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Evaluation of Short Message System Reminder Impact on Retinopathy of Prematurity Appointment Attendance in the Referral Center of Northeastern Iran

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Abstract

Background: Retinopathy of prematurity (ROP) is a significant cause of preventable vision impairment in newborns, particularly in developing countries. It can result in severe conditions such as retinal detachment, cataracts, glaucoma, and refractive errors. Therefore, screening and monitoring infants with ROP is crucial .This study was conducted to assess the effect of short message reminders on the attendance of infants with ROP at a tertiary referral center.

Methods: An observational case-control study was carried out at the ROP clinic in Khatam-Al-Anbia Hospital from September 2019 to March 2021. The study included a cohort of patients with follow-up appointments recorded in the ROP electronic system. Each group comprised 600 patients. Researchers used a questionnaire they developed to gauge the attitudes of parents who received short message service (SMS) reminders for upcoming appointments.

Results: In the control group, the non-attendance rate was 31%, while the intervention group that received SMS reminders had a slightly lower rate of 28.5%. However, receiving SMS reminders did not significantly increase patient attendance at scheduled appointments (p=0.344). Conversely, the chi-square test revealed that attendance was significantly associated with the father's education level (p=0.009), disease stages (p=0.001), and place of residence (p=0.023). Furthermore, according to the logistic regression analysis, SMS reminders did not significantly enhance patient attendance (Exp(B)=1.08, p=0.55).

Conclusion: Infant attendance at scheduled appointments was influenced by the father's social status, the patient's disease stage, and place of residence. Nonetheless, the implementation of reminder SMS did not have a statistically significant impact on attendance rates.

Key Words: Adherence to Treatment, Infant,Parent, Reasons for Non-Attendance, Retinopathy of Prematurity.

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1- INTRODUCTION

Retinopathy of prematurity (ROP) is a significant contributor to preventable visual impairment in newborns worldwide (1). The incidence of ROP has increased in developing countries over the past few decades (2, 3). In Iran, a developing country, the prevalence of ROP varies significantly, ranging from 1% to 70% across different regions (4). When ROP is present, it can result in various eye problems, including retinal detachment, cataracts, glaucoma, and refractive errors (5-7). Therefore, screening and monitoring infants diagnosed with ROP is crucial. In some cases, infants may require laser treatment or intravitreal anti-vascular endothelial growth factor (VEGF) injections to prevent neovascularization (3, 4, 8-10). Early detection and prompt treatment are essential for restoring and preserving vision in neonates. Regular follow-up exams can help prevent further complications (8). However, parents must ensure their child attends appointments on time to receive optimal care.

Ensuring timely outpatient follow-up for managing ROP is crucial, and parents play a key role in this process (11). However, non-attendance at hospital outpatient clinics is a common issue across various medical specialties, including ophthalmology, which primarily provides care on an outpatient basis (12). A study conducted at a Birmingham hospital in the United Kingdom revealed a non-attendance rate of 12.6% at an ophthalmology clinic (13). Patients cited forgetting the appointment, practice errors, and confusion over dates as the primary reasons for non-attendance (14). In addition, a lack of understanding about ROP among parents, poor scheduling of outpatient ophthalmologic examinations, issues with insurance companies, and difficulties in transporting an ill premature infant were proposed as causes for missing or delaying the examinations (9, 15). This non-attendance not only increases waiting times for other patients but also lengthens the treatment process, reduces the quality of patient care, and wastes healthcare resources (14,16). However, various studies have demonstrated the effectiveness of short message service (SMS) appointment reminders in reducing outpatient non-attendance. SMS reminders have been proven to be a more cost-effective approach than other phone reminder methods. Multiple studies have shown that SMS appointment reminders effectively reduce outpatient non-attendance and are more cost-effective than other phone reminder methods (13, 14, 17-20).

Consistent follow-up care is essential for the successful management of ROP, and any delay in treatment can result in complications. With the widespread availability of mobile phones, SMS reminders have emerged as a cost-effective, personalized, and rapid solution to encourage patients to attend follow-up appointments. Despite their potential, there is a lack of research on the efficacy of SMS reminders in improving the attendance of infants with ROP at clinics. To address this gap, this study aims to investigate the impact of SMS reminders on the attendance of patients with ROP at a tertiary referral center in Iran with 7554 recorded patients during September 2019 to March 2021, and also explore parental perceptions on the implementation of reminder systems.

