

Henry Ford Health

## Henry Ford Health Scholarly Commons

---

Sleep Medicine Articles

Sleep Medicine

---

8-25-2022

### Active Duty Service Members, Primary Managers, and Administrators' Perspectives on a Novel Sleep Telehealth Management Platform in the U.S. Military Healthcare System

Emerson M. Wickwire

Moaz Abdelwadoud

Jacob Collen

Hillary Edwards

Christian Labra

*See next page for additional authors*

Follow this and additional works at: [https://scholarlycommons.henryford.com/sleepmedicine\\_articles](https://scholarlycommons.henryford.com/sleepmedicine_articles)

---

#### Recommended Citation

Wickwire EM, Abdelwadoud M, Collen J, Edwards H, Labra C, Capaldi VF, Williams SG, Manber R, Assefa SZ, Drake CL, Albrecht JS, Bevan J, Mahoney A, Tatum ED, Pierre E, Mantua J, Grandner MA, and Mullins CD. Active Duty Service Members, Primary Managers, and Administrators' Perspectives on a Novel Sleep Telehealth Management Platform in the U.S. Military Healthcare System. Mil Med 2022; 187(9-10):e1201-e1208.

This Article is brought to you for free and open access by the Sleep Medicine at Henry Ford Health Scholarly Commons. It has been accepted for inclusion in Sleep Medicine Articles by an authorized administrator of Henry Ford Health Scholarly Commons.

---

## Authors

Emerson M. Wickwire, Moaz Abdelwadoud, Jacob Collen, Hillary Edwards, Christian Labra, Vincent F. Capaldi, Scott G. Williams, Rachel Manber, Samson Z. Assefa, Christopher L. Drake, Jennifer S. Albrecht, Jeffrey Bevan, Alexandra Mahoney, Eileen D. Tatum, Elysse Pierre, Janna Mantua, Michael A. Grandner, and C. Daniel Mullins

# Active Duty Service Members, Primary Managers, and Administrators' Perspectives on a Novel Sleep Telehealth Management Platform in the U.S. Military Healthcare System

Emerson M. Wickwire, PhD<sup>\*</sup>,†; Moaz Abdelwadoud, MD, DrPH, MPH<sup>‡</sup>;  
COL Jacob Collen, MD, FACP, FCCP, FAASM<sup>§,||</sup>; Hillary Edwards, MPH<sup>‡</sup>; LTC Christian Labra, MD<sup>¶</sup>;  
LTC Vincent F. Capaldi, II, ScM, MD, FAPA, FACP<sup>\*\*</sup>; LTC Scott G. Williams, MD<sup>\*\*</sup>;  
Rachel Manber, PhD<sup>††</sup>; Samson Z. Assefa, MD<sup>‡‡</sup>; Christopher L. Drake, PhD<sup>§§</sup>;  
Jennifer S. Albrecht, PhD<sup>|||</sup>; CPT Jeffrey Bevan, MD<sup>¶</sup>; CPT Alexandra Mahoney, DO<sup>¶</sup>;  
LT Eileen D. Tatum, MD<sup>¶</sup>; Elysse Pierre, MD<sup>¶</sup>; Janna Mantua, PhD<sup>\*\*</sup>;  
Michael A. Grandner, PhD, MTR<sup>¶¶</sup>; C. Daniel Mullins, PhD<sup>id</sup> <sup>‡</sup>

## ABSTRACT

### Introduction:

Sleep disorders are common in the military, and there is a gross shortage of sleep specialists in the military health system. The purposes of the present study were to (1) understand perceptions and expectations surrounding sleep telehealth approaches and (2) solicit feedback to optimize and refine a proposed novel sleep telehealth management platform. To accomplish these objectives, we investigated the perceptions, expectations, and preferences of active duty service members (ADSMs) with sleep disorders, primary care managers (PCMs), and administrative stakeholders regarding sleep telehealth management.

### Materials and Methods:

Using convenience sampling, we conducted five focus groups with 26 ADSMs and 11 individual interviews with PCMs from two military treatment facilities in the U.S National Capital Region and 11 individual interviews with administrative sleep stakeholders (9 military and 2 civilian).

### Results:

Active duty service members, PCMs, and administrative stakeholders provided insight regarding expectations for sleep telehealth as well as suggestions to optimize the novel sleep telehealth platform. In terms of outcomes, ADSMs expected sleep telehealth to improve sleep and convenience. Primary care managers expected improved sleep and other comorbidities, enhanced operational readiness, and reduced mortalities among their patients. Administrators expected increased access to care, optimized utilization of health services, realized cost savings, reduced accidents and errors, and improved military performance. In terms of the platform, for ADSMs, desired characteristics included delivery of timely clinical reports, improved patient-provider communication, and enhanced continuity of care. For PCMs and administrators, an

<sup>\*</sup>Sleep Disorders Center, Division of Pulmonary and Critical Care Medicine, Department of Medicine, University of Maryland School of Medicine, Baltimore, MD 21201, USA

