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Research Paper

Human factors/usability barriers to home medical devices among individuals with disabling conditions: In-depth interviews with positive airway pressure device users

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Abstract

Background: Evidence suggests that medical equipment often fails to accommodate the needs of individuals with disabling conditions. Few studies have focused on the accessibility of home medical devices such as positive airway pressure (PAP), which is a type of home medical equipment prescribed for long-term therapy.

Objective: The purpose of this study was to explore in detail the types of difficulties experienced by patients with physical/sensory impairments who use PAP devices, as an initial step in designing a questionnaire to survey users about this topic.

Methods: In this descriptive study, in-depth interviews were conducted with 19 participants (9 patients with physical/sensory impairment and 10 health care providers). Interviews were coded and analyzed for major topics.

Results: Participants detailed the numerous ways in which current PAP devices fail to meet the needs of individuals with physical/sensory impairments (e.g., tremor, poor depth perception, paresis), by requiring patients to perform manually difficult tasks, such as inserting PAP parts through small apertures, attaching parts using a twisting motion, and lifting arms overhead to apply PAP headgear. These demands contributed to patients' frustration with and reduced usage of the home medical device.

Conclusions: Our findings suggest that home medical devices such as PAP may not be currently designed to meet the needs of some users with physical/sensory impairments. Additional studies are needed to measure the prevalence and impact of impairment-related barriers on PAP adherence for this common medical equipment. Published by Elsevier Inc.

Keywords: Sleep apnea syndromes; Continuous positive airway pressure; Disabled persons; Equipment design

Approximately 16% of adults in the United States have difficulty with physical functioning, and 15% of the world's population has a disability.[1,2] An increasing number of individuals with health conditions and disabilities are expected to use home medical devices, which are a type of medical equipment, to monitor and treat their chronic health conditions.[3] Yet studies of medical equipment users with disabilities have found that the equipment may be difficult to use or even hazardous for some patients.[4–6]

Obstructive sleep apnea (OSA), which is prevalent among adults with disabilities (e.g., chronic spinal cord injury, stroke),[7,8] is the prototypical health condition treated with a home medical device—namely, positive airway pressure (PAP). PAP devices keep the airway open, thereby ensuring adequate airflow and blood oxygen levels and reducing cardiovascular morbidity and mortality.[9] These devices are comprised of a machine, tubing, mask, and straps. They require individuals to engage in nightly set up and maintenance tasks, which involve gross and fine motor movements and sensory input. Optimizing PAP design has the potential to increase access to PAP therapy, improve adherence to this lifesaving medical therapy, and minimize disability.

Human factors directly affect individuals' interactions with their home medical devices[10,11] and are a target for

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optimizing home medical devices. The Food and Drug Administration has issued documents to help manufacturers apply human factors engineering to improve the safety and effectiveness of home medical devices.[10] The Association for the Advancement of Medical Instrumentation (AAMI) recommends addressing human factors when designing equipment, to help users with a range of abilities.[11] For example, tactile cues on equipment controls can make the equipment easier to operate for users with impaired vision.

Few studies have examined barriers related to human factors among PAP users with physical/sensory impairments.[12–16] No studies have examined in detail the extent to which the design of current PAP devices (i.e., human factors) meets the needs of patients with physical or sensory impairments. One reason for the scarcity of data on this topic is an absence of self-administered questionnaires for measuring human factors associated with PAP devices among populations at risk for physical/sensory impairment.

In this study, we conducted in-depth interviews to identify ways in which the design of home medical devices for OSA treatment supports or impedes use among individuals with physical and/or sensory impairment. As a recommended initial step in questionnaire development,[17] in-depth interviews were designed to gather information that would inform development of questionnaire items about human factors associated with PAP devices.

Materials and methods

Setting, recruitment, and sample selection

The setting was one United States Department of Veterans Affairs (VA) Healthcare System, which includes an accredited sleep center. The center issues PAP machines from one major manufacturer and PAP parts (e.g., masks) from a variety of manufacturers.

We recruited both patients and health care providers. We felt that patients could provide rich descriptions of the types of impairments that impact PAP use and the amount of support from the health care system and their family. We felt that providers could offer a broad perspective on the types of individuals who have experienced discordant person–device interactions and would have in-depth knowledge of the health care environment (i.e., features of PAP equipment and health care systems that enable patients to use their equipment).

We posted recruitment flyers in clinics and offices and sent email invitations to providers listed in our center's online directory. Individuals who were interested in participating contacted our research office. Staff informed prospective participants about the study, including plans to digitally record each interview, and screened individuals for eligibility. Patients aged ⩾50 years who were current or past users of PAP equipment for OSA and reported difficulty using PAP equipment related to sensory or physical impairments were considered eligible. We focused on older adults because of the increased prevalence of disability associated with advanced age. We excluded patients with a self-reported diagnosis of dementia or Alzheimer's disease, because interview data from these patients may not be valid or reliable. Providers who self-identified as clinical staff (e.g., physician, nurse, respiratory therapist, physical therapist, occupational therapist) of the pulmonary, sleep medicine, geriatrics, or physical medicine and rehabilitation divisions at our local VA were eligible. All participants were compensated with a $50 gift card (VA employees conducted the interviews outside their tours-of-duty).

Conducting the interviews

Different interview guides were used for patients and for providers. Both guides were framed by the theoretical construct of the Enabling-Disabling Model, which describes disability as the product of an interaction between an individual and his/her environment, rather than a characteristic inherent to an individual with impairments.[18] All interviews were completed between October 2012 and May 2013. One field staff moderated each session while another recorded notes and asked follow up questions.

To focus our patient interviews on previously unidentified barriers to PAP therapy, we began each patient interview by displaying a list of 24 problems commonly known to contribute to difficulty using PAP equipment (see Appendix).[16,19] Patients were asked to identify which problems caused "trouble using [their] sleep apnea equipment" and then were asked about barriers that were not listed. Focusing on these newly identified barriers, respondents described in detail their experiences using their PAP equipment (see Table 1). We delved into these difficulties by asking additional open-ended questions and probes to encourage patients to describe their health, their impairment(s), their functional limitation(s), their environment including PAP design/features, family support, and health care provider support, and any discordant interactions between themselves and their current treatment environment. We also asked about supportive factors that could reduce this discordance, such as therapies directed at the physical/sensory impairment and improvements in PAP design/features. We asked each patient to identify his/her race/ethnicity and living arrangement (e.g., lives alone).

Our open-ended interview queries with providers encouraged providers to describe their experience treating patients with physical/sensory impairment and impressions about how the availability of caregiver/family involvement enables or impedes patients' use of their PAP equipment. When providers identified human factors, we probed for ways PAP equipment may be difficult for patients with specific types of physical/sensory impairments. We also asked providers to describe ways that their patients or colleagues have recommended to diminish discordance, such as improvements in PAP design/features. We asked providers to identify their clinical divisions/departments.