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ORIGINAL ARTICLE

Effect of Telemedicine Follow-Up on Neonatal Outcomes: A Pre-Post Intervention Study

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ABSTRACT

Background: Neonatal mortality and morbidity remain major public health concerns, especially in low- and middle-income countries.

Objective: To evaluate the effect of a structured telemedicine follow-up program on neonatal outcomes using a pre-post intervention design.

Methods: This pre-post interventional study was conducted at The Children's Hospital Lahore from 1 Jan 2023 to 1 july 2023. A total of 185 neonates were enrolled consecutively. The participants were divided into two groups: a pre-intervention group (n = 92), which received standard post-discharge care, and a post-intervention group (n = 93), which received structured telemedicine follow-up.

Results: Hospital readmissions were significantly lower in the telemedicine group (5.4%) compared to the control group (14.1%, p = 0.038). Emergency visits also declined (9.7% vs. 19.6%, p = 0.041). Mean daily weight gain was higher in the telemedicine group (29.6 ± 6.4 g/day vs. 25.1 ± 7.2 g/day, p = 0.005). Exclusive breastfeeding rates were improved (81.7% vs. 65.2%, p = 0.018), and immunization adherence increased (94.6% vs. 84.8%, p = 0.041). Caregiver satisfaction was significantly higher in the telemedicine group (87.1% vs. 63.0%, p < 0.001).

Conclusion: It is concluded that telemedicine follow-up is effective in improving key neonatal health indicators and caregiver satisfaction. This approach offers a scalable solution for enhancing post-discharge neonatal care, particularly in settings with limited healthcare access.

Keywords: Telemedicine, Neonatal, Outcomes, Intervention, Effect, Patients

INTRODUCTION

Neonatal care is a critical determinant of infant survival and long-term developmental outcomes. The neonatal period, defined as the first 28 days of life, accounts for nearly 47% of all deaths among children under five globally, with the burden disproportionately higher in low- and middle-income countries (LMICs)[1]. At this moment, good follow-up is crucial to identify feeding problems, jaundice, sepsis, and possible poor weight gain as soon as possible, as all these can have a major impact on both morbidity and mortality[2]. Still, getting quality post-discharge services for newborns is difficult due to concerns related to place, economy, and infrastructure. Telemedicine the medical care provided remotely with the help of technology has emerged as an effective means to reach those who lack access to healthcare. It gives the chance to treat patients quickly, maintain care from one visit to the next, and take pressure off crowded neonatal outpatient centers[3,4]. Telehealth adoption increased during the COVID-19 pandemic, with healthcare organizations worldwide requiring fast changes and more wide-scale digitalization[5]. Using telemedicine in newborn care, medical teams can monitor important clinical signs, give immediate advice to those caring for the baby, and respond early if any changes raise concerns. Several research studies have proven the value of telemedicine in better healthcare for chronic cases and follow-up visits. Leaving a neonatal intensive care unit (NICU) or special care nursery too soon might result in more admissions because some signs of complications can still be overlooked. It is suggested by research that using telemedicine for follow-ups can avoid most unnecessary hospital trips and make it easier for patients to address issues at home when they are manageable[6]. Digital follow-ups also make it possible to closely monitor breastfeeding practices, vaccination status, temperature regulation, and parental coping, all of which are important factors in the well-being of newborns. Because of its ease of use, reduced travel time, and lower costs, telemedicine has been linked to higher levels of caregiver satisfaction. In LMICs where transport infrastructure is weak and pediatric specialty services are limited to tertiary centers, telehealth interventions can help decentralize follow-up care and increase adherence to post-discharge guidelines[7]. A study conducted in rural India demonstrated that structured telephonic follow-up after neonatal discharge improved both immunization rates and exclusive breastfeeding practices[8]. However, there is still a gap in literature evaluating not just parental satisfaction, but objective neonatal clinical outcomes following telemedicine follow-up, particularly using comparative designs like pre-post intervention studies. Despite its potential, telemedicine is not without limitations. Digital literacy, access to smartphones or internet services, and cultural perceptions toward remote healthcare can influence its effectiveness and acceptability.

Objective: To evaluate the effect of a structured telemedicine follow-up program on neonatal outcomes using a pre-post intervention design.