<sup>†</sup>Department of Psychiatry, University of Maryland School of Medicine, Baltimore, MD 21201, USA

<sup>‡</sup>Department of Pharmaceutical Health Services Research, University of Maryland School of Pharmacy, Baltimore, MD 21201, USA

<sup>§</sup>Department of Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD 20814, USA

<sup>||</sup>Walter Reed National Military Medical Center, Sleep Disorders Center, Silver Spring, MD 20814, USA

<sup>¶</sup>Department of Family Medicine, Fort Belvoir Community Hospital, Ft Belvoir, VA 22060, USA

<sup>\*\*</sup>Center For Military Psychiatry and Neuroscience, Walter Reed Army Institute of Research, Silver Spring, MD 20910, USA

<sup>††</sup>Department of Psychiatry and Behavioral Sciences, School of Medicine, Stanford University, Palo Alto, CA 94305, USA

<sup>‡‡</sup>Sleep Medicine Clinic, Fort Belvoir Community Hospital, Ft Belvoir, VA 22060, USA

<sup>§§</sup>Sleep Research Center, Henry Ford Hospital, Detroit, MI 48377, USA

<sup>|||</sup>Department of Epidemiology and Public Health, University of Maryland School of Medicine, Baltimore, MD 21201, USA

<sup>¶¶</sup>Department of Psychiatry, University of Arizona College of Medicine, Tucson, AZ 85724, USA

Preliminary findings from this study were presented as a poster presentation under the title "Active-Duty Members' Opinions and Recommendations for a New Tele-Sleep Management Platform in the United States Military Treatment Facilities" in the Academy Health Annual Research Meeting—Digital Technologies, Data, and Analytics; July, 2020.

The material has been reviewed by the Walter Reed Army Institute of Research, Walter Reed National Military Medical Center, and Fort Belvoir Community Hospital. There is no objection to its publication. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting true views of the Department of the Army, the Defense Health Agency, or the Department of Defense.

doi:<https://doi.org/10.1093/milmed/usac006>

© The Association of Military Surgeons of the United States 2022. All rights reserved. For permissions, please e-mail: [journals.permissions@oup.com](mailto:journals.permissions@oup.com).

ideal sleep telehealth solution will improve the diagnosis and triage of sleep patients, save PCM time, be easy to use, and integrate with the electronic health record system.

# Conclusion:

The proposed sleep telehealth platform appealed to nearly all participants as a significant force multiplier to enhance sleep disorder management in the military. Stakeholders offered valuable recommendations to optimize the platform to ensure its successful real-world implementation.

## INTRODUCTION

Military work is characterized in part by an unrelenting tempo and nontraditional work schedules that result in widespread insufficient and disordered sleep among active duty service members (ADSMs).<sup>1</sup> At least 42% of ADSMs obtain only five or fewer hours of sleep per night, and only 28-32% obtain seven or more hours per night, the bare minimum sleep duration recommended for adults.<sup>2-5</sup> By contrast, over 70% of civilian adults report obtaining seven or more hours of sleep on a regular basis.<sup>6</sup> Clinical sleep disorders such as insomnia, obstructive sleep apnea (OSA), shift work disorder, nightmare disorder, and others are endemic among ADSMs.<sup>1,7,8</sup> More importantly, the extensive scientific literature demonstrates that these sleep problems are robustly associated with compromised health and military performance among ADSMs, including worsened medical and mental health, diminished quality of life, and rapid degradation of neurocognitive performance essential in combat and noncombat operational environments.<sup>2,9,10</sup>

Despite the prevalence and consequences of sleep problems in the military health system (MHS), there are well-recognized barriers that limit the effectiveness of sleep management in the military. In terms of clinical care, the most salient barrier is an insufficient number of specialist clinicians and sleep centers within the MHS, where high demand greatly exceeds available supply. For context, the prevalence of sleep disorders is rapidly increasing in the MHS. Between the years of 2005 and 2019, the prevalence of insomnia increased from 6 to 272 per 10,000 ADSMs and the prevalence of OSA increased from 11 to 333 per 10,000 ADSMs.<sup>11</sup> The increasing prevalence of these conditions has rapidly outpaced the ability for the MHS to provide evidence-based sleep specialty care. To our knowledge, in the entire MHS there are currently 17 sleep laboratories (12 Army, 3 Air Force, and 2 Navy) and 30 active duty sleep physicians (18 Army, 8 Air Force, and 4 Navy), five of whom are scheduled to retire in 2022. Even in locations where sleep specialty care is available, traditional sleep interventions are often time- and resource-intensive, frequently requiring multiple face-to-face sessions with a clinician to reach an acceptable patient outcome. To overcome these barriers, opportunities to leverage technology to increase access to care (i.e., adopt sleep telehealth approaches such as telemedicine, wearables, and internet/mobile health) have been identified, with promising initial results.

