

Optimal Length of Stay for Maternal and Neonatal Care in Indian Settings

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ABSTRACT

Background: Maternal and neonatal health requires skilled care and evidence-based practices to minimize morbidity and mortality. Effective clinical and nonclinical interventions, infrastructure, and trained professionals ensure high-quality care. Cloudnine Hospital Network (CHN) has strategically reduced Length of Stay (LoS) resulting in cost reduction.

Objective: This retrospective study aimed to identify factors influencing LoS after delivery at the CHN to optimize postpartum care in India.

Methods: Data from CHN hospital records (January 2007 - 2023, covering 156000 deliveries, were analyzed for LoS associated with normal vaginal and cesarean deliveries.

Results: The mean LoS was 2.67 ± 1.65 days. Normal vaginal and cesarean deliveries had mean LoS of 2.63 ± 1.41 days and 2.75 ± 2.08 days, respectively. The LoS was shorter than the national averages with over 80% discharged by the second and third days post-delivery.

Conclusion: Risk assessment and post-natal care must balance with functional recovery and resource utilization. The LoS should be individualized based on health, caregiving capabilities, and follow-up access. Enhanced recovery programs, like the Monarch Centre model, have notably reduced LoS, particularly for cesarean deliveries. Innovative post-discharge support through telemedicine and outpatient clinics complements high-quality, evidence-based practices, essential for improved maternal outcomes with shortened LoS.

Keywords: Delivery, obstetric; length of stay (LoS); patient discharge; postnatal care; pregnancy; postpartum period; enhanced recovery; cesarean section; India; quality of health care

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Introduction

Meaningful gains in maternal and neonatal outcomes can be obtained by extending high-quality care with appropriate risk assessment. Such care is necessary to ensure that mothers survive pregnancy and childbirth with minimal injuries and disabilities; this is necessary for the overall health and well-being of the mother and baby. Currently, the global maternal and neonatal mortality rates are about 223 deaths per 100,000 live births¹ and 18 deaths per 1000 live births,² respectively. Many of these deaths are preventable, especially in low- and middle-income countries (LMICs), where the burdens of adverse maternal and neonatal outcomes are especially high. The maternal and neonatal mortality rates in India are 97 per 100,000 live births³ and 25 per 1000 live births,⁴ respectively.

There is a need to ensure that skilled care and evidence-based practices are provided to restrict preventable maternal and newborn morbidity and mortality. Providing this quality of care requires the effective use of clinical and nonclinical interventions, strengthened infrastructure, and optimal skills and attitudes in healthcare providers.⁵ The following thematic areas have been outlined as being of high priority for the highest impact on maternal and newborn care:⁶ (a) labor monitoring and essential newborn care; (b) management of preeclampsia, eclampsia, and their complications; (c) management of postpartum hemorrhage; (d) management of difficult labor with appropriate medical interventions; (e) newborn resuscitation; (f) management of preterm labor, birth, and appropriate care of preterm babies; and (g) management of maternal and newborn infections.

Adequate length of stay (LoS) allows for the monitoring and management of postpartum complications and provides the necessary support. However, increased LoS is associated with an increase in the cost of services.⁷ Therefore, understanding the relationship between LoS and optimal outcomes is crucial for healthcare providers, policymakers, and researchers seeking to improve the quality of maternal and neonatal care, especially in resource-constrained settings. The LoS is a conveniently available indicator that reflects hospital activity and provides an indirect estimate of resource consumption and efficiency.^{8,9}

The rates of cesarean deliveries worldwide have increased almost three-fold in the last decade (from 7% (in 1990 to 21% in 2021), and are estimated to increase to 29% by 2030.¹⁰ Cesarean deliveries are more prone to complications and extended hospital stays than vaginal deliveries.^{7,11,12} However, with the adoption of enhanced recovery after surgery (ERAS) programs, the LoS can be reduced considerably without an increase in hospital readmission.¹³⁻¹⁵ Nevertheless, further investigations of postoperative care, especially focusing on the optimal LoS and successful implementation of the ERAS program, are much needed.

