



# Practice of enhanced recovery after cesarean delivery in resource-limited setting

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**Background:** Caesarean section is one of the most common procedures and clinician faces dual challenges with fetomaternal morbidity and mortality after caesarean delivery. Enhanced recovery after caesarean delivery protocols might effectively reduce postoperative fetomaternal morbidity and mortality. Therefore, this study aimed to assess practice of enhanced recovery after caesarean delivery among parturients who underwent elective caesarean delivery.

**Methods:** A cross-sectional study design was conducted from March to June 2021 on 225 consecutive parturients scheduled for elective caesarean delivery. A semi-structured questionnaire which developed from Society of Obstetric Anesthesia and Perinatology, evidence-based recommendations regarding enhanced recovery after a caesarean (2020) to collect data. Data was collected through direct observation, reviewing the chart, and patient's interview. Data were entered and analyzed in SPSS version 20.

**Result:** Preoperative pathway; limit fasting interval (91%), haemoglobin screen and optimization (82%), and patient education (100%) found good Areas of practice Intraoperative pathway; administering postoperative nausea and vomiting prophylaxis (100%), fluid optimization (88%), neuraxial anaesthesia with a neuraxial opioid (91%), initiating multimodal analgesia (88%), optimal uterotonic administration (88%), delayed umbilical cord clamping (85%), and prophylactic antibiotic (100%) found areas with good areas of practice. Postoperative pathways; initiation of multimodal analgesia (74%) and early removal of the urinary catheter (62%) were found areas good areas of practice

**Conclusion and recommendation:** The overall practice of enhanced recovery after caesarean delivery was below the target. The authors recommend that this comprehensive and specialized hospital administrator implement enhanced recovery after caesarean delivery protocol and give short-term training for health professionals' about the protocol

**Keywords:** Caesarean delivery, enhanced recovery after caesarean

## Background

Caesarean delivery (CD) is one of the most common major abdominal surgery performed in Ethiopia it reach to 29.55%<sup>[1]</sup>. It is one of the most common procedures to prevent health-threatening risks to the mother and infant<sup>[2]</sup>. However, clinicians faced Low Apgar score, perinatal asphyxia, neonatal sepsis, postpartum haemorrhage and febrile morbidity after the caesarean section in Ethiopia<sup>[1,2]</sup>.

## HIGHLIGHTS

- Overall practice of enhanced recovery after caesarean delivery was below the target.
- Applying enhanced recovery after caesarean protocols might be effectively reduced postoperative fetomaternal morbidity and mortality.
- Enhanced recovery after caesarean significantly decrease postoperative length of stay and total costs patient.

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Majority of women undergoing caesarean delivery are young and healthy<sup>[3]</sup>. This may leads to rapid recovery after delivery and able to care for their newborn<sup>[4]</sup>.

Caesarean delivery might have pain, infection and thromboembolic complications, nausea and gastrointestinal paralysis, fatigue, and stress response with subsequently increased demands on organ function. However applying multimodal interventions may reduce those undesirable squeals to improved early recovery and reduction in postoperative morbidity<sup>[5]</sup>. Applying enhanced recovery after caesarean (ERAC) delivery protocols may effectively address these advantages for women after CD<sup>[6]</sup>. It is combination of various perioperative multimodal approaches that integrate evidence-based interventions to reduce surgical stress, maintain postoperative physiological function, facilitate early recovery after surgery and decrease total mean opioid use by 42%<sup>[7,8]</sup>.

General principle of ERAC were use of regional anaesthetic technique, non-opioid analgesic approaches, avoidance of prolonged perioperative fasting, fluid balance, maintenance of normothermia, and promotion of postoperative recovery strategies<sup>[9]</sup> and it reduce length of stay, financial savings, satisfaction, breastfeeding success, and increase maternal-neonatal bonding<sup>[10]</sup>.

A study done in the USA stated that applying ERAC significantly decrease in postoperative length of stay by 7.8% and total costs decreased by 8.4%<sup>[11]</sup>. In addition, ERAC significantly reduced opioid medication by 74.6% and shorten hospital stay<sup>[7]</sup> and it has higher maternal satisfaction<sup>[7]</sup>.

Applying ERAC may benefit healthcare system by reducing waste of scarce medical resources and reducing the overall cost of healthcare by increasing the global quality of care and optimizing the quality of recovery after caesarean delivery. Therefore, the goals of this standard base study to asses' current practice of ERAC to improve fetomaternal outcomes with evidence-based and patient-centred care.