Unfortunately, despite numerous important and laudable achievements in military sleep research, clinical care, and

operational performance, prior efforts to enhance sleep management have been hindered by ineffective implementation at the military treatment facility (MTF) and MHS levels. In our experience, stagnation has resulted from a lack of engagement and alignment among diverse stakeholders including ADSM patients, primary care managers (PCMs), and health systems leaders with at-times competing interests. Active participation and “buy-in” from each of these constituency groups are needed to solve the military sleep problem.

To this end, the purpose of the present qualitative study was to gain insight into perceptions, expectations, and preferences of key stakeholders with vested interest in improving sleep-related outcomes within the MHS. Specifically, we sought to (1) understand how patients, providers, and administrative stakeholder groups perceive sleep telehealth approaches in general and (2) solicit feedback on optimal refinement and tailoring of a sleep telehealth platform. Such insights would be used to inform and guide subsequent implementation of sleep telehealth in two real-world MTFs.

## METHODS

Our research methods (participants, conduct of focus groups [FGs] and semi-structured interviews [SSIs], and approaches to data analysis) have been described previously in this journal.<sup>12</sup> Briefly, we conducted five in-person FGs with 26 ADSMs from Walter Reed National Military Medical Center (WRNMMC) and Fort Belvoir Community Hospital (FBCH) as well as 22 SSIs including 11 PCMs from WRNMMC and FBCH as well as 11 administrative stakeholders. This study received exempt approval from the WRNMMC IRB (WRNMMC-2019-0253, 917038) and the FBCH Department of Research Programs.

Whereas our prior report<sup>12</sup> presented results of the topics covered in the first half of FGs and SSIs, which focused on the general aspects of sleep management in the military, the current article presents the results of the second group of topics, which focused specifically on sleep telehealth. FGs and SSIs had two goals: (1) to discuss sleep telehealth in general and (2) to provide specific recommendations for a novel sleep telehealth platform. First, participants were provided a description of sleep telehealth (Table I) and asked to provide their general perceptions, preferences, and expectations for sleep telehealth approaches. Next, participants were provided a visual sleep telehealth schematic (Fig. 1) as well as screenshots for a novel sleep telehealth platform (WellTap) and to provide suggestions for improving it. The purposes of this platform are to (1) help PCMs assess sleep complaints,

**TABLE I.** Scripts to Describe Proposed Sleep Telehealth Workflow to Service Members, Primary Care Managers, and Economic Stakeholders

Focus Group Part 1. General sleep telehealth

Let us consider a scenario in which new sleep patients are referred into the new tele-sleep platform as first step in sleep disorder management. This platform will include a mobile app and wearable sensor, such as a Fitbit, to help assess and treat sleep disorders and to connect patients with sleep specialists as needed.

Focus Group Part 2. WellTap platform

1. After a primary care manager (PCM) refers a patient into the platform, the system monitors and assesses objective and subjective sleep patterns as well as daytime symptoms via a mobile interface and wearable sensor.
2. This wearable and patient-reported monitoring and assessment data are entered into a secure cloud for processing. Within 10 days, a detailed assessment report including provisional diagnoses and treatment recommendations is produced for patients and their PCMs. All provisional diagnosis and treatment recommendations are reviewed by healthcare providers.
3. On the back end, patients will be classified as low risk (indicating that their problem can likely be managed via the app alone), medium risk (indicating that they will need sleep navigator support), or high risk (indicating that they will require a referral to a sleep specialist).
4. Based on the assessment results, patients will be triaged to personalized treatments that include online modules for insufficient sleep, cognitive-behavioral treatment for insomnia, shift work, nightmares, and so on. All modules including referrals to sleep specialty care (and sleep studies) begin with an in-app behavioral sleep training or "healthy sleep habits."
5. The app will also provide a connection to a trained and supervised virtual sleep navigator who will be available for chat, video conferencing, and additional user needs. When needed, patients will be referred to the brick-and-mortar sleep disorder center for specialty referrals, particularly for those classified with a high-risk assessment.
6. In the future, we will use the same platform analytics approach to ensure a well-rested and alert fighting force in the operational environment.

(2) empower patients and PCMs to make evidence-based sleep treatment decisions, (3) deliver evidence-based behavioral sleep treatments via mobile devices, and (4) connect patients with sleep specialists in virtual or physical sleep centers. During this second portion of the FGs, participants were also queried regarding the perceived utility of a human "sleep navigator" to support patients during the sleep telehealth process. To ensure consistency and to avoid "leading" any responses, a standardized script was developed for each segment of the FGs (Table I). In addition, the concept of sleep telehealth was not intuitive to many participants. Active duty service members, PCMs, and administrative stakeholders reported varying levels of experience with telehealth and telemedicine, which resulted in a range of questions regarding operational definitions; these queries were addressed within the FGs and SSIs.