2- MATERIALS AND METHODS

2-1. Study Design

This observational case-control study was conducted at the ROP clinic of Khatam-al-Anbia Hospital (Mashhad University of Medical Sciences, Mashhad, Iran) between September 2019 and March 2021. The study included premature infants diagnosed with ROP.

2-2. Data Collection and Data Analysis

In the initial phase of the study, participants were selected through systematic sampling from a larger cohort database to ensure adequate population-level representation. The second phase involved more comprehensive qualitative assessments, utilizing convenience sampling among those participants from the first phase who were willing and able to attend the examination center. During the initial phase, patients who had previously attended their first follow-up appointment and had their parents' mobile numbers recorded in the ROP electronic database were selected. The sample size of 600 patients per group was determined using a systematic sampling approach based on data from Koshy's study on SMS reminders effectiveness in ophthalmology appointments (13) and the observed on-time attendance rate following the transmission of text messages. For the control group, patients with second or subsequent follow-up appointments scheduled between September 2019 and March 2020 were identified from the ROP electronic database. Starting in September 2020, the hospital implemented a policy of sending SMS reminders to all patients scheduled for their second or subsequent follow-up appointments two days before the scheduled date, as recorded in the ROP electronic health record, to encourage attendance. For the intervention group, patients whose parents received SMS reminders from the ROP electronic health record between September 2020 and March 2021 we identified. All assessments were carried out using standardized protocols to mitigate potential confounding factors, and participants exhibiting symptoms of acute illness or COVID-19 were excluded from the study.

Over six months from September 2020 to March 2021, the attendance and non-attendance status of 600 individual patients in each cohort were verified through data recorded in the ROP electronic database. The study explored the relationship between various background factors, such as infant age, birth weight, gender, parental education, disease stages, place of residence, and visit number with attendance and non-attendance rates. To evaluate the perspectives of parents who had received SMS reminders for their upcoming appointments, the researchers used a questionnaire they developed. The 15-item questionnaire was formulated after a review of pertinent literature and consultation with ophthalmologists. The face validity of the questionnaire was assessed by four ophthalmologists, one nurse, and five experts in medical informatics and health information management. The final version of the questionnaire was formulated based on their feedback. Content validity was evaluated using the content validity ratio (CVR) and content validity index (CVI), with all questionnaire items achieving a CVR score exceeding 62% and a CVI score above 0.79, indicating high relevancy, clarity, and simplicity (21). The questionnaire's reliability was assessed by Cronbach's alpha, yielding a score of 0.85. Due to the COVID-19 pandemic and restrictions on paper-based surveys, one project collaborator administered the questionnaire electronically following verbal questioning of parents. The questionnaire focused on the best methods for reminding parents about their infant's visit appointments.

The research employed a convenience sampling method involving a sample size of 220 determined using Cochran's formula. Data analysis was conducted using SPSS software version 25, wherein descriptive statistics were employed to define and describe the population and sample characteristics. A range of analytical techniques were utilized to examine the premature infant attendance rates at scheduled appointments and

investigate the connections between variables and attendance rates, including chi-square tests, independent t-tests, and logistic regression analyses, with a pre-set significance level of P value < 0.05.

2-3. Ethics Approval and Consent to Participate

The Research Ethics Committee of Mashhad University of Medical Sciences Research Council (IR.MUMS.MEDICAL.REC.1400.337) approved this study, which was conducted per the Declaration of Helsinki guidelines. Participants provided informed written consent to participate as determined by Ethics Committee. This paper does not include identifiable information about the participants, ensuring their privacy and confidentiality are upheld.

3- RESULTS

3-1. Quantitative Results

Table 1 presents the characteristics of infants with ROP in the study. Among the 600 patients selected for the intervention group, 71.5% adhered to their scheduled appointments. Meanwhile, the control group exhibited an attendance rate of 69%. This difference led to a 2.5% decrease in patients who did not attend appointments after sending SMS reminders to those in the intervention group (p=0.344). The chi-square test results showed significant differences between certain variables and attendance outcomes. Specifically, statistically significant variations were found in paternal education level (p=0.009), disease stage (p=0.001), place of residence (p=0.023), and attendance rates. However, no significant differences were found between attendance and maternal education level (p=0.201), infant age (24-41 weeks) (p=0.072), birth weight (590g-3500g) (p=0.157), and gender (p = 0.486) within the study groups.