### Significance of the study

Caesarean delivery is one of the most common surgeries performed worldwide. However, clinicians faced dual challenges after the caesarean delivery. Applying ERAC protocol has clinically and statistically significant results in reducing postoperative complications and hospital stays. In addition it has contemporary beneficial effects on all organizational healthcare deliveries. Therefore, this study aimed to assess the current practice of ERAC protocol.

### Methodology

The aim of the study was explained to each study participant, and informed consent was obtained. This study was registered with the UIN research registry and reported following Strengthening the reporting of cohort studies in surgery (STROCSS) criteria<sup>[12]</sup>.

### Study design and period

An institutional based, cross-sectional study was conducted from March to June 2021.

### Study area

The study was conducted at comprehensive and specialized hospitals, it located in North Gondar administrative zone, Amhara National, Regional state, Which is far from about 750 km Northwest of Addis Ababa (the capital city of Ethiopia). This comprehensive and specialized hospital has five operation theatres: main operation theatre, Obstetric operation theatre, Ophthalmological operation theatre, Gynecology (fistula ward) operation theatre and one surgical and medical ICU and the study conducted in obstetrics operation wards.

### Source and Study population

#### Source population

All women delivered by lower segment caesarean delivery from March to June 2021 in a study setting.

### Study population

All elective women scheduled and delivered by caesarean section under regional anaesthesia during the data collection period from March 26 to June 28/2021 G.C at the obstetric ward.

### Sample size

To determine the sample size, single population proportion formula was used. Since, as far as this work is concerned there is, the sample size for the study was calculated by considering 95% confidence interval, 5% margin of error, and 50% level of proportion and finally the sample size for the study was calculated as:

$$n = (z\alpha/2)^2 \times p \times q / d^2 \\ = (1.96)^2 \times (0.5)(0.5) / (0.05)^2 = 384$$

Where;  $n$  = sample size

$Z$  = desire 95% confidence,  $z = 1.96$

$P$  = proportion of practice of ERAC

Since our sample population ( $N$ ) is less than 10 000 (i.e. on average, 140 caesarean section was done per month in the study area it is less than the calculated sample size. Therefore, we included all parturient underwent elective caesarean section during the study period. Finally, a total of 225 parturient were included in this study and analyzed.

### Sampling technique

A consecutive sampling method was used from March 26 to June 28/2021. All consecutive parturient who underwent elective caesarean delivery under regional anaesthesia in study setting, based on the inclusion-exclusion criteria was included.

### Inclusion and exclusion criteria

#### Inclusion criteria

All parturients who underwent elective caesarean delivery were included in this study.

#### Exclusion criteria

Parturient not volunteer for participation in study, those having unpredicted intraoperative incident and admitted in intensive care unit, parturient underwent caesarean delivery under general anaesthesia were exclude from the study.

### Data collection methods

By using consecutive sampling method, data was collected from 225 parturients who underwent elective caesarean section. Data were collected prospectively and the study was blinded to anaesthetists, physicians, midwives and nurses. We used Society of Obstetric Anesthesia and Perinatology: evidence-based recommendations regarding ERAC (2020)<sup>[13]</sup> (Tables 1, 2, and 3) used as data collection tool to collect data. The standards directly changed into question forms with two integral checking components, "Yes", and "No". Based on these data collection tools; direct observation, reviewing the chart, and patients were asked about their management according to the standards of practice of ERAC systematically.

**Table 1**  
**Preoperative ERAC pathways.**

No	Standards	Target	Exception	Evidence	Data source
	Preoperative ERAC pathway elements	100%		ERAC	Based on the data collection tools direct observation, reviewing the chart and patients
1	Limit fasting interval ( II b) Low-grade level of evidence	100%		ERAC	
2	Contact the patient the day before delivery (Patient Education) (II b) Moderate-Grade Level of Evidence)	100%		ERAC	
3	Haemoglobin optimization (II a) Moderate-grade level of evidence	100%		ERAC	
4	Breastfeeding education (II a) Moderate-grade level of evidence	100%		ERAC	
5	Non-particulate Liquid Carbohydrate Loading ( II b) Low-grade level of evidence	100%	Diabetic women	ERAC	

Source of standards: Society of Obstetric Anesthesia and Perinatology: evidence-based recommendations regarding Enhanced Recovery after Caesarean (ERAC) (2020)<sup>[12]</sup>. ERAC, enhanced recovery after caesarean.