Our methods for qualitative data analysis have been described in detail elsewhere.<sup>12</sup> Briefly, audio recordings were transcribed verbatim. Thematic saturation was evaluated

by trained researchers who assessed whether new FGs or SSIs repeated the topics and themes as previous FGs or SSIs. Six phases of analysis included (1) familiarization, (2) generating codes, final codes were reached via consensus between the two facilitators, (3) extracting themes, (4) reviewing themes, (5) defining final themes and supporting quotes, and (6) producing the report.<sup>10</sup> Following qualitative analysis, several themes were extracted reflecting the two primary topics discussed in our FGs and SSIs.

## RESULTS

Major themes are presented below, and illustrative quotations for each theme are presented in Tables S2 and S3 (see Supplemental Materials).

### General Perceptions and Expectations

#### Preferences and desired characteristics of sleep telehealth

"Timely access to detailed reports, including sleep tracking data, will improve patient-provider communication and enhance continuity of care" (Theme#1). Several ADSMs emphasized that a telemedicine platform should offer them access to their own data and reports and consequently empower them to communicate more effectively with providers, for example, during a permanent change of station. Additionally, ADSMs reported desire that their providers review results from this platform, which would enhance continuity of care (Quotation#1).

Primary care managers and administrative stakeholders identified nine desired functions for an optimal military sleep telehealth platform:

1. *Comprehensive assessment, accurate diagnosis, and efficient triage of patients with sleep disorders.* Administrative stakeholders perceived multiple benefits to reviewing real-time, contextualized data to support comprehensive assessment, accurate diagnosis, and efficient triage of patients with sleep disorders (Theme#2, Quotation #2).
2. *PCM time saving.* Saving PCM time is a top priority within the MHS. Any new platform cannot increase provider burden or require much provider time. Multiple administrators reported that if a sleep telehealth tool required intensive training or additional work from PCMs, then providers will not use it, and implementation will be ineffective (Theme#3, Quotations #3&4).
3. *Integration with the existing electronic health record (EHR).* PCMs expressed that their current clinical workflows require near-constant engagement with the EHR and that as a result, they are unable to use additional systems or platforms. Administrators similarly perceived EHR integration as an important characteristic to maximize buy-in at the provider and health system levels. Thus, integration with the EHR represents a major opportunity to increase utility and buy-in for the new sleep telehealth platform (Theme#4, Quotation #5).

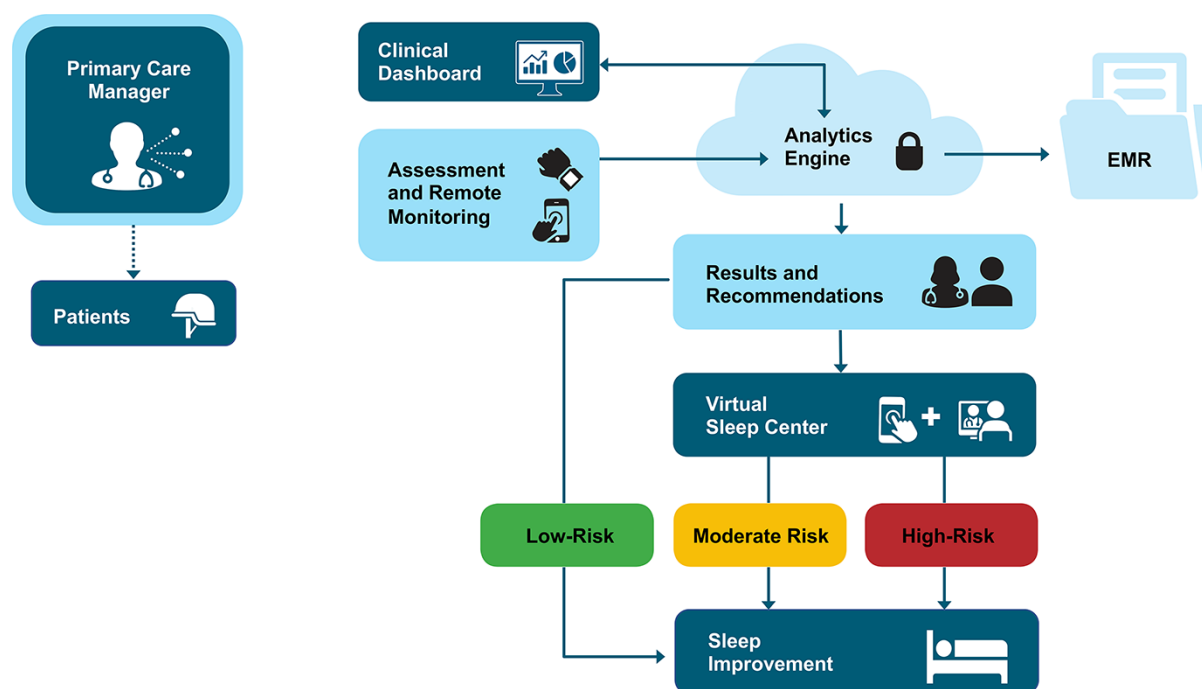


Image © WellTap.

