promoting breastfeeding and maternal−infant bonding; intravenous fluid optimization; delayed umbilical cord clamping; early oral intake; early mobilization; promotion of resting periods; early urinary catheter removal; venous thromboembolism prophylaxis; facilitated early discharge; anemia remediation; breastfeeding support; multimodal analgesia; glycemic control; and promotion of return of bowel function. The ERAS Society guidelines are similar, with the key differences of: fewer obstetrics-specific elements (only delayed cord clamping recommended); transverse uterus hysterotomy and subcuticular sutures; postoperatively; and immediate removal of the urinary catheter. The elements that constitute the ERAS program include: preoperatively, patient education and engagement, fluid and nutritional management, and early medical optimization; intraoperatively, prevention of hypothermia, infection prevention, and multimodal analgesia; postoperatively, multimodal analgesia, venous thromboembolism prophylaxis, promotion of early mobility, removal of urinary catheter, promotion of return of bowel function, and proactive discharge planning. ERAC expands on these ERAS principles to apply to obstetrics-specific concerns, and has been widely adopted over the past decade.[9−11]

There have been 2 systematic reviews and 2 meta-analyses comparing ERAC programs with standard care published since 2019, pooling data from 13 studies.[12−24] Seven new studies have been published since these reviews, which fulfill the same inclusion criteria.[12,22−31] There have been a number of identified perceived barriers to successful ERAS implementation, including staff shortages, lack of policy support, poor doctor−patient collaboration, poor multidisciplinary collaboration, and high costs.[32] The reasons are broad, but engaging the multidisciplinary team through consensus on guideline development, involvement in audit and quality improvement, and development of patient education materials are strategies that could improve implementation. The pace and enthusiasm for adoption of ERAC internationally has not yet been matched by high-quality evidence supporting its benefit. To date, studies evaluating the impact of ERAC have been heterogenous in terms of both reported outcomes and interventions implemented.[33] The aim of this narrative review is to describe the measures used to evaluate ERAC success. To provide a broader perspective, we also summarize evidence surrounding optimal measures for postpartum recovery in both the inpatient and outpatient settings.

The early days of enhanced recovery after cesarean delivery

Ilyas et al[34] first noted the lack of published evidence on outcomes in the ERAC literature systematic review. No studies at that point fulfilled their inclusion criteria, but they were able to publish a narrative review that demonstrated significant heterogeneity among individual protocols and outcome metrics used in clinical practice. In 2020, Sultan et al published a systematic review but with broader inclusion criteria; 11 peer-reviewed studies,[13−20,35−37] 34 abstracts, and 2 letters were included in the final review.[38] Most studies reported a reduction in length of hospital stay (LOS) and financial savings. Other reported outcomes were variable: some studies reported reduced opioid consumption,[17,18] but some found no difference[15,20]; only 1 study showed increased breastfeeding success rates associated with ERAC,[20] but other studies did not demonstrate any difference.[17,36] One study found improved maternal−neonatal bonding.[36] Comprehensive Grading of Recommendations, Assessment, Development and Evaluations (GRADE) scoring of these studies revealed that the level of evidence was either low or very low for all ERAC outcomes, which indicates that the true impact could be markedly different from that estimated.[39] This poor level of certainty in the evidence of benefit is because of the assessed risk of study bias, imprecision, inconsistency, indirectness and publication bias among the studies. However, despite weak evidence, given that most studies showed some benefit, with none showing evidence of harm, recommendations are in support of ERAC use.[38]

According to this early systematic review, LOS was the most commonly reported outcome measure, but there was variation in the reported units of time used, and what constituted the start and end of the clinical encounter. LOS is a commonly used quality measure in healthcare; it is assumed that if LOS decreases, care has been more efficient and effective. However, the relationship between LOS and these qualities may not be direct. Data from a study of trauma centers suggest that use of LOS as a quality benchmark among centers requires appropriate adjustment, with clinical factors only accounting for a minority of the variation observed, and most risk adjustment models do not include important nonclinical factors.[40] An example of this are the varying LOS practices in different international healthcare settings. Hospital stays of 3 days are not uncommon following CD in Japan and the United States,[41] in contrast to the surgical

short-stay initiatives recommended by the UK National Institute for Health and Care Excellence guidelines, for example. The 1996 Newborns' and Mothers' Health Protection Act stipulates that up to 48 hours following vaginal delivery and 96 hours after CD must be covered by health insurers, which affects LOS in the United States.[42] The optimum LOS following CD, however, is yet to be determined. Reporting maternal "readiness for discharge" would exclude delays because of hospital structures and neonatal factors, and may better compare maternal clinical care between institutions.[43−45] However, research is currently lacking on its use as a metric for ERAC, and discharge criteria are not standardized across institutions.

