ORIGINAL ARTICLE

Efficacy of a Novel Oral Health Education Method and Appointment Reminders on the Perceptions, Knowledge, and Adherence to Dental Appointments among Pregnant Women: A Randomized Controlled Trial

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Objective: To assess the efficacy of a novel oral health education method and appointment reminder system. It focused on the perceptions of service quality, oral health knowledge, and adherence to dental appointments among pregnant women.

Materials and Methods: A double-blinded, randomized controlled trial was conducted among 64 pregnant women. Half (32 pregnant women) were randomly allocated to the New Method group and the other half (32) were allocated to the Conventional Method group using blocked randomization method. Both groups received standard dental services. The New Method group received additional multimedia oral health knowledge and appointment reminders.

Results: Baseline characteristics, health status, expectations of service quality, and perceptions of service quality of both groups were similar at enrolment. Participants in both groups had 'High level' expectations and perceptions of service quality in all items. The mean (standard deviation) oral health knowledge scores at baseline were comparable with the New Method at 11.54 (3.71) and the Conventional Method at 11.33 (3.91). At the end of the research, perceptions of service quality held by the New Method group were significantly higher than those in the Conventional Method group (p=0.002). However, oral health knowledge scores at the end of the study were significantly higher in both groups compared to the baseline. The mean knowledge score was 14.20 (3.56) in the New Method group and 13.63 (3.54) in the Conventional Method group. The scores were not significantly different between the two groups (p=0.132). Attendance according to appointment was significantly higher in the New Method group at 88.5% compared to the Conventional Method group at 64%, with an odds ratio of 4.313 (p=0.040).

Conclusion: After receiving antenatal dental services, participants in both groups had comparable higher oral health knowledge. Participants enrolled in the New Method with an appointment reminder demonstrated greater adherence to the dental care schedule than those who did not. It is recommended to employ an appointment reminder system in the standard of dental care to improve communication channels between healthcare providers and patients.

Keywords: Oral health; Expectations of service quality; Perceptions of service quality; Attendance

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Untreated decay in permanent teeth remains a prevalent health issue. The World Health Organization (WHO) recommends public health interventions and regular dental care to address this oral health concern. This issue affects individuals across genders and age groups, with pregnant women being particularly vulnerable to oral health conditions[1]. Pregnant women are more prone to tooth decay and periodontal disease than other segments of the population. A report by the Bureau of Dental Health, Ministry of Public Health Thailand reveals that a sizable number of pregnant women, up to 90.3%, had tooth decay, while 90% were diagnosed with gingivitis. Additionally, 20% of pregnant women were identified as having periodontitis. Nearly 50% of pregnant women experience untreated oral health issues[2,3].

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Consistent and appropriate dental care for pregnant women can prevent severe dental complications and permanent tooth loss, reducing future expenses on dental healthcare. In 2019, WHO recommended the adoption of digital technology for health as a modern communication tool. This approach enables wider public communication and facilitates more effective monitoring and care for individuals with chronic diseases.

Research indicates that forgetting appointment dates is a commonly reported reason for missing treatment appointments[4-8], leading to missed opportunities for treatment and directly impacting patients' health and the service unit. Patients' miss appointments without prior cancellation pose a long-term burden on the health system[4,9,10]. Therefore, appointment reminders are deemed necessary for both patients and service providers[4,11,12].

At research setting, outcomes of dental performance between 2020 and 2022 indicated that approximately 12% of pregnant women with oral health problems did not receive dental care after dental examination. In the first round of dental service performance evaluation for the fiscal year 2022, research setting achieved 62% performance outcome in health promotion and prevention in pregnant population, against a 70% target. The findings indicate that there are still possibilities for improvement in promoting and preventing oral diseases, to provide comprehensive coverage, and further enhance the service quality. The present study assessed the efficacy of a novel oral health education method and an appointment reminder system on perceptions of service quality, oral health knowledge, and adherence to dental appointments among pregnant women.

Materials and Methods

The present study was a randomized controlled trial (RCT) focused on the efficacy of the New Oral Health Education Method and an appointment reminder system for individuals who received the New Dental Service Method. It compared this New Method and System with the Conventional Dental Service Method at Chakkarat Hospital in Nakhon Ratchasima Province.