Materials and Methods

Study design: This was a retrospective study conducted using data collected from hospital records at the Cloudnine Hospital Network (CHN) between January 2007 to January 2023. The data was collected across 29 branches of the CHN in India.

Ethics statement: Since this was a review of retrospective data without patient identification data, ethical approval was not required for this study.

Delivery protocols: The following steps were followed at all CHN hospitals, which offer 2 nights and 3 days package for both NVD (normal vaginal delivery) or LSCS (lower segment cesarean section):

- 1) All pregnant women were educated about labor, delivery, and recovery (LDR) through antenatal classes.
- 2) Women who underwent LSCS or NVD were encouraged to walk within 4 to 6 hours after delivery to promote early mobilization.
- 3) All babies were checked by an experienced pediatrician or neonatologist at birth.
- 4) All mothers were seen by a physiotherapist and lactation consultant soon after admission to the hospital.
- 5) Babies were encouraged to breastfeed within 30 minutes of birth irrespective of whether they were delivered by NVD or LSCS.
- 6) Physiotherapists supervised the early mobilization of all mothers in the first 24 hours after delivery and post-natal exercises were begun in the first 24 hours itself.

Results

There were 156,000 deliveries between January 2007 to January 2023, of which 95,160 (61%) were LSCS deliveries and 12,720 (8.2%) were instrumental deliveries (forceps and vacuum extraction for various maternal indications); the remaining were NVDs. Of these, 1248 cases (0.8%) had LoS >3 days (up to 5 days) due to maternal hypertension (either pregnancy-induced hypertension (PIH) or essential hypertension), cardiac diseases, or maternal fever. All others were discharged after 2 nights and 3 days. All cases were followed up for consultations with a senior obstetrician within a week of discharge.

Only 3 maternal deaths have occurred (maternal mortality rate [MMR] is 2 per 100,000). For babies delivered after >28 weeks of gestation, the survival rate is 99.8%. The neonatal mortality rate is 2 per 1000 live births, indicating high survival. Postpartum infection rates were 0.6%, which is much lower than the 5%–7%, which is the reported rate in the US.¹⁶ 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).

The mean LoS for all deliveries was 2.67±1.65 days (data from November 2022 to April 2023). The mean LoS for normal and cesarean deliveries were 2.63±1.41 days and 2.75±2.08 days, respectively. A comparison of the LoS at CHN with those from other published studies is provided in Table 1. The percentages of patients staying in the hospital for different durations of time are provided in Figure 1. A comparison of the data on LoS at the CHN with those from a nationwide study by Kumar *et al.* (2020) is provided in Table 2.

Table 1: The average length of stay (LoS; in days) reported by different studies

| Study | Normal delivery | Cesarean delivery | Study area |
|---------------------------------------|-----------------|-------------------|------------------|
| Hassan et al., 2022 ¹⁷ | - | 2.7 | Eastern Sudan |
| Federspiel et al., 2020 ¹⁸ | - | 2.7 | US |
| Kumar et al., 2020 ⁷ | 2.1 | 8.6 | India |
| Campbell et al., 2016 ¹² | 1.3–6.6 | 2.5–9.3 | 92 countries |
| Kruse et al., 2020 ¹⁹ | - | 2.4 | Denmark |
| Acharya, 2016 ²⁰ | 4 | 7 | Nepal |
| Cloudnine Hospital Network | 2.63 | 2.75 | 25 sites (India) |

Table 2: Proportion of patients (%) with different lengths of stay (LoS): A comparison of nationwide data with CHN data