Studies published since the latest enhanced recovery after cesarean delivery systematic review

There have since been 11 new peer-reviewed ERAC studies published that fulfill the same inclusion criteria as Sultan et al,[12,22−31] and 2 published meta-analyses comparing ERAC with standard care.[33,46] In the 22 ERAC implementation studies published to date, the outcomes described are wide-ranging and heterogeneous (Table 1). Of these studies, 4 are randomized controlled trials (RCTs)[13,20,23,24] and 2 are multicenter studies.[17,36] LOS remains the most popular outcome measure, most frequently reported in days. LOS was reduced in the ERAC group in most studies,[12,13,15,16,18−20,22,24,25,27,28,37] but unchanged in the rest.[14,17,21,23,29] Other process metrics include proportion of patients discharged on days 1 and 2, ERAC pathway compliance, and time to achieving interim clinical milestones such as first mobilization and urinary catheter removal. The main advantages of process metrics such as these are that they possess qualities of good key performance indicators. Being "SMART" (specific, measurable, achievable, relevant, and timely), they allow for prompt assessment of progress, so that problems can be addressed and performance closely monitored. The major disadvantages of process metrics in healthcare are that they do not measure patient experience and clinical outcome, which could be poor despite efficient processes, and do not necessarily translate to good clinical safety and quality. Of the 22 studies, only 1 reported reduced maternal readmission rates,[25] whereas 12 found no increase,[12−14,17−22,28,30,37] and the remaining 9 studies did not report this outcome.[15,16,23,24,27,29,35−37] One RCT showed a reduction in readmission rates associated with ERAC implementation.[25] Eight studies examined complication rates after CD (heterogeneous use of outcomes). One study found an increase in urinary retention and recatheterization associated with ERAC,[19] but 4 studies showed reduced time to urinary catheter removal with ERAC.[19,21,24,36] Seven studies measured time to mobilization after CD, with all studies reporting a reduction in the ERAC group.[15,19,20,35−37] For breastfeeding, 3 studies reported improved success rates with ERAC.[13,20,36] One study reported improved early maternal−neonatal bonding, with more positive emotions toward the relationship and greater comfort in cradling and breastfeeding the newborn.[36]

Maternal outcomes

Maternal outcome measures in ERAC implementation studies focus on maternal satisfaction and pain. Most strikingly, there were 8 different pain outcome measures used across studies, ranging from satisfaction with analgesia, maximum pain scores, pain on day 0 to day 4 and after discharge, and opioid use. Of these 8 pain outcomes, 18 different units of measurement or contexts were used. Opioid consumption was the most common pain outcome measure used, followed by postoperative pain intensity on the day of surgery. Unidimensional pain severity scales included the numerical rating scale and visual analogue scale, but varied from absolute scores to moderate (≥3) and severe (≥7) pain; timing of measurement varied in addition to context (during movement or at rest). Oral opioid consumption can be an unreliable outcome measure because patients can be reluctant to take such medication because of concerns regarding breast milk transfer and the recent drive to reduce opioid prescriptions. In addition, individual pain severity scores can be misleading when taken in isolation because women can function well with high pain scores. Given the number of and variation in maternal pain outcomes used in studies, and the fact that maternal pain is an important postpartum recovery domain with interactions with other recovery areas such as psychosocial well-being, a validated composite pain measure or core outcome set (COS) would be beneficial in this context. Cost savings were reported in 5 published articles[14,16,22−24]; however, financial savings as an outcome are dependent on the healthcare system and currency used, and as yet there has been no established metric in the ERAC setting (for example, cost per CD vs cost savings to the hospital per unit time).