Table-1. Baseline characteristics and attendance rate for patients in the intervention and control groups.

	SMS appointment reminders Sample=600	**No SMS appointment reminders Sample=600**
Gender (Number, %) **Female** **Male**	 305(50.8%) 295(49.2%)	 249(41.5%) 351(58.5%)
Visit (Number)	4.88~5	5.38~5
Birth age (Mean± SE, week)	31.11±2.76	30.63± 2.98
Birth_weight (gr)	1567.51±515.68	1500.93± 490.21
Parent Age (Mean± SE, Year) (Number, %) **Mother age** **Father age**	 32.03±7.92 36.89±8.27	 30.82±6.52 34.74±6.11
Mother education level (Number, %) **Low education** **High education**	 493(83) 101(17)	 399(79.8) 101(20.2)
Father education level (Number, %) **Low education** **High education**	 500(84.2) 94(15.8)	 401(80.2) 99(19.8)
Total follow-up group (Number, %) **Attendees** **Non-attendance Rate**	 429(71.5) 171(28.5)	 414(69) 186(31)
Non-attendance rate reduction (%) with SMS Reminders	2.5 (p-value = 0.344) *	

*Chi-square test.

Table-2. Logistic regression test results.

Variable	B	Wald	Sig	EXP(B)	95% CI for EXP(B)	
					Lower	Upper
Birth age	0.028	0.587	0.443	1.029	0.957	1.105
Birthweight	0.000	0.051	0.821	1.000	1.000	1.000
Mother education	-0.102	0.562	0.453	0.903	0.692	1.179
Father education	0.025	0.016	0.898	1.025	0.701	1.500
Group	0.514	6.181	0.013	1.672	1.115	2.506
Constant	0.080	0.348	0.555	1.083		

The independent t-test found a significant difference in the frequency of patient visits and attendance rates between the two groups ($p<0.0001$). This suggests that as the number of visits increased, attendance at scheduled appointments tended to decrease.

After adjusting for background variables, logistic regression analysis showed that SMS reminders did not significantly impact patient appointment adherence (Exp(B)=1.08, p=0.55) (Table 2). Paternal education emerged as the sole predictor of patient appointment attendance, with individuals having fathers with higher education levels being 1.115 times more likely to attend appointments (EXP(B)=1.67, p=0.013).

3-2. Qualitative Results

In the subsequent phase of the investigation, 223 parents who had been sent a reminder text message agreed to participate in the survey. Table 3 outlines the demographic profile of the infants' caregivers enrolled in the study. Among these caregivers, 63.7% were mothers who accompanied their infants to the appointments. Most caregivers had obtained a high school diploma or lower educational qualification and were unemployed.

Approximately 45.7% of caregivers have used appointment cards in the past to keep track of their infants' visit schedules. Most caregivers preferred to be reminded by the hospital of upcoming appointment dates.

Table-3. The demographic characteristics of participants.

Variables	No of patients (Total= 223)	Percentage (%)
Relative to the child		
Father	81	36.3
Mother	142	63.7
Educational level		
High school or less	78	35
Diploma	81	36.3
Associate's degree	19	8.5
Bachelor's degree	39	17.5
Master of Science or higher	6	2.7
Occupational status		
Employee	41	18.4
Not employee	176	78.9

Table-4. Attitude of parents regarding receiving appointment reminders.

Questions	Number (%)
How did you find out about your infant's appointment dates until now?	
Appointment card	102 (45.7)
Phone call	30 (13.5)
SMS	72 (32.3)
Personal calendar	14 (6.3)
How would you prefer to be reminded, of the infant's appointment date?	
Phone call	106 (47.5)
SMS	131 (58.7)
Email	0 (0)
Social networks	4 (1.8)
Fax	0 (0)
In your opinion, when is the best time to remind the infants of an appointment date?	
One day before the appointment date	94 (42.2)
Two to three days before the appointment date	92 (41.3)
One week before the appointment date	32 (14.3)
What information would you like to receive when sending a reminder?	
Infant's name	79 (35.4)
Appointment date	148 (66.4)
Name of physician	40 (17.9)
Place of visit	40 (17.9)
Visiting hours	71 (31.8)
Educational content to prepare the infant for examination	42 (18.8)

Table-5. Attitude of parents who receive SMS towards the sent SMS.

