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## Correspondence

# Tele-monitoring during dental treatment for homebound patients using a smartphone and a small vital sign measuring device



Japan is an aging society, and many dental patients have systemic diseases. The Ministry of Health, Labour and Welfare has advocated the importance of home-visit dental treatment to maintain the oral function of elderly homebound patients.<sup>1</sup> It is desirable that a dental anesthesiologist (DA) accompanies the dentist for home-visit treatment in case of systemic deterioration, but at present there is no such system. We developed a tele-monitoring system with a small vital sign measuring device (Checkme Pro B, Sanei Medisys Co. Ltd, Kyoto, Japan) for use in dental clinics.<sup>2</sup> However, a wi-fi environment and multiple cameras are necessary to monitor the patients, and installation is expensive and time-consuming. We have now successfully used a smartphone and the Checkme to monitor three patients undergoing home-visit dental treatment with a remote DA.

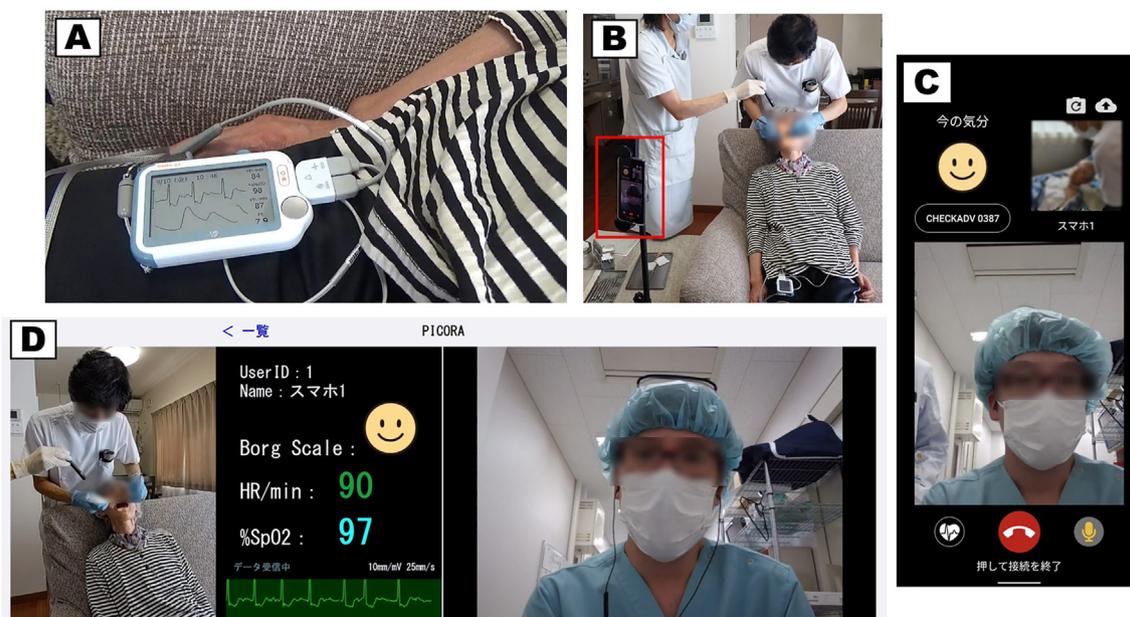
Written consent was obtained from all patients. Patient 1 (male, aged 73 years) had cerebral infarction, hypertension, and diabetes. Patient 2 (female, aged 71 years) had hypertension, atrial fibrillation, cerebral infarction, and had a mitral valve replacement, and patient 3 (female, aged 89 years) had hypertension and dementia. The on-site dentist provided patient 1 with swallowing training, patient 2 with scaling, and patient 3 with oral care. All patients were equipped with a Checkme to measure heart rate, electrocardiogram, and arterial oxygen saturation (Fig. 1A). A smartphone (Google Pixel 4a [5G], Google, Mountain View, CA, USA) was fixed to a tripod and placed near the

patients (Fig. 1B and C). A multi-vital monitor telemedicine application (PICORA, Sanei Medisys Co. Ltd) was initiated from the smartphone and connected to the Checkme. Patients' data were uploaded to the cloud via PICORA and monitored by the remote DA (Fig. 1D). Patient 2 had atrial fibrillation with an occasional heart rate increase up to 120 bpm. The patient was confirmed to have no symptoms of heart failure via a video call, and the DA could decide whether to continue the treatment. After the treatment, the on-site dentist reported that these devices were highly portable and easy to set up. The DA commented that the video was sometimes delayed with a high volume of data, but real-time monitoring was generally possible.

This system not only enabled remote monitoring of vital signs, but also helped determine via video calls whether to continue treatment for a patient with tachyarrhythmia. The FDI recommends a small, portable, battery-powered device for monitoring vital signs during dental treatment.<sup>3</sup> Both the Checkme and the smartphone are small and battery-powered, and meet the FDI recommended standards. No wi-fi environment is required because the data are uploaded through the mobile phone network. The communication path is encrypted (corresponding to SSL/TLS1.2) and secure. The Checkme costs approximately USD450, making it possible to introduce tele-monitoring at a lower cost. However, because blood pressure cannot be measured with a Checkme, a sphygmomanometer is also required.

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**Figure 1** (A) The small vital sign measuring device used in the study (Checkme Pro B, Sanei Medisys Co. Ltd, Kyoto, Japan). (B) Treatment for a homebound patient. The red frame indicates the location of the smartphone (Google Pixel 4a [5G], Google, Mountain View, CA, USA). (C) Smartphone screen during tele-monitoring. (D) Screen monitored by the dental anesthiologist.

Tele-monitoring by a DA using a smartphone and a Checkme is inexpensive, highly portable, and easy to prepare; therefore, it is an excellent system to improve safety in dental treatment for homebound patients.

### Declaration of competing interest

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

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