| LoS (days) | Normal | | | Cesarean | | | Total | | |
|------------|--------|---------|------|----------|---------|------|--------|---------|------|
| | Public | Private | CHN | Public | Private | CHN | Public | Private | CHN |
| 0 | 23.4 | 19.2 | 0.4 | 6.7 | 4.3 | 0.6 | 21.2 | 12.8 | 0.4 |
| 1 | 22.6 | 24.6 | 4.7 | 5.6 | 3.5 | 3.6 | 20.3 | 1.5 | 4.4 |
| 2 | 18.8 | 20.3 | 43.3 | 4.3 | 3.0 | 34.4 | 16.9 | 12.8 | 40.6 |
| 3 | 25.1 | 20.8 | 42.2 | 6.3 | 8.6 | 50.8 | 22.6 | 15.6 | 44.8 |
| 4 | 3.0 | 4.5 | 7.1 | 4.6 | 8.4 | 8.2 | 3.2 | 6.2 | 7.4 |
| 5 | 2.6 | 4.8 | 1.3 | 10.0 | 18.3 | 1.6 | 3.6 | 10.7 | 1.4 |
| 6 | 0.8 | 1.2 | 0.4 | 7.8 | 9.1 | 0.4 | 1.7 | 4.6 | 0.4 |
| 7 | 2.0 | 2.8 | 0.2 | 36.3 | 31.6 | 0.2 | 6.5 | 15.2 | 0.2 |
| >7 | 1.8 | 1.8 | 0.4 | 18.5 | 13.3 | 0.2 | 4.0 | 6.8 | 0.3 |

Nationwide data were gathered from the study by Kumar et al., 2020.⁷ CHN: Cloudnine Hospital Network; LoS: Lengths of stay.



Figure 1: Percentages of women (normal/Cesarean /total) with different lengths of stay (LoS) at the Cloudnine Hospital Network (CHN).

Comments

a. Principal findings

The Cloudnine Hospital Network (CHN) has adopted a protocol-driven ERAS program for maternal and neonatal care as indicated above. This has not only helped reduce maternal and neonatal morbidity and mortality but has also helped in reducing the costs involved in childbirth. The percentages of patients with different LoS are highly variable in the nationwide data. However, >80% of patients at the CHN were discharged on the second and third days after hospitalization.

b. Results in the context of what is known

In addition to the several factors that affect the functional recovery of the mother and newborn, hospital characteristics (e.g. capacity constraints) also affect the LoS.²¹ Although the LoS varies considerably across countries, the determinants affecting the LoS

can be segregated into the following categories:^{12,22} (a) patient characteristics; (b) clinical caregiver characteristics; (c) social or family environment characteristics; and (d) characteristics of the healthcare system. There is a lack of data from LMICs regarding the LoS after childbirth, as most studies in this field rely on data from high-income countries.²³ Despite scarce data, some patterns regarding the LoS are apparent in LMICs; for example, lower literacy levels, rural locations, and lower economic status are positively associated with shorter LoS after hospitalization for childbirth and this pattern is likely driven by a lack of awareness and unaffordability of care.⁷ Although the mean LoS after childbirth is longer in private health facilities than in public health facilities for normal deliveries, for cesarian deliveries, the mean LoS is more extended in public health facilities than in private health facilities. This could be because of the higher occurrence of complications in cesarean cases in public health facilities than in private health facilities.

c. Clinical implications

Postpartum complications after cesarean deliveries are of significant concern for healthcare services. A thorough assessment is required to optimize the LoS to ensure a balance between functional recovery and resource usage. While a very short stay may not give caregivers sufficient time to detect and treat complications, longer stays expose postpartum women and neonates to higher risks of nosocomial infections, sleep disturbances, or poor infant-feeding support.¹² Another critical motivating factor for shorter postpartum stays is cost.²⁴ Although the LoS for postpartum women and neonates has progressively declined over the past decade,²⁵ the existing guidelines from different countries indicate that physical and psychosocial risk factors should be thoroughly considered before early discharge.²⁶ Therefore, the LoS after a cesarean section delivery will not only include the time required to recover from the surgery but also the time required to adapt to parenthood.²⁷

