Can CUIs improve circadian rhythm disorders among the elderly?

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Abstract
From combating loneliness among the elderly to rendering healthcare workers more productive, CUIs have shown immense promise with regard to improvement in healthcare. But there is an overlooked aspect of health, *sleep*, and specifically how commonly ignored sleep disorders among the elderly can be treated. This provocation paper probes the capabilities of CUIs to aid healthcare workers in the treatment of body clock/circadian rhythm disorders among the aging population, a user group with a significantly different sense of temporality from the youth. Administering medication for these users on a regular basis is crucial and impunctuality can be fatal. Therefore, ensuring they attain quality sleep is also significantly integral to their well-being.

Author Keywords
elderly care, conversational user interfaces, circadian rhythm, sleeping disorders

CCS Concepts
•Human-centered computing → Human computer interaction (HCI); Human computer interaction (HCI);

Problem space
Circadian rhythm
This paper explores existing research and work involving CUIs in healthcare to mitigate the adverse effects of sleep

disorders among the elderly [22]. Often sleep disorders are over-simplified to one specific health issue, insomnia [7]. Insomnia is the inability to attain ample quality sleep extremely frequently [20]. Besides that, there is another overlooked sleep disorder, circadian rhythm disorder [8]. Normally humans have a regulated body clock that allows them to maintain a healthy sleep schedule helping them attain sleep at reasonable times [20]. People with circadian rhythm disorders often struggle to achieve a healthy sleep schedule [8]. On some patients, melatonin seems to be safe drug that works to remedy this when administered as prescribed [8]. Unfortunately, on many, it might not have the desired effect [8]. Many elderly suffer from circadian rhythm disorders [21, 7, 1] making this challenge more complicated by introducing 2 sets of users: healthcare workers [20] and older adults.

CUIs for Managing Circadian Rhythm Disorders among the Elderly with SRT

One of the most effective treatments for this that do not have adverse side effects [10] unlike sleeping pills is Sleep Restriction Therapy (SRT) [9]. CUIs are being used to monitor sleep patterns and recommend sleep behaviors [18, 3, 15]. Such monitoring and recommendation are essential aspects of SRT [9]. This suggests certain CUIs could improve the process of administering SRT for healthcare workers and the experience of undergoing SRT for older adults. SRT involves tracking patients' total time spent in bed and time spent sleeping. Those variables are used to calculate sleep efficiency and adjust bedtimes accordingly to alter the time spent in bed. CUIs might turn these tasks into conversational intents [14] instead of patients and/or healthcare workers having to record them on spreadsheets daily. Unfortunately, literature on the use of CUIs for treating circadian rhythm disorders is limited compared to CUIs used for sleep issues in general.

Difficulties of Implementing SRT

Implementing SRT is a tedious process [9]. It involves documenting people's sleep hygiene and tracking bedtimes and the time they wake up over several weeks. While it might have a long-lasting impact compared to other means, the logistics of this make it a tedious process. Moreover, it involves performing calculations to make adjustments to variables such as bedtimes and wake-up times. The most commonly used version of SRT also does not take temperature into account despite it being a major factor that influences sleep [16]. CUIs have the potential to offer a screenless modality for basic interactions while also automating logistics such as data inputs for key variables. The only issue might be with regards to dialog management if various implicit cues are present [13]. Conversations might become monotonous if the CUIs fail to conduct them naturally instead of treating them like question-and-answer pairs. Moreover, while being arguably the most effective treatment, employing sleep deprivation can be effortful [9]. It is a demanding task requiring the utmost discipline from the patients. This means diligently waking up at the same time every day without snoozing and not taking naps. The side effects of this might not be as painful and harmful as administering manufactured drugs such as 'sleeping pills' but is extremely difficult to endure regardless.

