



## Research Article

# Innovations in Recovery Programs in Maternal and Neonatal Health: Experiences from a Hospital Network

R Kishore Kumar<sup>1,2</sup>, Ruth Patterson<sup>1</sup>, Vidya Kumar<sup>1</sup>

<sup>1</sup>Cloudnine Hospital, Jayanagar, Bangalore, India.

<sup>2</sup>Adjunct Professor of Neonatology, Notre Dame University, Perth, Australia.

**\*Corresponding author:** R Kishore Kumar, Senior Consultant Neonatologist & Paediatrician, Cloudnine Hospital, Jayanagar, Bangalore 560011, India

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### Abstract

**Background:** The delivery of high-quality maternal and neonatal care is challenging in low- and middle-income countries. This study assesses a program aimed at offering evidence-informed care and enhancing service utilization. **Methods:** Data on the number of births, neonatal mortality, infant survival, maternal mortality, postpartum infection, pelvic floor damage, and breastfeeding were collected and analyzed retrospectively from the Cloudnine Hospital Network (CHN; encompassing 29 hospitals) from January 2007 to January 2023. The CHN's comprehensive maternity program covers pre-delivery, delivery, and post-delivery stages with mandated antenatal classes led by a multidisciplinary team to educate couples about pregnancy. Post-delivery support includes consultations with physiotherapists, lactation consultants, and nutritionists. **Results:** The CHN's program has resulted in negligible maternal and neonatal mortality rates (2 per 100,000 deliveries and 2 per 1,000 live births, respectively), and a 99.8% infant survival rate for those born after 28 weeks of gestation. Post-partum infection rates were only 0.6% and significantly lower than in national average. Pelvic floor damages were rare, and 95% of mothers were breastfeeding at discharge. **Conclusion:** The CHN's comprehensive care program effectively reduces maternal and neonatal mortality rates. This article highlights the critical aspects of optimal maternal and neonatal care based on the experiences of the CHN.

**Keywords:** Delivery, Enhanced Recovery After Surgery, Obstetric; Postnatal Care; Quality of Health Care

### Introduction

Extending high-quality care with appropriate risk assessment can potentially influence meaningful gains in maternal and neonatal outcomes. In addition to ensuring that mothers survive pregnancy and childbirth, successful maternal care covers efforts to reduce injury and disability to promote overall health and well-being. Although there has been a significant decline over the years, the global maternal and neonatal mortality rates remain at about 223 deaths per 100,000 live births [1] and 18 deaths per 1000 live births, [2] respectively, many of these being preventable. The burden of adverse maternal and neonatal outcomes is especially high in low- and middle-income countries (LMICs). In India, the maternal and neonatal mortality rates account for about 97 per 100,000 live births[3] and 25 per 1000 live births, [4] respectively.

### Key Notes

The critical components of a comprehensive maternal and neonatal care program in the Indian setting should focus on delivering evidence-informed care and enhancing service utilization.

A comprehensive care program encompassing pre-delivery, delivery, and post-delivery stages are essential for optimal outcomes.

These comprehensive maternal and neonatal care measures have resulted in negligible maternal and neonatal mortality, few postpartum infections, as well as excellent infant survival and breastfeeding success.

The three strategic priorities of a comprehensive maternal and neonatal health program include [5].

(a) understanding and removing barriers to services; (b) increasing the availability of evidence-informed services; and (c) improving utilization and demand for services. The issue of a quality gap in health services has been highlighted in the literature, which may affect outcomes despite an increase in care coverage. [6] Growing evidence shows that increasing access does not equate to high-quality care. [7] The Indian government has implemented the Janani Suraksha Yojana (JSY), a health program to promote antenatal care and institutional delivery among poor pregnant women [8]. However, evaluations of the program suggest that although there was a significant increase in the number of institutional deliveries, there was only a modest reduction in neonatal mortality [9,10]. The failure of increased uptake of antenatal and institutional visits to improve maternal and neonatal survival has been attributed to the poor quality of care provided [11]. Data suggest that effective delivery of evidence-based interventions in LMICs can substantially improve outcomes with an estimated decrease of 28%, 28%, and 22% in maternal deaths, neonatal deaths, and stillbirths, respectively. Ensuring timely access to skilled healthcare providers and emergency childbirth care is necessary [7].

## Materials And Methods

### Study Design

This retrospective study was based on an analysis of data from the Cloudnine hospital network (CHN) recorded between January 2007 (at inception) and January 2023. The data were collected across 29 branches of the CHN in India (see supplementary file 1). All consultants were recruited 5 years post MD or MRCOG/MRCP to ensure good quality services.

#### 1.2 Ethics Statement

This study obtained ethical clearance from the Institutional Ethical Review Board of Cloudnine Hospital Jayanagar Bangalore; since it was a review of retrospective data without patient identification data, ethical approval was not required for this study.

#### 1.3 Elements of comprehensive care

The following steps were taken to improve the maternal and neonatal outcomes at CHN:

##### Pre-delivery steps:

Antenatal classes for all couples undergoing pregnancy and childbirth were made compulsory.

