Monitoring Progress and Adherence with Positive Airway Pressure Therapy for Obstructive Sleep Apnea
The Roles of Telemedicine and Mobile Health Applications

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KEYWORDS

- CPAP adherence • CPAP follow-up • Telemedicine • Self-management • Patient engagement
- Mobile health applications • Wearable sensors • Electronic health records

KEY POINTS

- Telemedicine and its integration into the overall health technology ecosystem is a critical component of the evolving solution for obstructive sleep apnea management and continuous positive airway pressure (CPAP) adherence.
- Current strategies that can be practically implemented include the use of Web-education, adoption of automated and self-management CPAP follow-up platforms, and providing patients information regarding online support groups.
- The future holds unlimited possibilities, from the expansion of mobile health applications and wearable sensors to electronic health record integration that can streamline end-to-end comprehensive care and provide advanced analytics to enhance disease management and facilitate population health management.

INTRODUCTION

The world is changing. Technology is now integral to most aspects of the day-to-day lives for people in the United States, and this is true also of health care. In 2015, the *Wall Street Journal* published an article titled, "The Future of Medicine is in Your Smartphone."[1] Although this title is largely projecting into tomorrow, it is evident that the responsibilities of health care providers and the way that patients approach their health are already substantially evolving. From the widespread adoption of electronic health records (EHRs), to the ubiquitous nature of smartphone and health applications, to the increasing proliferation of wearable devices, it is clear that medicine must figure how to embrace technology and use it to the benefit of medical providers, the global health system, and ultimately for patients.

It is well documented that a major challenge for sleep specialists is optimizing adherence of patients with obstructive sleep apnea (OSA) to continuous positive airway pressure (CPAP) therapy. Literature generally reports that only half of patients remain adherent to CPAP 3 months after initiating therapy.[2] Efforts to improve adherence through advances in CPAP technology have not proven fruitful, whereas psychosocial interventions are often labor intensive and modest in effect. Given the impact of OSA on a person's overall well-being and on the public health system, it is imperative to successfully answer the following question: How can technology be a solution to the problem of CPAP adherence? The goal of this article is to explore sleep medicine's approach toward addressing this issue. The author provides a general overview of health-related technologies while clarifying the scope of telemedicine, discusses current and emerging sleep medicine telemedicine platforms, and understands the evolution of the health information technology (health IT) ecosystem and its anticipated impact on sleep medicine.

OVERVIEW OF TELEMEDICINE
Definitions

Telemedicine is key to improving our ability to care for patients with OSA. However, there is confusion regarding the meaning of telemedicine, and clarifying its definition and purview is necessary to create a framework for the overall discussion within this article. There are 2 basic types of telemedicine, synchronous and asynchronous. *Synchronous* refers to mechanisms in which medical care is delivered in real-time, and this includes video visits, which are often incorrectly used synonymously with telemedicine. Video visits may be useful for sleep medicine for several reasons:

1. Limits travel time for frequently sleepy patients
2. Expands the geographic area, particularly remote areas, in which a sleep specialist can provide care
3. Enhances CPAP education and troubleshooting over a simple telephone call because of the ability to visually assess and demonstrate mask fit and equipment use

In the author's sleep center, the use of video visits has expanded from sleep physicians to respiratory therapists (to provide CPAP troubleshooting); both patient and provider experience has been overwhelmingly positive. The American Academy of Sleep Medicine has recognized the value of expanding video visits within this field. It convened a task force that published a position

paper aimed at assisting sleep specialists in incorporating video visit capabilities into their practice: "American Academy of Sleep Medicine (AASM) Position Paper for the Use of Telemedicine for the Diagnosis and Treatment of Sleep Disorders".[3]

The limitation of synchronous telemedicine, however, is that it still requires face-to-face provider time. The American Telemedicine Association states that the 3 primary goals of telemedicine are to (1) improve access to care, (2) improve quality of care, and (3) improve efficiency or cost-effectiveness of care.[4] Although video visits can improve access and quality of care, its impact on care efficiency is modest at best. Rather, in order to do so, it requires the adoption of elements that largely fall under the purview of *asynchronous* telemedicine.

Asynchronous Telemedicine
Overview

Asynchronous telemedicine, also called store-and-forward, indicates that the encounter between patients and provider does not occur in real-time. Examples of this include the following:

- Electronic messaging: the use of e-mail and text messaging to communicate with patients or deliver medical information
- Remote monitoring: (1) accessing stored patient data from a medical test and reviewing at a later time from a remote location (eg, sleep physicians accessing polysomnography [PSG] data for interpretation) and (2) accessing patient-collected data from end-user devices, including wireless access of data from patients' home medical devices (eg, Glucometers, sphygmomanometer, CPAP devices) or data from personal mobile devices (eg, smartphones, tablets) that often have installed health applications or are linked to a wearable sensor
- Automated care mechanisms and self-management platforms: (1) platforms that automate patient feedback based on therapy adherence and (2) smartphone applications (often with wearable sensors) that can provide a continuous system of accountability

These elements are *key principles* that underpin the ability of asynchronous mechanisms to improve the efficiency of care delivery and are evident in the eventual discussion on sleep telemedicine platforms relevant to OSA management. For now, each of these principles is further explored.

Electronic messaging

Virtually all patients have access to e-mail and text messaging. In a research study performed in the