**FIGURE 1.** Stakeholder-derived sleep telehealth workflow to increase access to evidence-based sleep medicine care and improve military-relevant outcomes. In the primary care environment, primary care managers initiate the sleep telehealth monitoring process to help support evidence-based assessment, diagnosis, and triage of patients with sleep complaints, including connection with specialty care. Patients begin assessment including commercial-off-the-shelf wrist wearable device and twice-daily surveys regarding the impact of sleep and daytime function. Following a 10-day continuous sleep monitoring period, a secure cloud-based engine provides provisional assessment results and personalized treatment recommendations. Through a secure backend, providers receive exportable reports that can be uploaded into the electronic health record. For each patient, population health risk is rated high, medium, or low. Patients are then triaged into an appropriate level of case based on provider-confirmed risk status, provisional diagnoses, and patient preferences. Within-app, patients receive personalized training modules including disease-specific sleep education and evidence-based sleep training for common sleep problems such as insufficient sleep, insomnia, obstructive sleep apnea, shift work, and nightmares. The system continues remote monitoring and reporting of results. Expansions are underway to incorporate a comprehensive virtual sleep center including remote sleep specialist consultation, diagnostic testing, and treatment. Image WellTap. Used with permission.

4. **Technical reliability.** PCMs stressed the importance of reliable connectivity and glitch-free usage of the integrated sleep telehealth platform (Theme#5, Quotation #6).
5. **Rigorous security parameters.** Administrators stressed that successful implementation will require that the platform meet all military security standards, including security needs for service members in the field and for data security within the MHS (Theme#6, Quotation #7).
6. **Follow-up access.** PCMs reported that an important added value from the new sleep telehealth platform will be the ability to support ongoing follow-up, thus enhancing continuity of care and outcomes assessments (Theme#7, Quotation #8).
7. **Enhanced patient adherence.** Two important, related characteristics are (1) improved patient adherence and system efficiency and (2) ease of prescription refill for medications, devices, and supplies (Theme#8, Quotation #9).
8. **Diagnostic accuracy.** PCMs specifically requested sleep assessments that are reliable and valid (Theme#9, Quotations#10, 11).
9. **High usability for patients with varying levels of technology literacy.** PCMs reported that some extant tools are under-utilized by patients with low technology literacy; thus, the proposed platform should be intuitive and easy to use (Theme#10, Quotation #12).

### Expected clinical outcomes of sleep telehealth

In terms of outcomes, ADSMs expected that sleep telehealth would result in (1) improved sleep (Theme#11), (2) knowledge regarding the impact of sleep (Theme#12), (3) increased access to sleep care (Theme#13), (4) more frequent remote monitoring (Theme#14), and (5) remote provider communications (Theme#15) (Quotations # 13&14).

Primary care managers' expected outcomes from sleep telehealth approaches included (1) improving patient sleep and other comorbidities, (2) improving ADSM operational readiness, and (3) reducing mortality (Themes#16,17&18, Quotations #15,16&17). On the other hand, administrative stakeholders expected (1) improved access, service utilization, and cost saving; and (2) improved military performance and safety (Themes#19 & 20, Quotations #18&19).



## Feedback and Suggestions for Optimization of the Sleep Telehealth Platform

Participants provided feedback and suggestions for improvement regarding a sleep telehealth schematic (Fig. 1) as well as screenshots for a novel sleep telehealth platform (Well-Tap, Fig. 1). The purposes of the platform are to (1) help PCMs assess sleep complaints, (2) empower patients and PCMs to make evidence-based sleep treatment decisions, (3) deliver evidence-based behavioral sleep treatments via mobile devices, and (4) connect patients with sleep specialists in virtual or physical sleep centers.

## Stakeholder impressions regarding the proposed sleep telehealth platform

Active duty service members, PCMs, and administrative stakeholders expressed positive impressions about the proposed platform.

1. *Data aggregation and evidence-based decision support.* ADSMs agreed that collecting sleep data will offer providers more complete information to inform accurate diagnoses and support personalized treatment plans. Some patients mentioned that tracked data can complement self-report data (e.g., sleep diaries). In addition, many ADSMs noted the importance of the proposed sleep telehealth platform in supporting continuity of care especially during deployment. Notably, some ADSMs perceived that the sleep telehealth approaches should focus on diagnosis only. Patients also liked ongoing access to their own data. Primary care managers expressed similar thoughts (Theme 21, Quotations #20&21).
2. *Enhanced access and continuity of care via patient remote assessment and monitoring, triage, and indicated referral.* Most ADSMs perceived that the proposed sleep telehealth platform would improve communication and continuity of care from PCMs and sleep specialists. However, some participants felt that the approach could actually delay needed specialty care, for example, if a PCM initiated the sleep telehealth monitoring approach rather than made an immediate referral to a specialist for patients experiencing moderate to severe symptoms. Other ADSMs commented that a sleep telehealth approach would positively impact deployability and military readiness in the field (Theme 22, Quotation #22&23). Primary care managers also recognized improved patient communication and enhanced continuity of care as key benefits of the proposed platform. In addition, PCMs perceived benefit from the screening and triage functions of the proposed sleep telehealth platform, which PCMs perceived would empower them to assign more effectively patients to the appropriate level of care.