Meta-analyses of enhanced recovery after cesarean delivery studies

A meta-analysis published by Sultan et al[33] in 2021 aimed to strengthen previous recommendations on ERAC implementation. Twelve studies were included, involving 17,607 women (7914 with ERAC and 9693 without) recruited between 2013 and 2019.[12−20,22,23,26] Ten of the included 12 studies reported a reduction in the primary outcome measure, LOS, associated with ERAC implementation.[12,13−16,18−20,22,26] Subgroup analysis of data from 3 RCTs demonstrated no significant change in LOS associated with ERAC (mean difference [MD], −0.16 [−0.39 to 0.07] days; P=.17; I^2=81.7%).[13,20,23] ERAC was not associated with any significant change in maternal readmission rate (8 studies; odds ratio, 1.23 [0.96 −1.57]; P=.10; I^2=0%).[13,16−22] For secondary outcomes, ERAC was associated with reduced time to mobilization (3 studies; MD, −11.05 hours [−18.64 to −3.46]; P=.004; I^2=98%)[17,19,21]; time to urinary catheter removal (3 studies; MD, −13.19 hours [−17.59 to −8.79]; P<.001; I^2=97%)[14,19,21]; and

TABLE 1
Summary of metrics used to assess success of enhanced recovery after cesarean delivery in 22 published implementation studies[12–25,27–31,35–37]

ERAC metric	Number of peer-reviewed studies reporting outcome measure (units used in studies)	Time point(s) of outcome assessment	Publications[12–25,27–31,35–37] using outcome measures to report ERAC success
Process measures			
Length of hospital stay[a]	10 (d) 7 (h) 2 (qualitative)	Once outcome achieved	Days:[14,15,17–19,22,23,27,29,30] Hours: [12,13,16,20,28,39] Unspecified: [24,26]
D1 discharge	3 (%)	n/a	Percentage: [14,16,37] Qualitative: n/a
D2 discharge	2 (%)	n/a	[20,28]
Pathway or bundle compliance	1 (%)	n/a	Percentage: [12] Correlation: n/a
% first fluid in PACU	2 (%)	n/a	[15,36]
Timing of postoperative enteral nutrition	1 (h) 1 (qualitative)	n/a	Hours: [17] Qualitative:[24]
Time to first mobilization[b]	3 (h) 1 (qualitative)	n/a	Hours: [16,17,19] Qualitative: [24]
Mobilize <12 h	3 (%)	n/a	[15,17,36]
% D0 mobilization	1 (%)	n/a	Percentage:[35] Qualitative: n/a
IV catheter removal	1 (h postoperative)	n/a	[14]
Timing IV fluids stopped	1 (h postoperatively) 1 (% on D2)	n/a	Hour: [19] % D2: [17] Qualitative: n/a
Urinary catheter removal timing	2 (h) 1 (qualitative)	n/a	Hours:[14,19] PACU %: n/a Qualitative: [24]
% Urinary catheter removal (PACU to 24 h)	2 (%)	n/a	[15,36]
Outcome measures			
Maternal			
Maternal satisfaction	3 (numeric)	Time only stated in 1 study (D1)	Numeric: [14,24,36] Percentage: n/a Qualitative: n/a
Maximum pain scores	3 (NRS/10)		[18,26,30]
Pain scores D0	2 (NRS/10) 1 (VAS≥7) 1 (VAS/10) 1 (VAS>3 at rest, movement)	2 (6 hourly until discharge)	NRS/10: [18,26] VAS≥7: [13] VAS/10:[24] VAS>3 at rest, movement:[23]
Pain scores D1	1 (NRS/10) 1 (NRS/10 at rest, movement) 1 (VAS≥7) 1 (VAS/10) 1 (VAS>3, movement)	2 (6 hourly until discharge)	NRS/10: [26] NRS/10 (rest and movement): [36] VAS≥7: [13] VAS/10:[24] VAS>3, movement:[23]
Pain scores D2	2 (NRS/10) 1 (VAS/10)	1 (6 hourly until discharge)	NRS/10:[26,27] VAS/10:[24]
Pain scores D3	1 (pain scores) 1 (VAS/10)		[12] VAS/10:[24]

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(continued)

TABLE 1
Summary of metrics used to assess success of enhanced recovery after cesarean delivery in 22 published implementation studies12–25,27–31,35–37 *(continued)*