The data also reveals that the extension of LoS after a risk assessment has facilitated the delivery of quality care to those in need. Appropriate risk assessment and post-natal care need to be examined before considering early discharge.^{26,28} The practices adopted for the appropriate management of pregnancy-related

complications, newborn care, and management of maternal and newborn infections show encouraging results.⁶ Such practices, as applied at the CHN have limited maternal (2 per 1,00,000) and neonatal (2 per 1,000) mortality rates. The LoS should be evaluated based on the distinctive characteristics of the mothers and their infants.²⁸ Adequacy and access to appropriate follow-up care are also essential. Standardized processes, such as predischarge checklists, have been proposed to facilitate the uniform implementation of hospital discharge procedures after birth.²⁸ The discharge readiness should be assessed based on an assessment of maternal and neonatal health, the family's caregiving capabilities, and the availability of follow-up care.²⁸

d. Research implications

Early discharge with an individualized follow-up program has shown promising outcomes for both the mother and newborn.^{29,30} At-home visits by healthcare professionals can enhance patient satisfaction and outcomes.³¹ However, such an approach is limited by the cost and increased need for trained professionals. Models, such as the Monarch Centre model, have been proposed and implemented to reduce postnatal LoS for mothers and newborns.³² This model provides access to a community-based postpartum clinical care service, where women and newborns receive multidisciplinary care in an outpatient clinic during the first month following hospital discharge after delivery. Marked reductions in LoS were observed in this model, especially among women who had undergone cesarean delivery. Although reductions in the incurred costs have been the major focus of programs that aim to shorten LoS, the importance of patient experience and population health have also been highlighted.³³ Staffing and financial models for hospitals have shown that a reduction in the LoS results in less than proportionate savings in hospital cost due to the maintenance of contingent bed and staff capacity.⁸ Models should include measures for ensuring monitoring of postoperative safety and promote continuity of standard postpartum care in outpatient clinics.³² Women's reproductive care accounts for a considerable portion of hospitalization in India.³⁴ Measures to reduce the LoS in this group have the potential to translate to a high impact on the healthcare system. Women requiring larger abdominal incisions in cesarean delivery have benefitted from

measures to promote enhanced recovery via ERAS programs.¹⁴ Other approaches for post-discharge patient support, such as the use of videoconferencing or mobile phone applications, have also been evaluated in this context.³⁵ Hospital readmission rates before and after the implementation of the ERAS program can be an essential indicator of the success of such programs.³⁶ If adequate continuity of care is provided in outpatient settings, hospital readmission can be reduced. However, specific subgroups, such as the mothers of late preterm infants, may require additional support, necessitating more personalized approaches to early discharge.

e. Strengths and limitations

This study benefits from the large dataset collected across the multiple centers of the CHN. It evaluates the impact of the enhanced recovery program implemented at the CHN, providing valuable insights into its effectiveness in Indian settings. While the study offers significant insights, its retrospective design may introduce bias, and its findings may not be easily generalized beyond the CHN. The short follow-up period post-discharge may also provide an incomplete picture of long-term outcomes. External

validation in a diverse healthcare setting can enhance the applicability of this study.

f. Conclusion

Delivering high-quality care and using evidence-based practices, are both essential for improving maternal and newborn outcomes. This article highlights several areas for optimizing care, focusing on critical interventions that can have the highest impact. Postpartum complications following cesarean deliveries and risks associated with extended hospitalization must be taken into consideration when deciding on an optimal LoS. In this context, ERAS programs have shown promising results in improving postpartum care, reducing LoS, and enhancing patient satisfaction.