Questions	Yes (%)	No (%)
Have you ever forgotten your infant's appointment date?	16 (7.2)	199 (89.2)
Would you like to receive a reminder from the hospital about the date of your appointment?	204 (91.5)	17 (7.6)
Are you satisfied with the SMS sending time?	121 (54.3)	97 (43.5)
Is the content of the sent SMS clear?	119 (53.4)	99 (44.4)
Does texting affect your punctuality?	118 (52.9)	100 (44.8)
Would you like to continue sending SMS to remind you of the date of the appointment?	120 (53.8)	99 (44.4)

Additionally, 58.7% of caregivers preferred receiving appointment reminders via text, while 47.5% preferred phone call reminders. Regarding timing, 42.2% of caregivers believed receiving a reminder one day before the appointment was optimal. Caregivers indicated that an ideal text message should contain the infant's name, date, and appointment details (Table 4). Most caregivers said the SMS reminders were clear and helped them be on time. However, many caregivers were unhappy with the timing and content of the messages (Table 5).

4- DISCUSSION

Our investigation revealed that the use of SMS reminders did not have a significant impact on the attendance rate of infants at their scheduled appointments within the ROP clinic. We found that

certain variables, such as paternal education level, disease stage, and the patient's residential location, influenced attendance rates. Additionally, we noted a decrease in attendance rates as the number of visits increased, suggesting a possible correlation. Most parents expressed a preference for hospital-provided appointment reminders, with over fifty percent indicating a preference for receiving SMS reminders for follow-up visits.

Based on the study's findings, it was determined that sending SMS reminders did not significantly impact attendance at scheduled appointments. However, parents who received SMS messages were approximately 2% more likely to attend follow-up appointments than those who did not. Previous research by Gurol-Urganci et al. found that sending text message reminders to cell phones increased attendance rates for healthcare appointments (22). Additional studies, such as those conducted by Koshy and Liew, showed an absolute reduction in non-attendance rates of 6.9% and 7.4% in outpatient ophthalmology clinics (13, 23). However, Zebina's study revealed that sending SMS reminders did not significantly affect clinic attendance rates (24). Conversely, studies on follow-up after pediatric cataract surgery (25) and trabeculectomy surgery for glaucoma (26) showed significantly increased attendance rates of 47% and 65%, respectively, for groups that received SMS reminders. Considering the importance of timely ROP treatment for preventing blindness in premature infants and parents' increased awareness of appointment adherence, it is recommended that factors beyond SMS reminders, such as disease severity and nature, be considered when implementing and evaluating text messaging interventions to improve timely appointment attendance rates.

In our study, the control group (parents who did not receive SMS) had a non-attendance rate of 30.8%, which is higher than other medical specialties (13, 18, 27, 28). This suggests that non-attendance at ophthalmology appointments is a more significant issue. Downer's study, which included outpatient clinics for dermatology, gastroenterology, general medicine, pediatric dentistry, and plastic surgery, found a non-attendance rate of 23.4% in the control group (28). Similarly, a study conducted at the Pediatric Dentistry Department at the Edinburgh Dental Institute in Scotland found an overall non-attendance rate of 23.9% for the control group (18). In contrast, Adel Youssef's study reported a total non-attendance rate of 36.4% in the control group across three clinics (19). Brannan's study showed a non-attendance rate of 12% in the control group at the general ophthalmology clinic, which is lower than our study (27). The high non-attendance rate in our study may be attributed to the spread of COVID-19 in early 2020, leading to clinic closures and quarantines. To better contextualize the impact of SMS reminders, it is recommended that future studies analyze appointment attendance trends over multiple years.

According to the study, the father's educational background, disease stage, and place of residence influenced patients' attendance at their scheduled appointments. A higher level of education for the father, advanced stages of the disease, and proximity to the clinic were found to increase the likelihood of timely attendance. These findings align with previous research by Jensen and Finkelstein, which revealed that higher education levels and income were linked to greater attendance rates (29, 30). It is also possible that fathers with higher education levels had better health literacy and understanding of the disease, leading to their punctuality (31-33). Additionally, the

patient's residence was identified as affecting attendance probability, with differences observed within cities and between rural and urban areas (17, 29). For example, Corden's study showed that timely attendance increased and disease incidence decreased when children lived closer to hospitals and health centers (34). Similarly, Zidar's study found that age and place of residence influenced patient attendance at scheduled mammography screening appointments (35). However, distance and travel were not the primary reasons for non-attendance in Norris's study (36). For patients of the ROP clinic, such as premature infants, specialized care is required when traveling from distant places, and parents face limitations such as weather conditions, transportation availability, and cost, all of which impact the timely clinic attendance of the infants.