ERAC metric	Number of peer-reviewed studies reporting outcome measure (units used in studies)	Time point(s) of outcome assessment	Publications[12–25,27–31,35–37] using outcome measures to report ERAC success
Pain scores D4	1 (pain scores)		[12]
Opioid use	4 (mg morphine equivalents) 1 (qualitative)	Time period not stated	Morphine equivalents: [17,18,20,22,26,27,29,31] Qualitative: [12,23,30]
Need for opioids beyond 24 h (%)	2 (%)	No upper limit of time	[15,47]
PONV	3 (%)	24 h	[13,23,36]
Neonatal			
Breastfeeding success	3 (%)	1 (D1 and D7), 1 (6 wk)	Percentage: [14,17,20] Qualitative: n/a
Apgar scores			
Maternal–neonatal bonding			
Financial			
Projected cost savings	1 (yearly); 4 (during study period)	Yearly or during study period	Yearly: [14] Study period: [16,22–24] Analgesic: n/a Percentage financial savings: n/a
Balance measures			
Maternal reattendance rate	1 (%)	Time period not stated	[19]
Maternal readmissions after discharge	8 (%) 3 (qualitative)	2 (7 d), 1 (28 d), 4 (30 d after discharge)	Percentage[14]: (7 d), [22,37] (30 d)[13,16–19] Qualitative: [26,28,30]
Urinary recatheterization rate	1 (%)	Time periods not stated	[14]

"Qualitative" indicates that study reported either increase, decrease, or no change (ie, no quantitative data presented).

D, day after cesarean delivery; *ERAC*, enhanced recovery after cesarean delivery; *IV*, intravenous; *n/a*, not applicable; *NRS*, numerical reporting scale; *PACU*, postanesthesia care unit; *PONV*, postoperative nausea and vomiting; *VAS*, visual analogue scale.

[a] Unadjusted length of hospital stay, which is heavily influenced by nonclinical factors; [b] Mobilization not defined in studies.

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opioid consumption (5 studies; MD, −21.85 mg morphine equivalents [−33.19 to −10.50]; $P \leq .001$; I^2=91%).[12,18,20–22] Because of insufficient studies reporting variance data, meta-analysis of cost impact could not be performed. Individually, costs associated with ERAC were reported to be significantly lower in 2 US studies (postoperative cost reduced by $575.01 per patient, but no confidence intervals [CIs] were reported,[16] with Mullman et al[22] reporting a decrease in median costs following ERAC implementation of $349 per CD [95% CI, 0.91–0.95]). In the randomized study by Pan et al,[23] the mean cost of hospitalization was 2140 (standard deviation±335) vs 1568 (±304) RMB (currency of China) in the control and ERAC groups, respectively. Overall, as previously reported, the levels of evidence from available studies ranged from low to very low for all outcomes assessed (findings for LOS, time to first mobilization, time to urinary catheter removal, and opioid consumption were rated as low-level evidence, whereas those for the outcome of readmission after hospital discharge were rated as very low-level evidence). Simultaneously published in 2021, a meta-analysis by Meng et al[46] included 10 ERAC studies. Three studies[14,15,19] from the Sultan et al meta-analytic study were not included, and an RCT published in Chinese (without a full English translation), involving 572 women, was added.[24] Meng at al[46] also found that the primary outcome of LOS was reduced with ERAC and that secondary outcomes (complication rates, pain scores, opioid consumption, and hospitalization costs) were improved with ERAC. There were no differences in maternal readmission rates.

Summary of outcomes used in meta-analysis

The most common primary outcome measure used in studies was maternal LOS after CD. Secondary outcomes included time to first mobilization, time to urinary catheter removal, cumulative postoperative opioid consumption, pain scores, maternal readmission after discharge (up to 6 weeks), complication rates, and hospitalization costs.

TABLE 2
Core outcome set to be considered in enhanced recovery after cesarean delivery studies[45]

