Sleep disorders, a critical issue in global health, affect millions worldwide. Disorders ranging from insomnia to sleep apnea profoundly impact individual well-being and societal productivity [1]. While traditional diagnostic and therapeutic methods like polysomnography and cognitive-behavioral therapy for insomnia are effective, they are also labor-intensive, less patient-centered, and expensive. The emergence of digital phenotyping, using data from personal digital devices such as smartphones and wearables, heralds a promising new direction in sleep medicine [2].

Digital phenotyping offers several advantages over traditional methods. It allows continuous, active, and passive data collection in a patient’s natural environment, capturing a nuanced and comprehensive image of daily sleep patterns. These insights illuminate the interplay between sleep, lifestyle, behavior, health, and overall well-being [2]. Digital phenotyping is also cost-effective, negating the need for expensive equipment or hospitalization, facilitating early identification of high-risk individuals for testing, and reducing unnecessary healthcare expenditure.

Recent studies have validated the use of digital phenotyping in sleep medicine, revealing that sleep patterns derived from smartphones or wearable devices closely correlate with actigraphy, a non-invasive method for monitoring rest/activity cycles [3,4]. Techniques introduced to measure aspects such as sleep stages and sleep apnea events using only smartphone data demonstrate that digital phenotyping may facilitate screening for sleep disorders [5]. Additionally, conditions like mood disorders, closely linked to sleep-wake rhythms, can be assessed or predicted based on digital phenotypes [6].

Digital phenotyping also plays a vital role in treating sleep problems [7]. It can provide clinicians with real-time feedback on intervention effectiveness, enabling personalized and dynamic strategies. For instance, it might be instrumental in monitoring treatment response to cognitive-behavioral therapy for insomnia. The integration of digital phenotyping into digital therapies could lead to genuinely real-time, personalized digital treatments. Furthermore, digital phenotyping can empower individuals to proactively manage their sleep disorders [8]. Leading electronics companies are already developing technologies and services that can measure and provide feedback on sleep, empowering consumers to make healthy sleep-related behavioral changes.

However, integrating digital phenotyping into sleep medicine presents challenges, including data privacy, security concerns, and the need for standardized data collection and analysis methods. Addressing these issues is crucial to unlocking digital phenotyping’s full potential.

The future of digital phenotyping in sleep medicine is indeed promising, with practical implementations underway. Advances in artificial intelligence could lead to classification and prediction models for sleep disorders based on digital phenotypes [9]. The development of wearable technology will enable more comprehensive data collection, allowing exploration into new dimensions of sleep health, such as its impact on cognitive performance or emotional well-being. Digital phenotyping’s integration into the broader digital health ecosystem can provide a holistic view of a patient’s health, laying the groundwork for a more patient-centered approach.

Despite its tremendous potential, realizing the full promise of digital phenotyping requires overcoming challenges related to data privacy, standardization, and the development of robust and scalable algorithms. Establishing ethical guidelines, promoting digital phenotype literacy, and fostering interdisciplinary collaboration will be essential [10]. We hope that digital phenotyping
will be seamlessly integrated into the healthcare system in the future, revolutionizing our understanding and treatment of sleep disorders and placing patients at the center of their care.

In summary, digital phenotyping in sleep medicine holds significant promise. As we continue to explore this exciting field, we anticipate a future where sleep health is understood not only in the clinical setting but also within the context of our digital lives.

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Conflicts of Interest
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