Suggestions for CUIs for Sleep Restriction Therapy Among the Elderly

CUIs meant to be used by senior citizens need to be designed differently from the public. A significant number of designs fail to be inclusive in modern times [17]. This suggests the existence of various unhappy paths user experience-wise. One major concern might be exhibiting condescending tones during conversations [6]. Often the elderly speak slowly [6]. The challenge the CUI might have to overcome would be to speak at a pace that would not be

inferred as condescending. It also needs to be understandable. Another obstacle might be dialog management. While conversation analysis might be quite insightful with regards to that [13], the scenario is perhaps unprecedented in the case of senior care. Spontaneous pain points might arise as senior citizens undergo sleep restriction therapy. This suggests the CUI needs to be versatile to ensure total compliance to paramount procedures. Therefore, the CUI needs to be ready to serve senior citizens by being versatile and not patronizing.

Related work

CUIs are gradually becoming significantly useful in the healthcare sector [12, 14]. From mental health to treatment adherence, they are becoming ubiquitous. They have reached milestones such as being useful for training medical students and staff. In terms of elderly care, one of the major use cases is alleviating loneliness and attaining medical advice, which suggests that CUIs could also help with SRT.

Alleviating Loneliness

Many older adults needing care often have to endure several days weekly without speaking with anyone [11]. Moreover, the time of overworked healthcare staff might be strictly rationed [20]. This suggests they have limited time to socialize with their customers, the lonely older adults. Humans are social creatures [20]. Prolonged periods of loneliness have been compared to smoking excessively by Winch [24]. Therefore, instances such as this can be very detrimental to the well-being of senior citizens. Besides that, they are vulnerable to such issues because most communication technologies are catered to the youth [17]. They find modern devices such as smartphones difficult to use. Fortunately, voice-user interfaces seem to be more accessible for the elderly [19]. CUIs may help to alleviate loneliness by offering senior citizens opportunities to talk to them, which also presents opportunities for implementing practical routines and recommendations that SRT requires.

Healthcare CUIs

ELIZA emerged as arguably the first CUI in healthcare to provide psychotherapy back in the 1960s [12, 23]. People found it rather engaging to type text to an application that often sent rhetorical replies to keep the conversation flowing [4] despite its text-based interface [2]. Now in 2023, the world is experimenting with ChatGPT [5]. Beyond its ability to amuse users, it can also direct people to medical resources when requested. Its growing popularity caused by its surprisingly robust capabilities is making it more desirable. The situation presents CUIs with opportunities to tackle significantly difficult challenges in healthcare, but more research is needed to make them effective.

For one, interoperability across platforms and devices is important to consider for CUIs in healthcare. CUIs in recent years interfaced with other devices in supporting people's well-being [**?**]. Moore et al. (2019) [13] suggest that the process for achieving ubiquity across all platforms is not seamless yet because each platform has its nuances. Platform-wise CUIs are widely available on smartphones [14], but healthcare workers may need access to diverse devices and platforms, e.g., smartwatches, phones, and patient management systems, to deliver SRT.

In sum, CUIs have been frequently used for more than a decade [14] to supplement customer care services via telephones resulting in reduced wait times. Moreover, telehealth services have shown potential [19, 2]. This suggests that older adults might benefit from using such means to attain accurate health advice on demand without having to wait for busy health professionals. It is indicated that senior citizens felt more comfortable talking to a conversation

agent [19]. This allowed them to communicate their health issues and concerns without needing the healthcare staff, which can benefit implementing SRT in everyday life for the elderly.

The Future of CUIs for Managing Sleep Disorders for the Elderly

Several precursors exist in this space for treating circadian rhythm disorders, e.g. CUIs for senior care [11] and conversation agents for sleep management. Potentially, CUIs can be useful for managing circadian rhythm disorders among the elderly. The edges-cases and the complexity of implementing SRT for circadian rhythm disorders need to be looked into, as well as studies regarding the user experience expected by senior citizens while using CUIs. Using NCF [13] CUIs might make the task of tracking various sleep variables a matter of speaking to older adults with circadian rhythm disorders. There is immense potential for CUIs to not only reduce the complexities of healthcare for the elderly suffering from circadian rhythm disorders but also ensure proactive treatment of it to make it easier to manage.

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