### Data collection procedure

Data were collected by pretested questionnaire and data abstraction format using face to face interview and chart review. Data were taken during perioperatively during surgery and practice of preoperative, intraoperative and postoperative ERAC was recorded. Two anaesthetists collected the data and the data collection process was supervised by one qualified anaesthetist. The investigator facilitated data collector otherwise had no any role in the data collection process.

### Data analysis

After completion of data collection; the data were coded, entered, and cleaned for errors using SPSS software (version 20). Descriptive statics was used in terms of frequency and percentage. Finally, the result is presented using text and table.

### Result

#### Preoperative ERAC pathways

In this study during the preoperative period, 225 women were scheduled for caesarean delivery. All of 225 (100%) participants contacted by anaesthetist and residents and the risk and benefits caesarean delivery were discussed. None of the participants (0%) get breastfeeding education, perioperative fasting interval (91%), oral non-particulate liquid carbohydrate loading (21%), and haemoglobin Optimization (82%) (Fig 1). However, the overall adherence to ERAC is more than 59% of the target (Table 4). Preoperative pathway limit fasting interval, haemoglobin screen and optimization, and patient education were found good area of practice and breastfeeding education and preparation, and oral liquid carbohydrate 2 h before surgery were found areas need improvement.

**Table 2**  
**Intraoperative ERAC pathway.**

No	Standards	Target	Exception	Evidence	Data source
	Intraoperative ERAC pathway elements			ERAC	Based on the data collection tools direct observation, reviewing the chart and patients
1	Prevention of spinal-induced hypotension; (I, A) High-grade level of evidence	100%		ERAC	"
2	Maintenance of normothermia ( I, C) Low-grade level of evidence	100%		ERAC	"
3	optimized uterotonic administration (II, A, ) High-grade level of evidence	100%		ERAC	"
4	Antibiotic prophylaxis ( I,A) High-grade level of evidence	100%		ERAC	"
5	IONV/PONV prophylaxis (I, B) Moderate-grade level of evidence	100%		ERAC	"
6	Multimodal analgesia ( I, A) High-grade level of evidence	100%		ERAC	"
7	Promote maternal-infant bonding( II a) Low-grade level of evidence	100%		ERAC	"
8	Intravenous fluid optimization ( II a) Low-grade level of evidence	100%		ERAC	"
9	Delayed cord clamping ( I, level A) High-grade level of evidence	100%		ERAC	"

Source of standards: Society of Obstetric Anesthesia and Perinatology: evidence-based recommendations regarding Enhanced Recovery after Caesarean (ERAC) (2020)<sup>[12]</sup>. ERAC, enhanced recovery after caesarean.

**Table 3**  
**Postoperative ERAC pathways.**

Standard postoperative ERAC elements	Target	Source	Data source
Early oral intake(II b, Level C)	100%	ERAC	Based on the data collection tools direct observation, reviewing the chart and patients
Initiate multimodal analgesia	100%	ERAC	"
Promotion of resting periods and monitoring (II b, Level C)	100%	ERAC	"
Early mobilization (I, level B)	100%	ERAC	"
Early urinary catheter removal(II B, Level C)	100%	ERAC	"
Venous thromboembolism prophylaxis(I, Level A)	100%	ERAC	"
Breastfeeding Support (I, Level A)	100%	ERAC	"
Facilitate early discharge(II b, Level C)	100%	ERAC	"
Haemoglobin optimization(I, Level A)	100%	ERAC	"
Promotion of return of bowel function(II b, Level C)	100%	ERAC	"
Glycemic control(I, Level A)	100%	ERAC	"

ERAC, enhanced recovery after caesarean.