The inclusion criteria comprised of pregnant women aged 15 to 49 years attending their first antenatal care, possessing a smartphone with internet access, using the LINE mobile application, capable of participating in research activities, and willing to participate in the present study. A written informed consent signed by the participant, or a consent letter from their parents or legal guardians was required. Exclusion criteria were pregnant women receiving antenatal care from other hospitals, chronic diseases hindering their ability to attend activities, intellectual disability, or restricted communication abilities.

The sample size calculation was performed using Bernard Rosner's algorithm, with an alpha error of 0.05 and power of 0.90[13].

$$n_{tr\,t} = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2\,[\sigma^2_{tr\,t} + \sigma^2_{c_0 n/r}]}{\Delta^2}$$

$$r = \frac{n_{C_0 n}}{n_{tr\,t}} \quad \Delta = \mu_{tr\,t} - \mu_{C_0 n}$$

α=0.05, β=0.10

Power = 1–β = 0.90

Sample size estimations were calculated for four outcomes, expectations of service quality, perceptions of service quality, oral health knowledge, and attendance to the dental service. Of these outcomes, the 'Oral health knowledge' required the highest sample size of 50 participants. Additional samples were added in case of loss to follow-up. The final sample size was 64 participants. Thirty-two participants of the 64 were randomly selected and allocated to each group using a block-of-four randomization method. Participants were allocated to each group according to the content of an opaque prepared envelope with a code of "N" for New Method group or "C" for Conventional Method group. The information from the research was exclusively delivered to each participant via the LINE mobile application. Additionally, the participants in both groups were asked not to share information received to individuals who were not enrolled in the research. Health personnel who provided services to the participants were not involved in the data collection process. Moreover, the assessor (NW) of the research remained unaware of group allocations.

The research instrument comprised of a 21-item expectations and perceptions of service quality questionnaire with a 5-point Likert scale with 5 as the highest expectations of service quality/perceive the highest levels of service quality, 4 as high level of expectations of service quality/perceive the high levels of service quality, 3 as moderate level of service quality/perceive moderate level of service quality, 2 as lower level of service quality/perceive lower level of service quality, and 1 as do not expect service quality/do not acknowledge service quality. The present research instrument also comprised of

Table 1. Activity plan in the antenatal clinic for New Method group and Conventional Method group

Activities	Providers	New Method	Conventional Method	Time
1. Oral examination 2. Dental record 3. Make an appointment	Dental personnel/researcher	✓	✓	1st antenatal care visit
Add LINE OA[a]	Participants/researcher	✓	✓	When a pregnant woman was interested in participating in the research
Take a questionnaire on expectations and perceptions of service quality, and oral health knowledge	Participants	✓	✓	Before attending the 1st parent school session
Oral health education (by group)	Dental personnel/participants	✓	✓	1st parent school session
Oral health education via LINE Mobile application	Participants/researcher	✓		1 day after the completion of the parents' school's sessions, continuously, 5 days[b]
Oral health knowledge questionnaire	Participants	✓	✓	2 weeks[c]
Appointment reminder	Researcher	✓		3 days and 1 day before the appointment date
Dental treatment for pregnant women	Participants/researcher	✓	✓	
Take a perceptions of service quality questionnaire	Participants	✓	✓	When participant receiving dental care services

[a] The LINE Official Account, also known as LINE OA, is a service technology software developed by LY Corporation in Japan. The prototype account serves as a means for an organization to generate a greeting message, which is necessary for communication and dissemination of activity updates to patients who using the Line message including autoreply and individual chat feature.

[b] The 1st parent school session's contents were comparable. The contents are listed in the following order: Day 1, Common oral health problems during pregnancy; Day 2, Oral health maintenance recommendations during pregnancy and brushing technique; Day 3, The importance of oral health care during pregnancy; Day 4, How does a mother's oral health affect her child?; Day 5, Summary common oral health problems in pregnant women and the way to preserving their oral and dental well-being.

[c] After attending the first parent's school session for the Conventional Method group and after receiving consecutive education messages via LINE OA on the date of 2 weeks of learning through the media in LINE OA (14+5 days) for the New Method group.