Process metrics	Definition and units of measurement (where applicable)
Length of hospital stay	Time from delivery until hospital discharge (h)
Compliance with enhanced recovery protocol	Mean % of protocol items implemented per patient; ERAC and control groups
Duration of preoperative fasting (liquids)	Mean time since last liquid intake before induction of regional or general anesthesia (h)
Time to first fluid intake postoperatively	Mean time until first fluid intake following PACU admission (h)
Time to first solid food intake postoperatively	Mean time until first solid food intake following PACU admission (hours)
Times to mobilization and urinary catheter removal	Mean time from PACU admission to first walking with or without support
Readiness for discharge[a]; analysis of cost savings[a]	
Maternal outcomes	
Maternal morbidity (hospital readmissions or unplanned consultations)	Maternal inpatient rehospitalization (necessitating overnight stay) within 30 d of hospital discharge. Denominator is number of cesarean deliveries over the study period in the groups with and without the use of ERAC protocol (n/N and %). Unplanned outpatient visit(s) or emergency department visit(s) without hospital admission, within 30 d of hospital discharge. Denominator is number of cesarean deliveries over the study period in the groups with and without the use of ERAC protocol (n/N and %).
Maternal satisfaction with analgesia	Response to the proposed question: "How satisfied have you been with pain relief following your cesarean delivery?" Proposed Likert response options: very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, very dissatisfied.
Postpartum opioid use—mean opioid consumption	Mean dose (oral and IV) of opioid consumption, converted to mg morphine equivalents during postpartum inpatient hospital stay
Postpartum opioid use—proportion of women requiring opioids	Number and percentage of women requiring postpartum opioids (oral or IV, n/N and %)
Postpartum nausea or vomiting	Number and percentage of women experiencing and/or requiring treatment for nausea or vomiting from PACU until hospital discharge (n/N and %)
Obstetric Quality of Recovery-10	10-item composite measure completed by women at 36±12 h following delivery (median [IQR] score between 0 and 100)
Neonatal outcomes	
Breastfeeding by time of discharge	Number and percentage of women breastfeeding at the time of discharge (yes/no; yes response includes any breastfeeding [n/N and %])

ERAC, enhanced recovery after cesarean delivery; *IV*, intravenous; *IQR*, interquartile range; *PACU*, postanesthesia care unit.

[a] Requiring further research, not included in core outcome set.

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Delphi study to determine a core outcome set

A major barrier to the generation of high-quality evidence from meta-analysis is the large heterogeneity in clinical outcomes used in ERAC studies to date. Recently, expert consensus has been achieved in defining a COS for use in future ERAC studies.[45] The 31 stakeholders (including obstetricians, maternal–fetal medicine specialists, anesthesiologists, patients, and a midwife) recommended 15 measures, which cover key aspects of ERAC. The outcomes include process metrics and maternal and neonatal outcomes (Table 2). The Obstetric Quality of Recovery Score-10 (ObsQoR-10), a composite measure providing a score between 0 (worst possible recovery) and 100 (best possible recovery), was included in this COS.[48,49] Adoption of these recommended outcome measures in study protocols could improve the quality of evidence available in the future, and facilitate pooling of data and the optimization of ERAC program development. This COS offers a pragmatic approach by recommending subjective measures that can be influenced by nonclinical factors, as described for LOS. However, until more reliable outcome measure approaches are developed, validated, and adopted, such as "maternal readiness for discharge," there will be great benefit in at least ensuring concordance in future studies, until more advanced approaches are realized, which could be years away. The use of COS has been increasing in healthcare research over the past decade, and women's health is relatively new to this approach. However, there have been successes in rheumatology (OMERACT), with a high level of

uptake of these core outcomes in most studies, which has greatly benefited evidence synthesis in rheumatoid arthritis effectiveness studies.[50] It is hopeful that obstetrics could see similar benefits from COS uptake.

The postpartum recovery period

Process metrics have dominated the assessment of ERAC protocol success in research studies to date, with the intention of improved healthcare efficiency rather than postpartum recovery specifically. However, to comprehensively measure ERAC success, it is important to understand postpartum recovery as a construct. We are only just beginning to understand the complexity and importance of the postpartum recovery period. At 50 days postpartum, approximately 10% of women who undergo CD do not recover (as defined by pain resolution, cessation of opioids, and self-assessed functional recovery).[51] This is significant because poor postpartum recovery is likely to influence care of the neonate, infant development, family interactions, and future pregnancy choices. Despite this, limited guidance exists for assessing postpartum recovery, and inpatient and outpatient postpartum recovery remain poorly defined.[52] More recently, work exploring postpartum recovery has described it as a multidimensional and dynamic process, involving the interaction of a number of recovery health domains. Sultan et al[53] proposed 13 postpartum recovery domains to provide a framework to study the recovery process following childbirth. These were identified following a qualitative study involving 50 stakeholder interviews (postpartum patients, obstetricians, maternal−fetal medicine specialists, nurses, a midwife, and obstetrical anesthesiologists). The 13 postpartum recovery domains identified (ranked highest to lowest in order of weighted importance) were: psychosocial distress, surgical/medical factors, infant feeding and breast health, psychosocial support, pain, physical function, sleep, motherhood experience, infant health, fatigue, appearance, sexual function, and cognition. Several factors facilitating recovery were identified, including family support, breastfeeding support, and partner support. Inadequate social support was perceived as a factor that most hindered recovery. Frequent challenges faced at different postpartum time points were breastfeeding (weeks 1 and 3) and sleep (week 6). A better understanding of postpartum recovery profiles and trajectories after ERAC, including different patient subgroups, is needed to aid the optimization of ERAC evaluation and design of protocols. No ERAC studies to date have comprehensively explored protocol success in each of these 13 domains. This is likely because the weighting of relative importance of individual domains can vary over time. For example, postpartum depression usually presents in the outpatient setting, and sleep disorders such as insomnia tend to not be a significant feature associated with quality of inpatient postpartum recovery.