### Intraoperative ERAC pathways

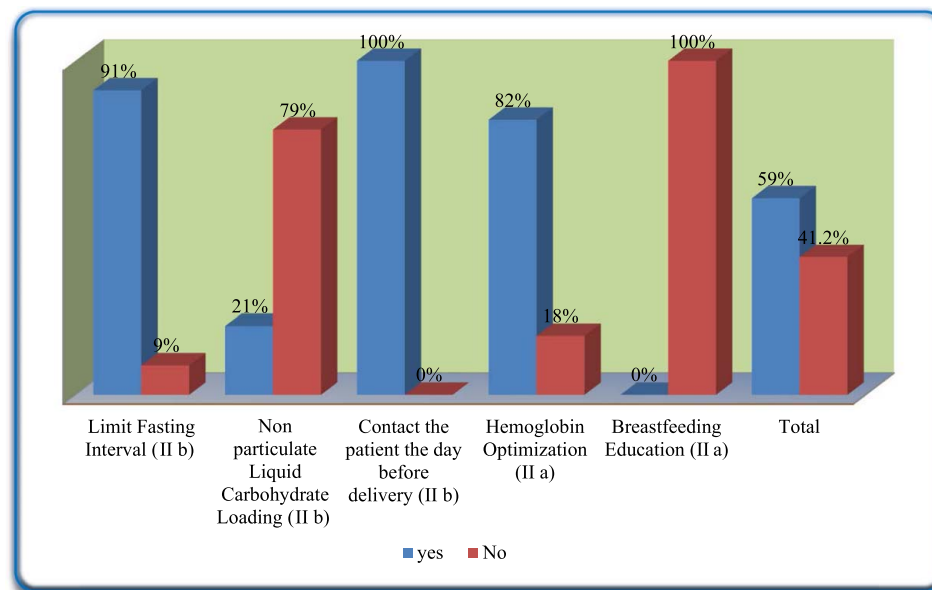
From the total 225 women underwent caesarean delivery all of 100% participants took intraoperative nausea vomiting (IONV) and antibiotic prophylaxis and none of the parturient maintenance of normothermia and promote maternal-Infant bonding were given, neuraxial anaesthesia with neuraxial opioid (91%), initiated multimodal analgesia (88%), prevention of spinal-induced hypotension (56%), and promote maternal-Infant bonding given, optimized uterotonic administration (88%), delayed cord clamping (85%) (Fig 2). However, overall adherence to ERAC is more than 79% of the target (Table 5). IONV/PONV prophylaxis, fluid optimization, neuraxial anaesthesia with a neuraxial opioid, initiate multimodal analgesia, optimal uterotonic administration, delayed umbilical cord clamping and Prophylactic antibiotic were founds a good area of practice and prevention of spinal-induced hypotension, promote breastfeeding and maternal- infant bonding, and maintenance of normothermia were found areas needs improvements.

### Postoperative ERAC pathways

From the total of 225 participants scheduled for caesarean delivery 47% of the participants initiate early oral intake, 74% of the participants discussed initiation of multimodal analgesia, none of the clinician promote of early return of bowel function (Table 6). Initiation of multimodal analgesia and early removal of the urinary catheter were found areas good areas of practice and early oral intake, promotion of resting periods and monitoring, venous thromboembolism prophylaxis, breastfeeding support, and promotion of return of bowel function found area need improvement.

### Discussion

Caesarean section needs to address the safety of healthcare provided for both mother and child born by improving the global the quality of care and optimizing quality of recovery after caesarean. Applying enhanced recovery helps to improve quality of care



**Figure 1.** Preoperative enhanced recovery after caesarean (ERAC) chart on practice of preoperative ERAC pathway among parturient. underwent caesarean delivery (N = 225).

**Table 4**  
**Practice of preoperative ERAC pathway among parturient underwent CD (N = 225).**

Preoperative ERAC elements	No. audited participants based on the standard	The average for yes or no	
		Yes (%)	No (%)
Limit fasting interval ( II b)	225	91	9
Non-particulate liquid carbohydrate loading ( II b)	225	21	79
Contact the patient the day before delivery (II b)	225	100	0
Haemoglobin optimization (II a)	225	82	18
Breastfeeding education (II a)	225	0	100

CD, caesarean delivery; ERAC, enhanced recovery after caesarean.

delivery. Besides some physiological variables, clinicians should consider the physical, emotive, cognitive, and functional outcomes.

In present study most of anaesthetist practice neuraxial anaesthesia with neuraxial opioids on 91% parturient underwent elective CD. This supported by guidelines for Obstetric Anaesthesia and ERAC recommended neuraxial techniques with neuraxial opioids recommended for most CD because these techniques are associated with good maternal and neonatal outcomes<sup>[14]</sup>. The role of an anaesthesiologist in ERAC should cover the areas including management of perioperative hypotension, prevention and treatment of intraoperative and postoperative nausea and vomiting, prevention of hypothermia and multimodal perioperative pain management strategy<sup>[15]</sup>.