According to our study, attendance rates decrease as the number of visits increases. This finding is consistent with previous studies, which have identified the number of prior visits as the primary reason for patient no-shows (37-39). As patients visit outpatient clinics more frequently, they are less likely to attend appointments. This means that even if a patient has made significant progress and is nearing recovery, they may still miss their next appointment due to the perception of their progress or lack thereof. Additionally, patients who spend extended periods in clinics and are dissatisfied with their treatment may decide to skip their next appointment altogether.

In our study, nearly all participants expressed a desire to receive reminders from the hospital for their follow-up appointments. Interestingly, 89% of parents reported that they did not forget their appointments. Previous research has suggested that patients favor using reminders, which effectively prevent missed appointments (20, 23, 24, 40-42). This is particularly important in the case of ROP, a disease that can have significant consequences for an infant's health, vision, prospects, and overall well-being. Parents understand the importance of timely appointment attendance to benefit their infant's health and quality of life.

According to the study, more than half of parents preferred receiving SMS reminders for follow-up visits, consistent with previous research indicating that 98% of patients with mobile phones are open to receiving text message reminders for their outpatient appointments While SMS has been demonstrated to be an effective means of reminding patients, phone calls are sometimes even more effective (23, 43, 44). In this study, parents ranked phone calls as their second choice after SMS. The main reason for preferring SMS was that it allowed parents to read the text at their convenience, unlike phone calls, which require an immediate response.

In light of this study, it is important to acknowledge certain limitations. Firstly, the accuracy and currency of phone numbers documented in hospital databases may be questionable, as has been observed in prior research on recall systems (20, 45). Moreover, the study design is not considered optimal, highlighting the need for a randomized controlled trial. It is recommended that combining educational and reminder strategies, such as multimodal interventions, may prove more effective in promoting desired health behaviors during follow-up. For instance, Yang et al.'s successful post-trabeculectomy follow-up trial incorporated SMS reminders with supplementary interventions such as providing complimentary postoperative medications (26). Furthermore, the data collection period for the study was limited to six months, which may not have accounted for any potential monthly or seasonal fluctuations in absenteeism rates. However, by maintaining consistency within this timeframe, the observed

differences were impacted minimally. Some of the data collection occurred during the COVID-19 pandemic, which may have affected participants' behavior or their patterns for seeking healthcare. Standardized protocols were followed consistently, and individuals displaying COVID-19 symptoms or experiencing acute illnesses were excluded from the study. However, it is important to note that residual confounding may still be possible. It is worth noting that this study was the first to investigate the effectiveness of SMS reminders in improving appointment attendance among premature infants at an ROP clinic. SMS reminders require minimal staff training or involvement as the message delivery is automated before implementing any new intervention in a healthcare system, it is essential to assess patient acceptance rates, which was carried out in this study (46). Despite the limitations, our findings indicate a positive outcome in advancing ROP care in developing countries.

While the study offered valuable insights, it fell short in exploring the reasons for parental absences. This underscores the necessity for further research to address this gap, particularly for parents of infants with ROP. Future randomized controlled trials involving multiple ROP clinics should be conducted to gain a more comprehensive understanding of the efficacy of SMS reminders in improving follow-up appointment attendance. Given the observed limitations in participant engagement and response tracking, implementing two-way messaging systems or multimodal communication—such as combining phone calls, text messages, and app-based follow-ups—could enhance the effectiveness of the intervention. These strategies may help address the gaps identified in our current methodology and improve outcomes in the future. This will enable patients to promptly communicate appointment cancellations, leading to efficient reallocation of appointment slots to other waiting patients.

5- CONCLUSION

In conclusion, SMS reminders alone have not significantly increased patients' attendance at scheduled appointments. Thus, it is essential to consider various factors such as the specific characteristics of the disease, parents' educational background, the extent and severity of the condition, distance, and associated costs when developing interventions. By incorporating these variables into the intervention design, it is possible to customize the approach to better cater to the target population's unique requirements and improve the overall effectiveness of the interventions.

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7-DATA AVAILABILITY

The data that support the findings of this study are available upon request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

8-CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interests.

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