## Potential barriers to adoption

Active duty service members reported two primary concerns that create barriers to adoption: losing in-person care and

communications with providers (Theme #23; Quotation #24) and experiencing disjointed care. Specifically, some ADSMs expressed concern that adding more steps to the sleep management process could delay referral to a sleep specialist (Quotation #25).

From the PCM perspective, the primary concern is additional administrative burden, such as paperwork or an additional system login (Theme#24, Quotations#25&26). Validity and reliability of assessment were also highlighted (Theme#25, Quotations#27&28). Finally, PCMs indicated that failure to monitor patient treatment adherence would be a major barrier to adoption (Theme#26, Quotation#29).

Administrators expressed concerns about the accuracy of data captured from a mobile device (Theme#27, Quotation#30). In addition, these economic decision-makers wanted to perform market research to evaluate available tools and costs (Theme#28, Quotation#31).

## Suggestions to enhance real-world implementation

Primary care managers provided two helpful suggestions to ensure successful implementation of the proposed platform:

1. *Provide a clear timeline for actions and outcomes* (Theme#29). Primary care managers emphasized the importance of time for both providers and patients. Primary care managers suggested to add a clear timeline for included treatments in the proposed platform as well as expected clinical outcomes (Quotation #32).
2. *Engage commanders and gain command support* (Theme#30). Primary care managers highlighted that engaging commanders and gaining high-level support is key for successful implementation, especially for deployed ADSMs (Quotation #33).

Likewise, administrative stakeholders offered two suggestions for enhancing the efficiency and effectiveness of the proposed platform:

3. *Include the primary care team* (Theme#31). Administrative stakeholders recommended that multiple members of the primary care team should be involved in the implementation efforts. Delegating responsibilities across the team would reduce provider-specific burdens and accelerate the ability to initiate patient onboarding (Quotation #35).
4. *Follow-up clinically and evaluate long-term outcomes* (Theme#32). Administrators emphasized the importance of clinical follow-up and long-term patient outcomes (Quotation #35).

## Perceptions regarding sleep navigator support

“The roles, responsibilities, and qualifications of the Sleep Navigator must be clearly defined” (Theme #33). Although the concept of “sleep navigator” was positively received by ADSMs, this was an unfamiliar term, and ADSMs were uncertain regarding the specific functions of the sleep navigator. Active duty service members reported that their

expectations for health providers were based on provider type (e.g., physician, psychologist, or nurse), and other members of the healthcare team were often perceived as technical rather than clinical (Quotation #36).

“A sleep navigator can be either technical or clinical, but not both” (Theme #34). ADSMs spoke about specifying the navigator’s role to be either technical or clinical based on his/her qualifications (Quotation #37).

“The sleep navigator should be the initial point of contact for patients” (Theme #35). Sleep navigators appealed to PCMs because of their ability to provide patient support. Primary care managers recommended that the sleep navigator should be the first to respond to patient queries and generally support patients in completing tasks recommended by PCMs (Quotation #38&39).

“Real-time support is essential” (Theme#36). Some PCMs pinpointed that navigator support should be available real-time to ensure coverage for all time zones of deployed ADSMs (Quotation #40).

### Overall appeal of the proposed sleep telehealth platform

“The vast majority of ADSMs, PCMs, and administrative stakeholders agreed on the overall utility of the proposed sleep telehealth platform” (Theme #37). Most participants showed great interest in the proposed sleep telehealth platform. Active duty service members and PCMs perceived that the platform could serve as a significant forced multiplier to enhance sleep disorders management in the military. Of 11 PCMs interviewed, 10 reported that the proposed platform represented an appealing and helpful approach to improve sleep disorder management in the MHS. (One PCM deferred providing a final opinion until after the platform was implemented.) Primary care managers expressed particular interest in several elements of the proposed sleep telehealth platform: (1) improved assessment, diagnosis, triage, and referral, (2) ease of use, and (3) navigator support. Administrative stakeholders appreciated the potential impact of leveraging technology to enhance sleep care, efficient allocation of healthcare resources, and realized cost savings (Quotations #41–45).

## DISCUSSION

The results of this qualitative stakeholder engagement study demonstrate that ADSM patients, PCMs, and health system administrators perceive multiple benefits and several important risks associated with adopting sleep telehealth approaches in the MHS. Further, these key stakeholders offered valuable ideas from diverse perspectives regarding how to optimize a sleep telehealth management platform for implementation in the primary care setting. Overall, our findings support sleep telehealth approaches as a promising pathway to increase access to evidence-based sleep medicine care and, in so doing, could improve military-relevant outcomes in the MHS. At the same time, these data make clear that solving the military sleep problem will require sustained effort from diverse stakeholders with at-times competing interests.