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REFERENCES

1. Maternal mortality. UNICEF DATA, <https://data.unicef.org/topic/maternal-health/maternal-mortality/> (2019, accessed May 8, 2023).
2. Neonatal mortality. UNICEF DATA, <https://data.unicef.org/topic/child-survival/neonatal-mortality/> (2019, accessed May 8, 2023).
3. PIB-MMR. Significant Decline in the Maternal Mortality Ratio (MMR) from 130 in 2014-16 to 97 per lakh live births in 2018-20: Dr. Mansukh Mandaviya, <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1879912> (2023, accessed May 8, 2023).
4. PIB-NMR. Health an integral component of social welfare, leitmotif for the Government, <https://pib.gov.in/PressReleasePage.aspx?PRID=1894904> (2023, accessed May 8, 2023).
5. Strengthening Equity. Every woman, every child.; http://apps.who.int/iris/bitstream/handle/10665/85757/9789241505949_eng.pdf?sequence=1 (accessed June 1, 2023).
6. Tunçalp Ö, Were WM, MacLennan C, Oladapo OT, Gülmezoglu AM, Bahl R, et al. Quality of care for pregnant women and newborns-the WHO vision. *BJOG* 2015;122:1045–49. doi: <https://doi.org/10.1111/1471-0528.13451>
7. Kumar P, Dhillon P. Length of stay after childbirth in India: a comparative study of public and private health institutions. *BMC Pregnancy Childbirth* 2020;20:181. DOI: 10.1186/s12884-020-2839-9
8. Bowers J, Cheyne H. Reducing the length of postnatal hospital stay: implications for cost and quality of care. *BMC Health Serv Res* 2016;16:16. doi: 10.1186/s12913-015-1214-4.
9. Ghaffari P, Vanda R, Aramesh S, Jamali L, Bazarganipour F, Ghatee MA. Hospital discharge on the first compared with the second day after a planned cesarean delivery had equivalent maternal postpartum outcomes: a randomized single-blind controlled clinical trial. *BMC Pregnancy Childbirth* 2021;21:466. doi: <https://doi.org/10.1186/s12884-021-03873-8>
10. Caesarean section rates continue to rise, amid growing inequalities in access, <https://www.who.int/news/item/16-06-2021-caesarean-section-rates-continue-to-rise-amid-growing-inequalities-in-access> (accessed May 30, 2023).