Table 2. Intervention of the New Method and Conventional Method

New Method	Conventional Method
In the first antenatal visit, dental staff examined patient's dental health in the antenatal clinic. The dental staff recorded the results into the dental checkup record and patient's health record booklet	Identical to the New Method
Dental staff scheduled dental services appointments for pregnant women with oral health problems at a service unit in the second trimester	Identical to the New Method
Dental staff provided oral health knowledge in groups to patient who attended the 1st antenatal care in the parents' school	Identical to the New Method
The researcher provided oral health knowledge to patients by disseminating oral health knowledge in the following formats via the LINE mobile application system: text messaging, multimedia applications to enable patient's self-learning	Only offered within the parent's school
The researcher established an appointment reminder system for patient using a short message via LINE Official Account notifications in 3 days and 1 day before the appointment	No reminder

a 20-item 20 total scores of oral health knowledge questionnaire with three-choices as correct, incorrect, and do-not-know. Accurate responses received one point, while inaccurate and do-not-know responses received zero score.

Activity plan in the antenatal clinic

Activity plan in the antenatal clinic for New Method group and Conventional Method group are shown in Table 1. The Conventional Method of antenatal care provides standard treatment for pregnant women covers health promotion and dental services to pregnant women to maintain their oral and dental health[14].

Intervention

There were two interventions, namely the New Method and the Conventional Method (see Table 2).

Statistical analyses

The data analyses encompassed the use of descriptive statistics including frequency, percentage, mean, standard deviation (SD), maximum, minimum, median, and interquartile range for both the age and pregnancy data. To compare groups receiving different dental services, independent t-tests were employed, examining differences in oral health knowledge scores and the percentage of pregnant women received dental services through hospital

appointment, which included expectations and perceptions of service quality. The Mantel-Haenszel common odds ratio was performed to calculate the effect size of receiving dental services according to appointments.

Intra-group comparisons using paired t-tests were performed at enrolment and at the end of the research to analyze differences in perceptions of service quality and oral health knowledge scores for those receiving the same dental services. All statistical analyses were conducted using IBM SPSS Statistic, version 27.0 (IBM Corp., Armonk, NY, USA)[15].

Ethical approval

The present research received ethical approval from the Human Research Ethics Review Committee, the Faculty of Public Health, Mahidol University with the identification number MUPH 2023-030. The research was registered in the Thai Clinical Trial Registry (TCTR) under certification number TCTR20230409003. All participants were provided with comprehensive information regarding the research activities, delivered verbally by the researcher and supplemented with relevant supporting documents. This ensured that participants were well-informed and had access to all necessary details about the research procedures and objectives.

Results

Participant flow

Sixty-seven participants were initially invited to participate in the present study, with 64 being eligible and enrolled. Half the participants were assigned and allocated to the New Method group, and another half to the Conventional Method group. At the end of the research, 81.25% in the New Method group and 78.13% in the Conventional Method group completed the study (see Figure 1).

The findings from the 64 participants enrolled in the present research project showed the average ages of participants were 26.34 years in the New Method group, and 27.25 years in the Conventional Method group. Both groups displayed the same range of ages, the New Method group being from 15 to 41 and the Conventional Method group from 15 to 42. Participants in both groups completed upper secondary school and had family incomes ranging from 5,001 to 10,000 Baht per month. All participants had support when requiring medical care, with the majority utilizing Universal Coverage.

Notably, 50% of the New Method group had

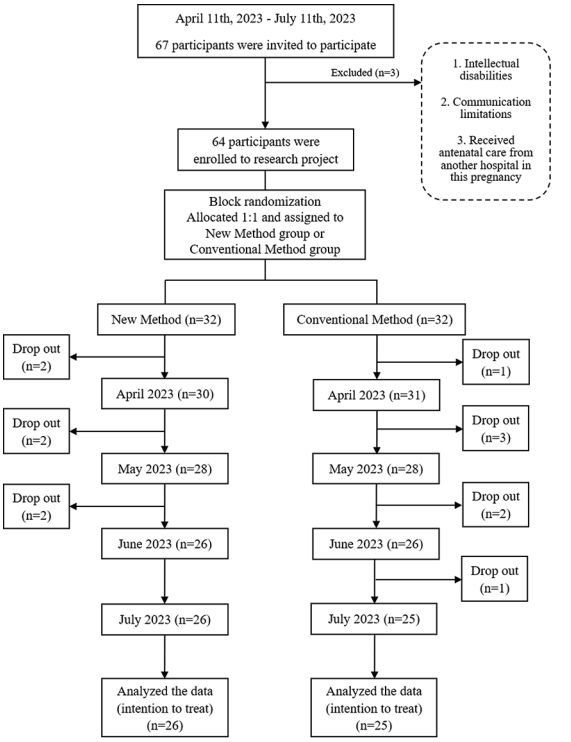

Figure 1. Participant flow.

received dental health education during a previous pregnancy, while one-third of the Conventional Method group had received the same. Importantly, there were no statistically significantly different in baseline characteristics between the two groups (see Table 3).