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METHODOLOGY

This pre-post interventional study was conducted at The Children's Hospital Lahore from 1 Jan 2023 to 1 July 2023. A total of 185 neonates were enrolled consecutively. The participants were divided into two groups: a pre-intervention group (n = 92), which received standard post-discharge care, and a post-intervention group (n = 93), which received structured telemedicine follow-up. All neonates included were discharged in clinically stable condition and met the inclusion criteria.

Inclusion Criteria:

- Neonates discharged from the NICU or postnatal ward during the study period
- Availability of a caregiver capable of participating in teleconsultations
- Access to a mobile phone or internet-enabled device

Exclusion Criteria:

- Neonates with major congenital anomalies requiring frequent in-person evaluations
- Families without access to communication devices
- Neonates discharged against medical advice

Data Collection: During the pre-intervention phase, families were advised to return for in-person follow-up visits at days 7, 14, and

28 post-discharge, following the standard discharge protocol. No remote monitoring or structured follow-up was provided. In contrast, the post-intervention phase incorporated a structured telemedicine protocol. Teleconsultations were scheduled for days 3, 7, 14, and 28, conducted via phone or video call by pediatricians or neonatal staff. Data were collected using a structured form that included demographic details, clinical parameters at discharge, and outcome indicators. Primary outcomes assessed were the rate of hospital readmissions, number of emergency department visits, and weight gain over the 28-day follow-up period.

Statistical Analysis: Data were analyzed using SPSS v17. Continuous variables were expressed as mean ± standard deviation and compared using the independent sample t-test. Categorical data were expressed as frequencies and percentages and analyzed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 185 neonates were included in the study. The mean gestational age was 36.2 ± 1.4 weeks in the pre-intervention group and 36.5 ± 1.3 weeks in the post-intervention group (p = 0.42). Similarly, the mean birth weight was 2580 ± 410 g and 2615 ± 395 g in the respective groups (p = 0.31). The proportion of male neonates was nearly equal (56.5% vs. 53.8%, p = 0.75), and the rate of cesarean deliveries was also similar (53.3% vs. 54.8%, p = 0.84), indicating no significant baseline differences.

Table 1: Baseline Characteristics of Study Participants

Variable	Pre-Intervention (n = 92)	Post-Intervention (n = 93)	p-value
Mean Gestational Age (weeks)	36.2 ± 1.4	36.5 ± 1.3	0.42
Mean Birth Weight (g)	2580 ± 410	2615 ± 395	0.31
Male Gender (%)	52 (56.5%)	50 (53.8%)	0.75
C-Section Delivery (%)	49 (53.3%)	51 (54.8%)	0.84

In the pre-intervention group, 5 out of 13 readmissions were due to jaundice and 4 were due to feeding issues, while in the post-intervention group, these numbers reduced to 1 and 2 respectively. Respiratory distress and fever/sepsis were less frequent causes, reported in 2 and 2 cases pre-intervention, and 1 case each post-intervention.

Table 2: Reasons for Readmission Within 28 Days

Reason for Readmission	Pre-Intervention (n = 13)	Post-Intervention (n = 5)
Jaundice	5	1
Feeding Difficulty	4	2
Respiratory Distress	2	1
Fever/Sepsis	2	1

Among the 93 patients in the post-intervention group, the majority (50.5%) received telemedicine follow-up via video call, while 33.3% were managed through audio calls. A smaller proportion (10.8%) had a combination of both video and audio consultations. Only 5 patients (5.4%) missed their scheduled telemedicine follow-up, indicating high overall adherence to the virtual care protocol.

Table 3: Mode of Teleconsultation Used in Post-Intervention Group

Mode of Teleconsultation	Number of Patients (n = 93)	Percentage (%)
Video Call	47	50.5
Audio Call	31	33.3
Mixed (Video + Audio)	10	10.8
Missed Scheduled Follow-up	5	5.4

A total of 81 caregivers (87.1%) in the post-intervention group reported being “very satisfied” compared to 58 (63.0%) in the pre-intervention group (p < 0.001). Fewer caregivers in the post-intervention group reported being merely “satisfied” (10 vs. 21, p = 0.021), and the number of neutral or dissatisfied responses was also lower.