Patient-reported outcome measures in enhanced recovery after cesarean delivery studies

There are notable deficiencies in the range of ERAC metrics used to date. A patient-reported outcome measure (PROM) is a survey instrument that evaluates multiple dimensions of patient health. The ObsQoR PROM has been included in the recently published COS for use in future ERAC studies.[45] However, equivalent outpatient measures of functional recovery are needed: few ERAC studies reported long-term complications, including the impact of ERAC on postpartum recovery domains such as sleep, psychosocial distress (depression), and breast health. Secondly, there is also a paucity of patient-reported experience measures and satisfaction measures, which further limits service development and improvement. Finally, neonatal health is infrequently reported in ERAC studies but is an important outcome measure to also consider.

PROMs can complement other outcomes such as biomarkers and clinician-reported outcomes.[54] They are essential to assess the treatment impact for many conditions where physiological measures are limited or not appropriate. PROMs are also cheap, easy to distribute, and now considered gold-standard measures for postoperative recovery.[55,56] This reputation contributes to their role in the distribution of tariff-based supplements. PROMs have been used extensively in obstetrical research, and it has been considered that the integration of patient-centered domains into patient care may enhance patient preparation for postpartum recovery and improve outcomes.[57]

Review of patient-reported outcome measures used to assess postpartum recovery

In a scoping and systematic review by Sultan et al,[56] a total of 201 and 73 PROMs that have been used to assess postpartum recovery in outpatient and inpatient studies, respectively, were identified. The top 5 recovery domains (with highest to lowest numbers of PROMs) used to assess outpatient recovery were psychosocial distress (77 PROMs), psychosocial support (27 PROMs), surgical complications (26 PROMs), motherhood experience (16 PROMs), and sexual function (13 PROMs). Among inpatient studies, the top 5 domains were psychosocial distress (32 PROMs), motherhood experience (7 PROMs), psychosocial support (5 PROMs), fatigue (5 PROMs), and cognition (3 PROMs). The 3 most frequently used PROMs were the Edinburgh Postnatal Depression Scale, Short-Form 36 Health Survey, and the Female Sexual Function Index. In this review, most PROMs evaluated a single domain of recovery, but future research should focus on determining the psychometric properties of these PROMs to recommend the best measures for each individual postpartum recovery domain.[55] Table 3 summarizes the best available PROMs that have been psychometrically evaluated and recommended for the assessment of overall postpartum recovery and its individual domains.

COSMIN methodology

COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) has created a critical appraisal checklist with clear assessment criteria for

TABLE 3
Summary of inpatient and outpatient postpartum recovery patient-reported outcome measures identified from COSMIN evaluation

Postpartum recovery domain	Recommended PROM[reference]	Postpartum-specific (yes/no)	Comment
Inpatient			
Global Functional recovery	Obstetric Quality of Recovery (ObsQoR)[48,49]	Yes	Initially 11 items, reduced to 10 items. Validation ongoing in translated versions and diverse populations. 24 h postpartum (ObsQoR-10 validated for up to 72 h postpartum)
Outpatient			
Global	World Health Organization Quality of Life—BREF (WHO-QOLBREF)[56]	No	6 wk postpartum
Pain	Brief Pain Inventory-Short Form (BPI-SF)[58]	No	The only PROM with adequate content validity and internal consistency (low-quality evidence)
Psychosocial distress	Edinburgh Postnatal Depression Scale (EPDS)[59]	Yes	Sufficient content validity, with moderate evidence for sufficient internal consistency, which was not observed in other PROMs
	Anxiety: State-Trait Anxiety Inventory (STAI)	No	Registered with PROSPERO 2021 CRD42021260004 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021260004
Sleep	Bergen Insomnia Scale (BIS)[60]	No	Does not assess several important domains of sleep, eg, sleep duration (and efficiency), chronotype, sleep-disordered breathing, and medication use
Fatigue	Fatigue Assessment Scale[61]	No	The only PROM with adequate content validity and internal consistency
Motherhood experience	Postpartum bonding Questionnaire[62]	Yes	The only PROM with sufficient structural validity, internal consistency, and reliability