Among participants receiving antenatal care for the first time, the New Method group had an average gestational age of 83.34 days, while the Conventional Method group had an average gestational age of 84.06 days. The New Method group reported an average of 1.91 pregnancies, with 0.19 abortions, whereas the Conventional Method group reported an average of 2.09 pregnancies, with 0.28 abortions. Both groups experienced gingivitis and other oral issues, with 62.50% of the New Method group and 65.60% of the Conventional Method group had been infected with COVID-19. There were no statistically significantly different in baseline health status between the two groups (see Table 4).

At enrolment, 64 participants in both groups exhibited high expectations and perceptions of service quality, with no statistically significantly different found. Oral health knowledge scores were comparable between the two groups, with the mean (SD) score of the New Method group being 11.54

Table 3. Baseline characteristics of participants in the New Method group (n=32) and Conventional Method group (n=32) at the antenatal clinic Chakkarat Hospital 2023, at enrolment (n=64)

Baseline characteristics	Total (n=64)	New Method (n=32)	Conventional Method (n=32)	p-value
Age (years)				0.617[a]
Mean (SD)	26.80 (7.17)	26.34 (6.77)	27.25 (7.64)	
Min, max	15, 42	15, 41	15, 42	
Median [IQR]	26 [12.75]	25 [11]	26 [13.75]	
Highest education level; n (%)				0.517[b]
Primary school	7 (10.9)	2 (6.3)	5 (15.6)	
Lower secondary school	24 (37.5)	11 (34.4)	13 (40.6)	
Upper secondary school	25 (39.1)	15 (46.8)	10 (31.3)	
Collage/university	8 (12.5)	4 (12.5)	4 (12.5)	
Occupation; n (%)				0.561[b]
Employee	30 (46.9)	15 (46.8)	15 (46.9)	
Unemployment	14 (21.9)	9 (28.1)	5 (15.6)	
Company employee	6 (9.4)	2 (6.3)	4 (12.5)	
Agricultural	7 (10.9)	2 (6.3)	5 (15.6)	
Others	7 (10.9)	4 (12.5)	3 (9.4)	
Family income (Baht/month); n (%)				0.196[b]
0 to 5,000	10 (15.6)	5 (15.6)	5 (15.6)	
5,001 to 10,000	28 (43.8)	16 (50.0)	12 (37.5)	
10,001 to 15,000	16 (25.0)	9 (28.1)	7 (21.9)	
15,001 to 20,000	5 (7.8)	2 (6.3)	3 (9.4)	
>20,000	5 (7.8)	0 (0.0)	5 (15.6)	
Family care; n (%)				0.492[b]
No	2 (3.1)	0 (0.0)	2 (6.2)	
Yes	62 (96.9)	32 (100)	30 (93.8)	
Medical Scheme; n (%)				0.595[c]
Universal Coverage	43 (67.2)	23 (71.9)	20 (62.5)	
Social Security Scheme	21 (32.8)	9 (28.1)	12 (37.5)	
Health education history; n (%)				0.371[b]
Ever	26 (40.6)	16 (50.0)	10 (31.2)	
Never	38 (59.4)	16 (50.0)	22 (68.8)	

SD=standard deviation; IQR=interquartile range
Statistically significant at $p<0.05$, [a] Independent t-test, [b] Fisher's exact test, [c] Chi-square test

(3.71) points and the Conventional Method group being 11.33 (3.91) points.

At the end of the research, there were results from 51 participants who completed the study. Participants in both groups maintained high perceptions of service quality, except for the item related to the timing of service performance, which was rated as 'Moderate'. Statistically significant differences in several aspects of service quality are shown in Table 5. The oral health knowledge scores remained similar between the two groups, with the mean score of the New Method group being 14.2 (3.56) and the Conventional Method group being 13.63 (3.54).