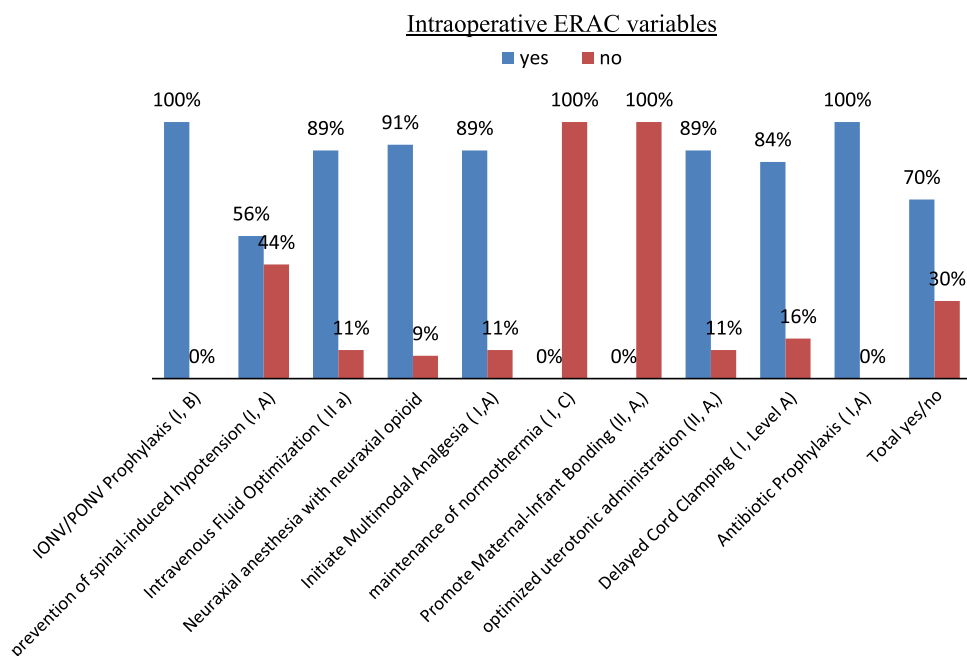
Caesarean section (CS) is associated with an increasing risk of maternal and neonatal morbidity and mortality<sup>[16]</sup>. Even though many obstetric units have introduced enhanced recovery (ER) as

a means of reducing the length of stay for planned CS<sup>[17]</sup> in this study health care provider in obstetrics unit practice on facilitation of early discharge among 21% parturient underwent CD. In addition, review done by Paton *et al.*<sup>[15]</sup> stated that there is the considerable reduction in the length of hospital stay (the number of days in hospital after surgery) and the total length of stay (total days spent in hospital including any readmissions). In addition, Components demonstrating the greatest impact on the length of stay in any surgical setting were delayed umbilical cord clamping (CD / vaginal birth –assumed to be relevant to the mother and infant) reduced by 16.40 days<sup>[18]</sup>.

Early initiation of oral intake and limiting preoperative fasting one of the component of ERAC protocol and preoperative enhancing drinks (gastrointestinal surgery reduced by 0.97 days - moderate quality evidence)<sup>[19]</sup>. However, in this study healthcare providers not practice early initiation of postoperative oral intake in most of parturient (53%) and limiting preoperative fasting interval on 9% of parturient underwent elective caesarean section. This might be even if a healthcare provider knows ERAC protocol most of them not implement ERAC protocol.

Studies show that perioperative pain control is the key component of ERAC protocol and untreated pain may hinder mothers to care her baby, delay early mobilization, and even induce anxiety and depression<sup>[20]</sup>. In this study health care providers in maternity ward practice initiating intraoperative and postoperative period multimodal analgesia strategy were 88% and 74% respectively on parturient underwent elective caesarean section. In addition, Lester *et al.*<sup>[7]</sup> reported that after implementing the ERAC protocol, the total mean inpatient oral morphine equivalents administered to women postpartum decreased by 42% after implementation.

Nausea and vomiting are the frequent during CD than other non-obstetric surgery due to spinal anaesthesia- induced acute



**Figure 2.** Intraoperative enhanced recovery after caesarean (ERAC) charts on practice of intraoperative ERAC pathway among parturient. underwent caesarean delivery (N = 225)

**Table 5****Practice of intraoperative ERAC pathway among parturient underwent CD (N = 225).**

Intraoperative ERAC elements	No. audited participants based on the standard	Yes (%)	No (%)
IONV/PONV prophylaxis (I, B)	225	100	0
prevention of spinal-induced hypotension (I, A)	225	56	44
Intravenous fluid optimization (II a)	225	88	12
Neuraxial anaesthesia with neuraxial opioid	225	91	9
Initiate multimodal analgesia (I,A)	225	88	12
maintenance of normothermia (I, C)	225	0	100
Promote maternal-infant bonding( II a)	225	0	100
optimized uterotonic administration (II, A, )	225	88	12
Delayed cord clamping (I, Level A)	225	85	15
Antibiotic prophylaxis (I,A)	225	100	0

