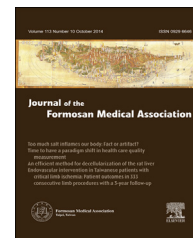




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ORIGINAL ARTICLE

Improvements in dental care using a new mobile app with cloud services



Chia-Yung Lin ^{a,b}, Kang-Lin Peng ^c, Ji Chen ^c, Jui-Yuan Tsai ^d,
Yu-Chee Tseng ^c, Jhih-Ren Yang ^a, Min-Huey Chen ^{b,*}

^a Dentistry Department, National Taiwan University Hospital Hsinchu Branch, Hsinchu, Taiwan, ROC

^b Department of Dentistry, School of Dentistry, National Taiwan University, Taipei, Taiwan, ROC

^c Department of Computer Science and Engineering, National Chiao Tung University, Hsinchu City, Taiwan, ROC

^d Information Management Office, National Taiwan University Hospital Hsinchu Branch, Hsinchu, Taiwan, ROC

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KEYWORDS

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Background/Purpose: Traditional dental care, which includes long-term oral hygiene maintenance and scheduled dental appointments, requires effective communication between dentists and patients. In this study, a new system was designed to provide a platform for direct communication between dentists and patients.

Methods: A new mobile app, Dental Calendar, combined with cloud services specific for dental care was created by a team constituted by dentists, computer scientists, and service scientists. This new system would remind patients about every scheduled appointment, and help them take pictures of their own oral cavity parts that require dental treatment and send them to dentists along with a symptom description. Dentists, by contrast, could confirm or change appointments easily and provide professional advice to their patients immediately. In this study, 26 dentists and 32 patients were evaluated by a questionnaire containing eight dental-service items before and after using this system. Paired sample *t* test was used for statistical analysis.

Results: After using the Dental Calendar combined with cloud services, dentists were able to improve appointment arrangements significantly, taking care of the patients with sudden worse prosthesis ($p < 0.05$). Patients also achieved significant improvement in appointment reminder systems, rearrangement of appointments in case of sudden worse prosthesis, and establishment of a direct relationship with dentists ($p < 0.05$).

Conclusion: Our new mobile app, Dental Calendar, in combination with cloud services, provides efficient service to both dentists and patients, and helps establish a better relationship

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

* Corresponding author. Department of Dentistry, School of Dentistry, National Taiwan University, No. 1, Changde St., Zhongzheng Dist., Taipei City 10048, Taiwan, ROC.

E-mail address: minhueychen@ntu.edu.tw (M.-H. Chen).

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between them. It also helps dentists to arrange appointments for patients with sudden worsening of prosthesis function.

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Introduction

Wide disparities in dental care and variation in dental manpower distribution exist in Taiwan.¹ The National Health Insurance system adopted by the government offers a comprehensive single-payer, fee-for-service health benefits; however, this has resulted in increased utilization of dental services and uneven distribution of dentists and care.² Some not-so-serious diseases, such as peri-implantitis and full ceramic crown fracture, are associated with high morbidity and are of more concern to patients due to associated high dental expenses. Therefore, we need to minimize delays in treatment by optimizing available resources. In addition to chair-side treatment, traditional dental care processes including oral hygiene maintenance, scheduled dental appointments, a good cooperation between dentists and patients, and dental emergency treatment are very time consuming. Among these procedures, communication between patients and dentists at every scheduled appointment plays a key role, especially for patients who have received expensive dental prosthesis. Dentists require to follow up these patients regularly and sometimes call them earlier for observation, to prevent the occurrence of any unresolvable problems later; more time may also be saved if the patients receiving high-priced dental prosthesis do not face any problems. Many dentists would overbook appointments frequently to prevent idle dental chair capacity. However, this method was not very effective, and an appropriate organizational system was required to be designed for a quick diagnosis of patients' oral condition to increase dental chair-time utilization.³ Besides, with an unhealthy tendency of dentist-patient relationship in Taiwan an easy comfortable communication platform for the autonomy claimed by patients and informed consent provided by dentists could be developed to soothe these ethical and legal issues.⁴ Telemedicine, including mobile technology and cloud services, is of interest because it provides an excellent system for communication between patients and dentists and referral from primary care sites to hospitals.⁵ However, few publications have reported experiences in dental care with telemedicine, and most reports described the use of telemedicine as broadcast directly or synchronously.⁶⁻⁸ A few reports described the telemedicine system as an optimal tool for diagnosis, consultation, and referral.⁹⁻¹² Therefore, our group used the techniques of mobile technology combined with the cloud computing service to create a new app for making an efficient, qualified, and valuable dental care system. This new app has been discussed in detail in the Methods section. It helps avoid unnecessary travel for patients, makes dental chair-time utilization more efficient, and reduces the failure rate of dental prosthesis by providing appropriate treatment in time. The purposes of this research are to improve traditional dental care services

through an interdisciplinary collaboration and to enhance the application of mobile technology combined with cloud service in the field of dental care.

Methods

Motivating scenario

Dental Calendar is a new mobile app specifically designed for dentists and patients. Patients can install it on their smartphones or mobile devices when making appointments with dentists at clinics. One week before every scheduled appointment, Dental Calendar would automatically remind patients and confirm whether they would be able to visit the dental clinic or not. Patients can take photos of their oral cavity using smart phones (selfie), and through cloud services send them to dentists and confirm whether they would arrive at the clinic on time. If patients are unable to attend their scheduled appointments, dentists can arrange another appointment through cloud services, thus saving time. If patients still cannot come at the new time, then dentists can contact them directly over the phone. A flowchart of the system is shown in Fig. 1.

Architecture overview of the system

Dental Calendar comprises three main elements: a phone app, a Java server, and a web server (Fig. 2).

Phone app

Patients can install this new app, Dental Calendar, on their smart phones easily. Dental Calendar has the following five functions (Fig. 3): (1) Individual calendar. After dental treatment, a patient makes the next appointment with the dentist at the clinic. The scheduled days on the patient's calendars would be circled by a red tooth (Fig. 3A and B). (2) Schedule reminder. One week before every scheduled appointment, Dental Calendar would remind patients automatically and confirm whether they can come to the dental clinics or not (Fig. 3C and D). (3) Symptom report. In addition to conveying patients' answers regarding visiting the dental clinics, the app would request patients to take dental pictures and write messages about their oral conditions. All this information would be sent to dentists through cloud services (Fig. 3E). (4) New appointment notification. If patients have difficulty in attending the original appointments, dentists can make new appointments and Dental Calendar would notify patients automatically (Fig. 3F and G). (5) Private messages. After examining the reported symptoms, dentists can give some instructions regarding oral hygiene care or arrange earlier appointments for patients, and patients can read these messages from the designated column (Fig. 3H).

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