11. Mascarello KC, Horta BL, Silveira MF. Maternal complications and cesarean section without indication: systematic review and meta-analysis. *Rev Saude Publica* 2017;51:105. doi: 10.11606/S1518-8787.2017051000389
12. Campbell OMR, Cegolon L, Macleod D, Benova L. Length of stay after childbirth in 92 countries and associated factors in 30 low- and middle-income countries: Compilation of reported data and a cross-sectional analysis from nationally representative surveys. *PLoS Med* 2016;13:e1001972. doi: 10.1371/journal.pmed.1001972
13. Wrench IJ, Allison A, Galimberti A, Radley S, Wilson MJ. Introduction of enhanced recovery for elective caesarean section enabling next day discharge: a tertiary centre experience. *Int J Obstet Anesth* 2015;24:124–30. doi: 10.1016/j.ijoa.2015.01.003
14. Corso E, Hind D, Beever D, Fuller G, Wilson MJ, Wrench IJ, et al. Enhanced recovery after elective caesarean: a rapid review of clinical protocols, and an umbrella review of systematic reviews. *BMC Pregnancy Childbirth*; 17 2017. doi: 10.1186/s12884-017-1265-0.
15. Fay EE, Hitti JE, Delgado CM, Savitsky LM, Mills EB, Slater JL, et al. An enhanced recovery after surgery pathway for cesarean delivery decreases hospital stay and cost. *Obstet Anesth Dig* 2020; 40:124–25. doi: 10.1016/j.ajog.2019.06.041.
16. Boushra M, Rahman O. Postpartum Infection. StatPearls Publishing, 2022.
17. Hassan B, Mandar O, Alhabardi N, Adam I. Length of hospital stay after cesarean delivery and its determinants among women in eastern Sudan. *Int J Womens Health* 2022;14:731–38. doi: 10.2147/IJWH.S356855
18. Federspiel JJ, Suresh SC, Darwin KC, Szymanski LM. Hospitalization duration following uncomplicated cesarean delivery: Predictors, facility variation, and outcomes. *AJP Rep* 2020;10:e187–97. doi: 10.1055/s-0040-1709681
19. Kruse AR, Arendt LH, Jakobsen DH, Kehlet H, Lauszus FF, Forman A, et al. Length of hospital stay after cesarean section in Denmark from 2004 to 2016: A national register-based study. *Acta Obstet Gynecol Scand* 2021;100:244–51. doi: <https://doi.org/10.1111/aogs.14000>
20. Acharya J. Are free maternity services completely free of costs? *Osong Public Health Res Perspect* 2016;7:26–31. doi: 10.1016/j.phrp.2015.11.002.
21. McMahon SA, Mohan D, LeFevre AE, Mosha I, Mpembeni R, Chase RP, et al. “You should go so that others can come”; the role of facilities in determining an early departure after childbirth in Morogoro Region, Tanzania. *BMC Pregnancy Childbirth* 2015;15:328.
22. Schorr E. Theoretical framework for determining hospital length of stay (LOS). *BMC Proc* 2012;6:P32. doi: 10.1186/1753-6561-6-S4-P32
23. Brown S, Small R, Faber B, Krastev A, Davis P. Early postnatal discharge from hospital for healthy mothers and term infants. *Cochrane Database Syst Rev* 2002;CD002958. doi: 10.1002/14651858.CD002958.
24. Martell LK. The hospital and the postpartum experience: a historical analysis. *J Obstet Gynecol Neonatal Nurs* 2000;29:65–72. doi: 10.1111/j.1552-6909.2000.tb02757.x
25. Plusquin C, Uvin V, Drakopoulos P, Brucker P De, Rosetti J, Brucker, M. De. Reduction of hospital stay at maternity unit: an evaluation of the impact on maternal and neonatal readmission. *J Obstet Gynaecol* 2020; 40:46–52. doi: <https://doi.org/10.1080/01443615.2019.1603211>
26. Lindblad V, Gaardsted PS, Melgaard D. Early discharge of first-time parents and their newborn: A scoping review. *Eur J Midwifery* 2021;5:46. doi: 10.18332/ejm/140792
27. Peahl AF, Smith R, Johnson TRB. Better late than never: why obstetricians must implement enhanced recovery after cesarean. *Am J Obstet Gynecol* 2019;221:117.e1-117.e7.
28. Guidelines for perinatal care, eighth edition book, <https://www.acog.org/store/products/clinical-resources/guidelines-for-perinatal-care> (accessed June 1, 2023).
29. De Carolis MP, Cocca C, Valente E, Lacerenza S, Rubortone SA, Zuppa AA, et al. Individualized follow up programme and early discharge in term neonates. *Ital J Pediatr* 2014;40:70.
30. Escobar GJ, Braveman PA, Ackerson L, Odouli R, Coeleman-Phox K, Capra AM, et al. A randomized comparison of home visits and hospital-based group follow-up visits after early postpartum discharge. *Pediatrics* 2001;108:719–27. doi: 10.1542/peds.108.3.719.
31. Dodge KA, Goodman WB, Murphy RA, O'Donnell K, Sato J, Guptill S. Implementation and randomized controlled trial evaluation of universal postnatal nurse home visiting. *Am J Public Health* 2014;104 Suppl 1:S136-43. doi: 10.2105/AJPH.2013.301361.
32. Hardy G, Colas JA, Weiss D, Millar D, Forster A, Walker M, et al. Effect of an innovative community-based care model, the Monarch Centre, on postpartum length of stay: an interrupted time-series study. *CMAJ Open* 2018;6:E261–68. doi: 10.9778/cmajo.20180033.
33. Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Aff (Millwood)* 2008;27:759–69. doi: 10.1377/hlthaff.27.3.759.
34. Tripathy JP, Shewade HD, Mishra S, Kumar AMV, Harries AD. Cost of hospitalization for childbirth in India: how equitable it is in the post-NRHM era? *BMC Res Notes*; 10. Epub ahead of print December 2017. doi: 10.1186/s13104-017-2729-z.
35. Danbjørg DB, Wagner L, Kristensen BR, Clemensen J. Intervention among new parents followed up by an interview study exploring their experiences of telemedicine

after early postnatal discharge. *Midwifery* 2015;31:574–81. doi: 10.1016/j.midw.2015.02.007.

Medical Association journal 2018;190:E846–47. doi: 10.1503/cmaj.180836

36. Chen I, Choudhry AJ, Wen SW. Minimizing length of hospital stay for women's reproductive care. *Canadian*