Moreover, the mean score difference between pre- and post-intervention within the New Method group was 2.89 (3.87), $p<0.001$ and the Conventional Method group was 2.32 (4.12), $p<0.001$.

Additionally, a statistically significant difference was observed in the number of participants attending dental service as appointed with the New Method group exhibited a higher attendance rate than the Conventional Method group with an odds ratio of 4.313 ($p=0.040$) (see Table 6).

Discussion

The present study aimed to assess the efficacy of a novel oral health education method and an appointment reminder system on the perceptions of service quality, oral health knowledge, and adherence to dental appointments among pregnant women.

Table 4. Health status of participants in the New Method group (n=32) and Conventional Method group (n=32) at the antenatal clinic Chakkarat Hospital 2023, at enrolment (n=64)

Health status	Total (n=64)	New Method (n=32)	Conventional Method (n=32)	p-value
Gestational age (day)				0.685[a]
Mean (SD)	83.70 (34.22)	83.34 (35.48)	84.06 (33.48)	
Min, max	29,202	29, 176	36,202	
Median [IQR]	76 (43.50)	77 (36.50)	76 (44.50)	
Number of pregnancies (time); n (%)				0.117[b]
1	25 (39.1)	12 (37.5)	13 (40.6)	
2	19 (29.7)	11 (34.4)	8 (25.0)	
3	15 (23.4)	9 (28.1)	6 (18.8)	
4	5 (7.8)	0 (0.0)	5 (15.6)	
Number of abortions (time); n (%)				0.750[b]
0	51 (79.7)	27 (84.4)	24 (75.0)	
1	11 (17.2)	4 (12.5)	7 (21.9)	
2	2 (3.1)	1 (3.1)	1 (3.1)	
Medical history; n (%)				0.492[b]
No	63 (98.50)	31 (96.90)	32 (100)	
Hypertension	1 (1.60)	1 (3.10)	0 (0)	
Dental history and oral health conditions; n (%)				
Gingivitis	64 (100)	32 (100)	32 (100)	N/A
Calculus	57 (89.0)	31 (96.9)	26 (81.3)	0.104[b]
Dental caries	34 (53.0)	17 (53.1)	17 (53.1)	1.000[c]
Impacted tooth	29 (45.0)	17 (53.1)	12 (37.5)	0.315[c]
Irreversible pulpitis/pulp necrosis	2 (3.0)	1 (3.1)	1 (3.1)	1.000[b]
COVID-19 infection; n (%)				1.000[c]
Ever	41 (64.1)	20 (62.5)	21 (65.6)	
Never	23 (35.9)	12 (37.5)	11 (34.4)	

SD=standard deviation; IQR=interquartile range; N/A=not available
Statistically significant at $p<0.05$, [a] Independent t-test, [b] Fisher's exact test, [c] Chi-square test

Table 5. Overall perceptions of service quality in the New Method group (n=26) and Conventional Method group (n=25) at the antenatal clinic Chakkarat Hospital 2023, at the end of research (n=51)

Perceptions of service quality	New Method (n=26); Mean (SD)	Conventional Method (n=25); Mean (SD)	p-value
Overall perceptions of service quality	4.16 (0.40)	3.79 (0.53)	0.002*
Assurance	4.30 (0.39)	4.04 (0.55)	0.059
Empathy	4.36 (0.32)	3.63 (0.37)	<0.001*
Tangibles	3.98 (0.53)	3.99 (0.75)	0.960
Reliability	4.07 (0.42)	3.72 (0.57)	0.016*
Responsiveness	4.09 (0.34)	3.58 (0.42)	<0.001*

* Independent t-test, statistically significant at $p<0.05$

Table 6. Number of attendances according to appointment in the New Method group (n=26) and Conventional Method group (n=25) at the antenatal clinic Chakkarat Hospital 2023, at the end of research (n=51)

	New Method (n=26); n (%)	Conventional Method (n=25); n (%)	Odds ratio	p-value
Number of attendances according to appointment			4.313[a]	0.040[b]
Yes	23 (88.5)	16 (64)		
No	3 (11.5)	9 (36)		

[a] Mantel-Haenszel common odds ratio estimate, [b] Chi-square test, statistically significant at $p<0.05$

The baseline characteristics and health status of both research groups were similar, indicating a successful randomization process and creating comparable groups. It ensures that any differences in outcomes between the groups can be attributed to the interventions being studied, rather than pre-existing conditions between both groups.