The antenatal classes also involved obstetricians, neonatologists, anesthetists, physiotherapists, lactation consultants, and dietitians.

Education regarding the changes the body goes through during pregnancy, how to preserve the body, nutritional requirements, pelvic floor exercises, and preparation for breastfeeding along with the importance of the same were provided.

Identifying the support person for the new mother.

Educating the support person and partner in the role they could/should play.

##### Steps during delivery:

Allowing the partner into the labor delivery and recovery (LDR), including if required in operation theatre (OT).

Duty doctors were duty obstetricians (Post MD), duty pediatricians (Post MD), and duty anesthetists (Post MD) for efficient and prompt services.

All staff were sensitized and trained to handle emergencies and provide appropriate care periodically.

##### Post-delivery steps:

Continued support to new parents through appropriate follow-ups and consultations with physiotherapists, lactation consultants, and nutritionists in the hospital.

Newborn screening of all babies for all metabolic disorders, hearing disorders, and CCCHD (Critical Cyanotic Congenital Heart Diseases).

## Results

The CHN has delivered more than 156,000 babies across 29 centers in India. Among these, there have been only three maternal deaths so far; this translates to a maternal mortality rate (MMR) of 2 per 100,000. The infant survival rate is 99.8% for babies born >28 weeks of gestation. The neonatal mortality rate is 2 per 1000 live births. The postpartum infection rates were 0.6%, which is much lower than the 5%–7% that has been reported in the United States [12]. Pelvic floor damages were virtually nil and 95% of the mothers were successfully breastfeeding at the time of discharge. The CHN is the only hospital chain from Asia to be part of the VON (Vermont Oxford Network).

## Discussion

Focusing on the delivery of high-quality comprehensive care, the CHN has adopted evidence-based practices. The outcomes of these practices are apparent in the low maternal and neonatal mortality rates, low postpartum infection rates, low occurrences of complications, and high breastfeeding success rates. Antenatal care aims to provide necessary services for preventing pregnancy complications, providing counseling for birth, and preparing for emergencies [13]. Timely initiation of antenatal care provides an

opportunity for early screening of risk factors. Through training and counseling, the expecting mothers can be equipped to recognize the warning signs of labor and make informed choices during labor and delivery. In addition to antenatal care, adequate follow-up care is also essential. As a part of the discharge process, evaluating maternal and neonatal health, caregiving capabilities of the family, and ensuring the availability of follow-up care can be critical [14]. The practices followed at CHN include such evidence-based practices for facilitating access as well as delivering quality care through skilled healthcare professionals specializing in relevant domains.

### Maternal and neonatal outcomes: Cesarean delivery

Worldwide, the rate of cesarean delivery has increased from 7% in 1990 to 21% in 2021 and is estimated to increase to 29% by 2030 [15]. When medically justified, caesarian deliveries can be effective at preventing maternal and perinatal mortality and morbidity [16]. However, as with any surgery, such a procedure is associated with short- and long-term risks [16]. The risks are higher, especially when access to comprehensive obstetric care is limited.<sup>16</sup> Elective cesarean deliveries are known to be associated with longer hospital stays and recovery times for mothers, and increased maternal blood loss [17]. Infants born through cesarean deliveries experience increased rates of neonatal infection and neonatal intensive care unit (NICU) admissions when compared with those born via vaginal deliveries [18-20]. Additionally, cesarean deliveries have a higher likelihood of not initiating/delaying breastfeeding [21]. Such risks need to be considered when monitoring for complications associated with cesarean deliveries.

Although an enhanced recovery after surgery (ERAS) protocol has been developed to optimize maternal recovery after cesarean deliveries, there is much heterogeneity in the reported outcomes from studies assessing the impact of this protocol [22,23]. A core set of outcomes for the assessment of ERAS protocols after cesarean delivery has been proposed by an international consensus study [23]. These outcome measures include Length of hospital stay Compliance with the ERAS protocol Maternal morbidity (hospital readmission or unplanned consultations) Provision of optimal analgesia (maternal satisfaction, compliance with analgesia, opioid consumption or requirement, and incidence of nausea or vomiting) Fasting times Breastfeeding success

Times to mobilization and urinary catheter removal  
Enhanced recovery after cesarian delivery

The ERAS protocol has been implemented after cesarean delivery to optimize perioperative care in many settings [24-27]. The ERAS protocol is a multimodal pathway that provides an evidence-based system to facilitate improved maternal outcomes, functional recovery, maternal-infant bonding, maternal satisfaction, and improved patient experience [28,29].

This approach involves a multidisciplinary team involving obstetricians, anesthesiologists, nurses, hospitals, and patients. The key components of the ERAS protocol for cesarean deliveries include preoperative optimization, intraoperative techniques, and postoperative management.<sup>28</sup> These encompass various aspects of care, such as preoperative counseling, nutritional optimization, optimized anesthesia and pain management, early mobilization, and postoperative monitoring. The key components of the ERAS protocol after cesarean delivery are outlined in Table 1.