Like many areas of health care, sleep medicine is in the midst of a technology and telehealth boom in the United States and worldwide. As a result, patients with sleep complaints can be assessed, diagnosed, and treated entirely remotely; and virtually all sleep patients can benefit from some aspect of sleep telehealth care. For example, for patients requiring behavioral sleep treatments (e.g., for problems including insufficient sleep, insomnia disorder, nightmare disorders, shift work, or other circadian rhythm sleep disorders), care could be made available virtually via telemedicine, and/or digital therapeutic interventions can be administered remotely with or without human support. For selected patients at risk for OSA, the most common organic sleep disorder among military personnel, home sleep apnea testing can provide remote provision of accurate diagnosis. Medical devices such as continuous positive airway pressure therapy can be equipped with cloud-based remote monitoring capabilities. This latter approach empowers the clinician to monitor adherence, support ongoing usage, and adjust pressure prescriptions as needed. In the present study, ADSM patients, PCMs, and administrative stakeholders reported a very broad range of perceived benefits from these aspects of sleep telehealth, including increased access and improved continuity of care; more efficient and accurate assessment, diagnosis, education, and triage of sleep patients; provision of evidence-based treatment recommendations and interventions; enhanced system efficiency and appropriate allocation of resources; long-term outcomes tracking at the MHS level; and improved military readiness.

At the same time, in order to realize the great promise of sleep telehealth, it is vital to acknowledge and overcome the potential barriers identified by ADSMs, PCMs, and administrative stakeholders. Perhaps most importantly, ADSM patients expressed concern over losing personal contact with their health providers, including both their PCMs and their sleep specialists. This valid concern speaks to the trust and therapeutic alliance that exist between participants in our study and their MHS providers. Active duty service members also expressed concern that sleep telehealth might be a barrier to their being referred to a sleep specialist. For their part, economic stakeholders wanted to ensure the accuracy of mobile data and to perform market research before investment. Each of these concerns identified by ADSMs, PCMs, and economic stakeholders are understandable, and actionable strategies are being developed to mitigate these risks.

In addition to demonstrating the importance of sleep telehealth in general, the results highlight the importance of outcomes at both the patient level (e.g., ease of use, diagnostic accuracy, and delivery of personalized treatment plans) and the MHS level (e.g., increased value, cost savings, and improved military-relevant outcomes including readiness). In this vein, stakeholders of all types routinely commented on (1) consumer sleep technology and (2) a “sleep navigator” to support patients throughout the sleep telehealth



process. Regarding consumer sleep technology, stakeholders reported awareness that many military personnel wear fitness devices that track sleep. Although there remain important gaps in knowledge, data from these commercial off-the-shelf (COTS) solutions provide objective data that can potentially supplement and inform routine clinical care. Further, COTS solutions have advantages of scalability and potential field application, suggesting one ADSM-centered pathway to bridge the gap and provide support in both medical and operational environments. At the same time, wearable devices in secure and deployed environments require careful consideration to ensure operational security. Regarding the sleep navigator, ADSMs emphasized the need to manage expectations and to educate patients on the clinical or technical role of the sleep navigator. Primary care managers perceived many benefits to the sleep navigator to guide patients through the sleep telehealth assessment process, particularly to answer questions and help advise next steps, such as care coordination to a virtual sleep center.

Finally, PCMs and administrative stakeholders consistently highlighted the potential economic benefit that could be realized by adopting an integrated sleep telehealth mobile platform. In the modern healthcare climate of rising costs on the one hand and limited resources on the other, these stakeholders viewed sleep telehealth as a potential pathway to improve military health and readiness outcomes while reducing costs to the Defense Health Agency (DHA) and other stakeholders. This potential benefit of sleep telehealth is especially important given the documented personal and economic costs of untreated insomnia disorder,<sup>13</sup> OSA,<sup>14</sup> and other sleep problems, as well as the potential economic benefit associated with treatment of these conditions.<sup>15,16</sup> Beyond these general sleep health economic concerns, MHS stakeholders highlighted the importance of reduced leakage of MHS beneficiaries to the purchased care network as an important potential economic benefit to the DHA of sleep telehealth approaches. Given current DHA integration planning, advancing understanding regarding economic aspects of sleep telehealth in the context of direct vs. purchased care is an important direction for future research.

Our study possesses strengths. Most important, this is the first qualitative engagement study to elicit feedback from diverse military stakeholders including patients, providers, and economic decision-makers regarding sleep telehealth in the military, with emphasis on implementation. We employed rigorous qualitative research methods, including the development of scripts to avoid “leading” responses. At the same time, participants were drawn from two MTFs with accredited sleep centers in the National Capitol Region. An important future direction will be to engage stakeholders in more remote areas without sleep resources. Even so, our results highlight that it will be necessary to engage diverse stakeholders with at-times competing interests to solve the military sleep problem.