The mean scores at post-intervention within both groups were statistically significant higher than at pre-intervention. However, at the end of the study the oral health knowledge scores of the New Method group and the Conventional group were similar. This contrasts with a study by Nguanjairak et al.[16], which focused on dental health education in pregnant women using the LINE mobile application. In that study, the experimental group perceived benefits in treating gingivitis through scaling and toothbrushing compared to the control group. Similarly, the findings of this research differed from a study by Fernández-Gutiérrez et al.[17], which explored the use of mobile applications in educating immigrant populations in Spain. It concluded that the mobile application 'e_SaludAble' increased health literacy among immigrant populations. In other studies, such as those by Hongchuvech et al. and Taneepanichskul, the Line application was found to be effective in delivering health information and improved health knowledge[18,19].

The divergent findings could be attributed to contextual factors, the duration of the study, and the actual capabilities of the LINE mobile application. The LINE mobile application in the present study (Official account entitled 'Mother#Chakkarat Hospital') might not be suitable for the specific population who could not access the service. Therefore, this application might not have much efficacy among them in distributing health information.

At the end of the present research, participants' perceptions of service quality were assessed, revealing statistically significant differences across all items, including responsiveness, empathy, and reliability of service quality. The New Method group, benefiting from appointment reminders and continuous delivery of oral health knowledge over a 5-day period, engaged in communication with service providers more than the Conventional Method group. This approach created a dynamic resembling a service provider with a focus on engaging service recipients.

A statistically significant difference in attendance was observed between the two groups based upon whether an opportunity to make appointments existed. However, the researcher identified several probable factors contributing to the observed disparities in dental service attendance. In the New Method group, participants received two appointment reminders via the LINE mobile application, first at three days and later at one day before the appointment date. In contrast, the Conventional Method group did not receive any appointment reminder. The adherence to dental services based on appointments within the New Method group demonstrates the efficacy of the appointment reminder system implemented by the New Method intervention. This finding aligned with previous studies, such as Lin et al.'s research[20], which demonstrated that text message appointment reminders increased appointment adherence in a pediatric clinic. Another study by Stormon et al.[21] supported this finding, suggesting that brief messages effectively reduce absenteeism in community dental service units.

The present study found that various facts influenced patients' attendance including financial status, health conditions, forgetfulness, travel-related issues, waiting times, and the appointment system. The present study found that, apart from forgetfulness, other factors, such as health conditions, financial status, and family care were not statistically significantly different ($p>0.05$) at the point of participant enrolment. Consequently, the researcher concluded that participants' attendance at dental appointments were influenced by the presence or absence of appointment reminders. This highlighted the significant role that reminders play in enhancing appointment adherence in the context of dental services.

Limitation

The present study specifically focused on first-time pregnant women recently initiated antenatal care, possessed a personal smartphone, and proficient in utilizing the LINE Mobile Application and the internet. Consequently, the findings may not be directly applicable to pregnant women in alternative scenarios. It was essential to note that this investigation concentrated on understanding the expectations and perceptions regarding the fundamental service quality experienced by participants at the service point. A comprehensive gap analysis was not conducted in this present study, and the generalizability of the findings should be interpreted within the specified context.

Conclusion

After receiving antenatal dental services, participants in both groups had comparable higher

oral health knowledge. Participants enrolled in the New Method with appointment reminder system had more adherence to the dental care schedule than those who did not. The efficacy of the New Method was demonstrated through the service reminder system. However, in oral health education, this was not the case. It is recommended that the appointment reminder system is integrated into dental care procedures. This will improve communication channels between healthcare providers and patients. It will also enhance the quality of dental services and will be crucial for healthcare providers and patients.

What is already known in this topic?

The dental services provided for pregnant women in the antenatal clinics at the community hospitals studied show potential for improvement to meet key performance indicators effectively.

What does this study add?

Appointment reminder plays a crucial role in encouraging individuals to adhere to their dental service appointment. By establishing an efficient communication channel, there is an ability to enhance the overall positive perceptions of service quality. This efficient communication strategy can contribute to a more positive patient experience, increased attendance, and reinforcing the commitment to provide quality dental services.

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Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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