PROM, patient-reported outcome measure.

Ciechanowicz. Measuring enhanced recovery. Am J Obstet Gynecol Glob Rep 2022.

evaluation of methodological quality of studies reporting PROMs, and appraisal of psychometric results of the PROMs identified and the overall quality of measurement properties.[63] This is a robust and evidence-based approach to determine the best currently available measures for a specific construct, and takes into account 8 different measurement properties and quality of studies using risk-of-bias assessment and a modified GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach to determine the best PROM. In 2019, Sharawi et al[64] performed a systematic review using COSMIN criteria to identify and evaluate the quality of PROM instruments that have been used to assess functional recovery following CD. They identified 13 PROMs used to assess the quality of recovery after CD in 20 studies. They concluded that very few adequate measures of functional recovery following CD exist, and that overall the ObsQoR-11 (since modified to the 10-item ObsQoR-10) achieved the highest COSMIN standards for any PROM. ObsQoR has since also been recommended as the best available composite measure of inpatient postpartum recovery following any delivery mode.[64]

Several further COSMIN reviews have been conducted or are in progress[65] to determine the best available PROMs for overall postpartum quality of life and recovery health and for individual domains of postpartum recovery (Table 3). Another benefit of this is helping to identify knowledge gaps and deficiencies in existing measures, and likely necessary modifications for adapting existing Class A measures (measures recommended for use using COSMIN criteria) for the postpartum population.

Summary

There remains a wide variation in protocols, with disparate outcome measures used in published ERAC studies. The most common measure reported is LOS, a useful process metric, but one that is significantly influenced by nonclinical factors.[40] Controlling for these factors or instead measuring time to maternal "readiness for discharge" could provide a truer reflection of early postpartum recovery. Other common outcomes used include time to mobilization, urinary catheter removal, and opioid consumption. Reported outcomes related to infant health and maternal experience and satisfaction with care are limited. PROMs are established as gold-standard measures in perioperative care research, and can be particularly suited for measuring longer-term health outcomes. They are, however, underutilized in current ERAC studies. The systematic, evidence-based evaluation of current PROMs used for postpartum recovery identified by COSMIN criteria will aid and encourage their use in the future, and could provide more

definitive evidence for ERAC benefits in the later postpartum recovery period. ObsQoR is the best performing PROM for inpatient ERAC recovery, and should be adopted in future ERAC research studies.

The overall quality of evidence supporting ERAC outcomes can be optimized through the use of standardized interventions recommended by the SOAP and the ERAS Society and using cluster-randomization (entire hospitals randomized to either implement ERAC or not) and graded-implementation (single interventions implemented and assessed at a time) study designs. More robust evidence can be achieved by using standardized outcomes, including the recently recommended COS for ERAC studies.[45] Finally, there is far more established evidence for improved outcomes, patient satisfaction, and reduced costs with ERAS in the non-obstetrical surgical subspecialties because these programs were developed in the 1990s, allowing for much more evidence to have been generated to date.[11] The first reports of ERAS in obstetrics were published in 2013, 18 years after publication of reports in the colorectal population. We therefore consider that ERAC is of enormous interest to obstetricians, obstetrical anesthesiologists, and nurses caring for these patients, particularly given that CD rates are increasing and are projected to account for a third of all births by 2030. There is therefore a need to improve the efficiency and outcomes of CD, and ERAC seems to be a well-supported way of achieving this. Ultimately, ERAC interventions are cost-effective and have been shown to improve patient outcomes, experience, and satisfaction without risking complications or maternal readmission to hospital. Thus, there is rapidly increasing interest in introducing these protocols in institutions that care for patients undergoing CD. ■

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