## CONCLUSION

This is the first study to engage diverse stakeholders to solicit feedback regarding sleep telehealth approaches in the MHS or any health system. The results not only highlight the importance of sleep telehealth but also provide valuable insight into optimization of a novel sleep telehealth platform for use in the MHS. In this and other health systems, demand for sleep medicine care greatly exceeds available supply of sleep medicine specialty care, frequently resulting in suboptimal outcomes and straining the already busy network. Given the high prevalence and well-documented consequences of sleep disorders in the U.S. military, this status quo is simply not sustainable. Leveraging sleep telehealth represents one viable approach to increasing access to care, improving military-relevant outcomes, and solving the military sleep problem, potentially while reducing costs. Carefully considered and well-implemented system-level changes, including sleep telehealth approaches such as the platform studied in this project, are necessary to manage military health and to ensure military readiness for the future. Indeed, related strategy development and planning are currently underway as part of ongoing DHA integration.

## ACKNOWLEDGMENTS

We thank all participants including patients, providers, health systems, and industry leaders as well as multiple research administrators who helped make this work possible.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

## FUNDING

This research was supported by a research grant awarded from the U.S. Department of Defense (via the Medical Technology Enterprise Consortium) to The University of Maryland, Baltimore (PI: E.M.W.).

## CONFLICT OF INTEREST STATEMENT

E.M.W. and J.S.A.’s institution has received research support from AASM Foundation, U.S. Department of Defense, Merck, and ResMed. E.M.W. has served as a scientific consultant to DayZz, Eisai, Merck, and Purdue and is an equity shareholder in WellTap. C.L.D. has received research support from Jazz, Merck, Eisai, Harmony, and Seven and is a speaker for Jazz, Eisai, Harmony, and Procter and Gamble. M.A.G. has received grants from Jazz Pharmaceuticals, Kemin Foods, and CeraZ. He has served as a consultant for Merck, Idorsia, Fitbit, Natrol, Athleta, Casper, NightFood, Simple Habit, Unilever, and LYMA. C.D.M. serves as a consultant to AstraZeneca, Bayer Pharmaceuticals, Incyte, Merck, Pfizer, Sanofi, and Takeda.

## REFERENCES

1. Williams SG, Collen J, Wickwire E, Lettieri CJ, Mysliwiec V: The impact of sleep on soldier performance. *Curr Psychiatry Rep* 2014; 16(8): 459.
2. Mysliwiec V, McGraw L, Pierce R, Smith P, Trapp B, Roth BJ: Sleep disorders and associated medical comorbidities in active duty military personnel. *Sleep* 2013; 36(2): 167–74.
3. Luxton DD, Greenburg D, Ryan J, Niven A, Wheeler G, Mysliwiec V: Prevalence and impact of short sleep duration in redeployed OIF soldiers. *Sleep* 2011; 34(9): 1189–95.

4. Hirshkowitz M, Whiton K, Albert SM, et al: National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health* 2015; 1(1): 40–3.
5. Watson NF, Badr MS, Belenky G, et al: Recommended amount of sleep for a healthy adult: a joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. *J Clin Sleep Med* 2015; 11(6): 591–2.
6. Krueger PM, Friedman EM: Sleep duration in the United States: a cross-sectional population-based study. *Am J Epidemiol* 2009; 169(9): 1052–63.
7. Capaldi VF, Balkin TJ, Mysliwiec V: Optimizing sleep in the military: challenges and opportunities. *Chest* 2019; 155(1): 215–26.
8. Devine JK, Collen J, Choynowski JJ, Capaldi V: Sleep disturbances and predictors of nondeployability among active-duty Army soldiers: an odds ratio analysis of medical healthcare data from fiscal year 2018. *Mil Med Res* 2020; 7(1): 10.
9. Belenky G, Wesensten NJ, Thorne DR, et al: Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *J Sleep Res* 2003; 12(1): 1–12.
10. Van Dongen HPA, Maislin G, Mullington JM, Dinges DF: The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep* 2003; 26(2): 117–29.
11. Moore BA, Tison LM, Palacios JG, Peterson AL, Mysliwiec V: Incidence of insomnia and obstructive sleep apnea in active duty United States military service members. *Sleep* 2021; 44(7): zsab024.
12. Abdelwadoud M, Collen J, Edwards H, et al: Engaging stakeholders to optimize sleep disorders' management in the U.S. military: a qualitative analysis. *Mil Med* 2021: usab341.
13. Wickwire EM, Tom SE, Scharf SM, Vadlamani A, Bulatao IG, Albrecht JS: Untreated insomnia increases all-cause health care utilization and costs among Medicare beneficiaries. *Sleep* 2019; 42(4): zsz007.
14. Wickwire EM, Tom SE, Vadlamani A, et al: Older adult US Medicare beneficiaries with untreated obstructive sleep apnea are heavier users of health care than matched control patients. *J Clin Sleep Med* 2020; 16(1): 81–9.
15. Wickwire EM, Shaya FT, Scharf SM: Health economics of insomnia treatments: is there a return on investment for a good night's sleep? *Sleep Med Rev* 2016; 30: 72–82.
16. Wickwire EM, Albrecht JS, Towe MM, et al: The impact of treatments for OSA on monetized health economic outcomes: a systematic review. *Chest* 2019; 155(5): 947–61.