#### Recommendations

- ◆ Antenatal education classes should be offered to all pregnant individuals, encompassing comprehensive training on risk awareness, and recognizing warning signs of problems in pregnancy/childbirth.
- ◆ A thorough risk assessment should be conducted to determine the appropriate length of stay for individuals at high risk, thereby mitigating the potential complications associated with inadequate inpatient care.
- ◆ It is recommended that patients be monitored by a team of obstetricians, neonatologists, and anesthesiologists to facilitate early identification and management of any potential complications during pregnancy and childbirth.
- ◆ To ensure optimal quality of care for high-risk individuals, the implementation of a referral system is advised. This system would establish a connection between peripheral healthcare facilities with limited resources and central hubs equipped with adequate resources.
- ◆ Strict adherence to infection control practices is crucial to minimize the occurrence of surgical site infections and enhance patient safety.

### Impact of the ERAS protocol after cesarean delivery on maternal and neonatal outcomes

Studies evaluating the impact of the ERAS protocol for cesarean delivery have shown encouraging results in maternal perioperative outcomes. A systematic review and meta-analysis of evidence related to the impact of the ERAS protocol on maternal recovery indicated that there are significant reductions in the length of stay, time to mobilization, time to urinary catheter removal, and opioid consumption, without affecting hospital readmission rates [30]. Hospital readmission rates indicate the safety of the ERAS protocol and affect the quality of life of patients [31]. Consistent with the ERAS protocol in nonobstetric settings, the results in obstetric settings demonstrate a reduced rate of postoperative complications [32]. This is important because postoperative complications hinder early discharge and can potentially impact healthcare costs and resource utilization.

However, there is a shortage of high-quality evidence demonstrating the benefits of ERAS protocols for cesarean delivery [22, 30]. Despite this, it has been hypothesized that small gains in related parameters synergistically provide statistically significant impacts on patient recovery [33]. Assessing the impact on neonatal outcomes is also essential for the evaluation of the success of the

ERAS model. The impact of the ERAS protocol on neonatal outcomes was assessed in a retrospective analysis [17]. It was observed that after the implementation of ERAS, the study group experienced fewer composite neonatal complications and greater breastfeeding rates. Overall, the implementation of the ERAC protocol did not negatively impact neonates, and potential benefits for both mother and baby were reported.

Preoperative	Intraoperative	Postoperative
<ul style="list-style-type: none"><li>◆ Patient education</li><li>◆ Limited fasting interval</li><li>◆ Carbohydrate loading</li></ul>	<ul style="list-style-type: none"><li>◆ Prevent and treat spinal-induced hypotension</li><li>◆ Maintain normothermia</li><li>◆ Intraop and postop nausea and vomiting prophylaxis</li><li>◆ Optimal uterotonic administration</li><li>◆ Multimodal analgesia</li><li>◆ Promote breastfeeding and maternal–infant bonding</li></ul>	<ul style="list-style-type: none"><li>◆ Early oral intake</li><li>◆ Early mobilization</li><li>◆ Promote resting periods</li><li>◆ Early urinary catheter removal</li><li>◆ Venous thromboembolism prophylaxis</li><li>◆ Continue multimodal analgesia</li><li>◆ Breastfeeding support</li><li>◆ Promote return of bowel function</li></ul>
Source: Patel K, <i>et al.</i> 2021 [28]. ERAS: Enhanced recovery after surgery.		

**Table 1:** Key components of the ERAS protocol after cesarean delivery

**Barriers to delivering comprehensive care**

In addition to promoting overall maternal well-being, implementing ERAS principles reduces the length of stay considerably, which can be reflected in the reduced burden on hospital resources and the costs of childbirth incurred by patients. Several pre-, intra-, and postoperative interventions have been studied for incorporation into the protocol [34]. The quality of evidence and the variability in metrics used for the measurement of outcomes can pose a barrier in choosing the most appropriate intervention [34]. There are several barriers to implementing the ERAS pathway in developing countries, including the lack of infrastructure and trained personnel [29]. The possibility of overcoming challenges encountered in resource-constrained settings using the hub and spoke model has been suggested [35]. This model proposes augmenting weak peripheral settings by connecting them to a resource-rich hub. The hubs can support the peripheral facilities with infrastructure, technical expertise, and trained resources. The operational setup for the implementation of the hub and spoke model in India has been described by Srivastava *et al.* 2020 [36]. Although fraught with multiple challenges, the quality of care provided by childbirth centers can be improved by adapting the ERAS model for Indian settings. With increasing evidence regarding the real-world effectiveness of the ERAS model in improving maternal and neonatal health after cesarian delivery, significantly reducing the length of stay, and lowering the costs of childbirth incurred by patients, this model has the potential to ensure affordable maternity healthcare in India.

**Conclusions**

The experiences of the CHN in implementing the ERAS pathway can serve as a model for optimizing maternal and neonatal outcomes. Adapting the ERAS model to Indian settings

can significantly improve the quality of care and reduce the costs of childbirth. However, continued research and collaborative efforts are needed to further explore the barriers in this field and to provide solutions that can ultimately improve maternal and neonatal health outcomes in diverse healthcare settings.

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