CD, caesarean delivery; ERAC, enhanced recovery after caesarean.

sympathetic blockade may hyperactivate the gastrointestinal tract and acute hypotension causes cerebral ischaemia and activates the vomiting center<sup>[21]</sup>. However, in present study the practice of prevention and management of perioperative nausea and vomiting was practiced among all parturient underwent elective caesarean section. On other hand most healthcare provider in not stratify the risk of perioperative nausea and vomiting.

Perioperative hypothermia (core temperature <36°C) can occur rapidly after spinal anaesthesia during CD and the thermoregulation will be altered for several hours. In current study none of healthcare provider practices prevention and management of perioperative hypothermia strategy for parturient underwent CD. This might be most of health care providers reported that there no availability of active warming device in study setting. However, perioperative hypothermia may leads to wound infection, myocardial ischaemia, coagulopathy, shivering, reduced drug metabolism, prolonged LOS, and poor patient satisfaction<sup>[22]</sup>.

During CD, maternal hypotension is a common complication caused by vasodilatation. Maternal hypotension leads to a series of symptoms including intraoperative nausea and vomiting (IONV), dyspnoea, and dizziness frequently after severe hypotension. Furthermore, severe hypotension may decrease uteroplacental flow and increase the incidence of foetal acidosis, which may be detrimental to the foetus<sup>[23]</sup>. However, In this study the practice of prevention of spinal induce maternal hypotensive were 56%. Most of the health anaesthetist stated that this might be

explained by lack of spinal anaesthesia adjuvant and appropriate vasopressor in study setting

### Limitation

These study single-centre cross-sectional studies and only focused on elective caesarean delivery, not explore the cause of non-adherence, unable to asses outcome of ERAC after implementing the protocol were considered as limitation of the study.

### Conclusions and recommendation

The overall adherence preoperative pathway to ERAC is more than 59% of the target. Therefore, patient education were found good area of practice and breastfeeding education and preparation, and oral liquid carbohydrate 2hrs before surgery were found areas need improvement.

During intraoperative pathway the overall adherence to ERAC is more than 79% of the target. Therefore, prevention of spinal-induced hypotension, promote breastfeeding and maternal-infant bonding, and maintenance of normothermia were found areas needs improvements

Postoperative pathways the overall adherence of ERAC is around 40% of the target. Therefore, early oral intake, promotion of resting periods and monitoring, venous thromboembolism prophylaxis, breastfeeding support, and promotion of return of bowel function found area need improvement. Finally, we suggest that the hospital administrator implement enhanced recovery after caesarean delivery protocol and give short-term training for health professionals' about ERAC protocol and future researchers' can do in multicenter, explore about the cause no non-adherence and the outcomes of implementing of ERAC protocol.

**Table 6****Practice of postoperative ERAC pathway among parturient underwent CD (N = 225).**

Postoperative ERAC elements	Yes (%)	No (%)
Early oral intake	47	53
Initiate multimodal analgesia	74	26
Promotion of resting periods and monitoring	44	56
Early mobilization	50	50
Early urinary catheter removal	62	38
Venous thromboembolism prophylaxis	6	94
Breastfeeding support	29	71
Facillitate early discharge	21	79
Haemoglobin optimization	60	40
Promotion of return of bowel function	0	100
Glycemic control	50	50

### Ethical approval

Ethical clearance obtained from the institutional ethical review committee. The aim of the study explained to the participant, and informed consent was obtained. Anyone not volunteering for participation informed that they had the full right not to participate or stop at any time.

### Consent for publication

Not applicable.

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## Author contribution

This work carried out in collaboration among all authors. A.F.I. contributed to the conception, the review, and interpreted the result. T.B.M., T.D.F., B.A.T. and B.M.A., in commenting from conception until manuscript preparation.

## Conflicts of interest disclosure

The authors declared that they have no competing interests.

## Research registration unique identifying number (UIN)

Research registry used Unique Identifying number or registration ID: 9071 Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://www.researchregistry.com/browse-the-registry#home/>.

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## Availability of data and materials

All data generated or analyzed during this study were included in this published article and available at request.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

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