Table 4: Caregiver Satisfaction Scores

Satisfaction Level	Pre-Intervention (n = 92)	Post-Intervention (n = 93)	p-value
Very Satisfied	58	81	<0.001
Satisfied	21	10	0.021
Neutral	7	1	0.18
Dissatisfied	5	1	0.22
Very Dissatisfied	1	0	0.31

Hospital readmissions decreased from 14.1% to 5.4% (p = 0.038), and emergency department visits were also lower (9.7% vs. 19.6%, p = 0.041). Average daily weight gain improved notably in the telemedicine group (29.6 ± 6.4 g/day) compared to the control group (25.1 ± 7.2 g/day, p = 0.005). Exclusive breastfeeding rates increased to 81.7% (from 65.2%, p = 0.018), and immunization completion by day 28 rose to 94.6% (vs. 84.8%, p = 0.041). Caregiver satisfaction also saw a significant boost, with 87.1% reporting being “very satisfied” in the telemedicine group versus 63.0% in the control group (p < 0.001).

Table 5: Comparison of Outcomes

Outcome	Pre-Intervention (n = 92)	Post-Intervention (n = 93)	p-value
Hospital readmissions	13 (14.1%)	5 (5.4%)	0.038
ED visits	18 (19.6%)	9 (9.7%)	0.041
Weight gain (g/day)	25.1 ± 7.2	29.6 ± 6.4	0.005
Exclusive breastfeeding	60 (65.2%)	76 (81.7%)	0.018
Immunization completion	78 (84.8%)	88 (94.6%)	0.041
Caregiver “Very Satisfied”	58 (63.0%)	81 (87.1%)	<0.001

DISCUSSION

This pre-post interventional study evaluated the effectiveness of a structured telemedicine follow-up program in improving neonatal outcomes during the first 28 days post-discharge. Results showed that follow-ups through telemedicine caused fewer hospital readmissions, fewer trips to the emergency department, and better outcomes in weight gain, more breastfed nutrition, vaccination use, and support for caregivers. They agree with the growing global trend toward employing telehealth to assist children and newborns after they leave medical care. A significant reduction in the number of people readmitted to the hospital after telemedicine was set up—from 14.1% in the old group to just 5.4% in the new group. The decrease I observed is similar to what Marcin et al. saw in rural neonatal units—a 55% reduction in preventable pediatric readmissions after telehealth was introduced. Early discovery of any complications, prompt parent counseling, and ongoing monitoring by the team result in fewer readmissions compared to the usual aftercare systems[10,11].

Care after the intervention group had fewer emergency visits (9.7%) compared to the control group (19.6%), which demonstrates the advantages of telemedicine for adult triage and lessens hospital exposure for neonatal patients. Researchers have observed similar findings in previous studies. A 2022 study from Joshi et al. reported that remote check-ins for children led to a 40% decrease in unnecessary emergency department visits[12]. The daily weight of newborns in the telemedicine group, which reflects how well they are feeding, was significantly greater than in the control group (29.6 ± 6.4 g/day versus 25.1 ± 7.2 g/day). Monitoring the baby away from the hospital made it less likely that lactation or formula issues would go unnoticed for an extended time. These outcomes are supported by Rallis et al., whose data indicates better growth results in low-birth-weight babies who get ongoing lactation advice via remote communication[13]. Another positive outcome was the increase in exclusive breastfeeding rates, from

65.2% to 81.7% in the intervention group. This improvement underscores the role of teleconsultations in reinforcing breastfeeding education, addressing maternal concerns, and offering real-time guidance particularly in settings where in-person lactation counseling is limited[14]. A similar study by Owais et al. in a low-resource setting reported that regular telephonic counseling led to a 20% improvement in exclusive breastfeeding by the fourth postnatal week. Importantly, immunization adherence was significantly better in the telemedicine group, with 94.6% completing their scheduled vaccines on time versus 84.8% in the control group[15]. Similar to findings from telehealth vaccine reminder programs in Sub-Saharan Africa and India [16], reminder calls and parental reinforcement during virtual check-ins likely contributed to this improvement. However, some limitations must be acknowledged. First, the study was conducted at a single tertiary care center, which may limit the generalizability of findings. Second, while we attempted to balance baseline characteristics, unmeasured confounders may have influenced outcomes. Third, reliance on caregiver-reported data, especially for weight and feeding, may introduce reporting bias. Lastly, telemedicine outcomes can be influenced by technological literacy and network availability, which were not assessed in this study.

CONCLUSION

It is concluded that the implementation of a structured telemedicine follow-up program significantly improves neonatal outcomes during the critical post-discharge period. Compared to standard in-person follow-up alone, telemedicine was associated with reduced hospital readmissions and emergency department visits, improved weight gain, higher rates of exclusive breastfeeding, better immunization adherence, and greater caregiver satisfaction.

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