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From Consumer to Clinic: Unlocking Sleep's Potential in Modern Healthcare

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Sleep

The Rise from Overlooked to Essential

Despite its central role in maintaining well-being, sleep has historically been sidelined in both medical practice and public discourse. For decades, it has been overshadowed by more visible preventive health behaviors like nutrition and exercise. Often seen as optional (or worse, a sign of weakness), sleep was long treated as a negotiable lifestyle choice rather than a foundational biological need, one that impacts virtually every system in the human body.

That narrative has shifted over the last decade. In the wake of the global pandemic, amid rising rates of mental health issues and chronic conditions, a growing population of empowered health consumers is redefining what it means to take care of oneself. The days of bragging about surviving on four hours of sleep have gone, and high-performing athletes, business leaders, and influencers alike now elevate sleep as a cornerstone of physical and cognitive performance.

As sleep gains mainstream recognition, so does the demand for tools and technologies that measure, enhance, and personalize it. Sleep measurement has evolved from controlled laboratory settings to continuous, real-world monitoring through consumer wearables, modern smart beds, and other in-room tracking devices. But this momentum raises new questions: How accurately can we measure sleep in real-world settings? How do we translate passive monitoring into meaningful, individualized interventions? And what role should healthcare stakeholders, from clinicians to pharma to tech innovators, play in optimizing sleep as a lever for better outcomes across physical, mental, and preventative health?

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Eve Van Cauter
University of Chicago

"Human health rests on three core pillars: sleep, nutrition, and physical activity. While diet and exercise have received significant attention, sleep has long been overlooked, despite its equal importance."

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Sleep & Health

The Science

Sleep Health: *A Definition*

Despite some variation in how it's defined across research and clinical settings, sleep health is often described as "a multidimensional pattern of sleep and wakefulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being."

Sleep Quality: *A Definition*

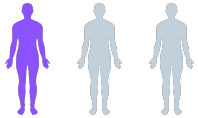
Sleep quality is defined as an individual's self-satisfaction with all aspects of the sleep experience. Sleep quality can be assessed subjectively and objectively. The National Sleep Foundation outlines several indicators of sleep quality among otherwise healthy individuals and in clinical populations.

Humans spend nearly one-third of their lives asleep. And yet, it's only in the past few decades that science has begun to uncover the depth of sleep's role in health and disease. Far from a passive state, sleep is now understood as an active, biologically regulated process with critical functions: facilitating memory consolidation, repairing tissues, regulating hormones, fortifying immune defense, and supporting emotional and metabolic stability.

Sleep touches nearly every organ system and plays a defining role in long-term health outcomes. Its disruption has been linked to increased risks of cardiovascular disease, obesity, mood disorders, immune response, and neurodegeneration. Still, causes of insufficient sleep, including underdiagnosed and misunderstood sleep disorders, often coexist with chronic physical and mental health conditions in ways that complicate treatment and recovery.

Despite this mounting evidence, sleep often lacks the urgency or visibility afforded to issues like ultra-processed foods or physical inactivity. That disconnect is no longer sustainable. If our goal is truly preventive, personalized, whole-person care, sleep must be fully integrated into how we define, measure, and support health culturally, clinically, and systemically.

Sleep, The Overlooked Pillar of Health



Despite consensus that adults should **get between 7 and 9 hours of sleep per night,** the CDC reports that **1 in 3 U.S. adults report shorter bed times**.

The Ripple Effect

Part of the challenge lies in perception. Poor sleep is often dismissed as a nuisance or secondary symptom. However, **as a fundamental pillar of wellness, when sleep falters, it triggers a ripple effect on other health pillars,** such as fueling poor nutrition through cravings and reducing motivation for physical activity.

Furthermore, with mounting evidence that poor sleep carries serious health and economic consequences, our urgency in recognizing sleep as foundational to health must match the rising prevalence of these conditions.

The Underdiagnosis Crisis

Beyond poor sleep health, over 90 subtypes of sleep disorders exist, which are both widespread and often misdiagnosed.

In the US., up to **70 million people** are affected by sleep disorders. Up to **40 million do not receive adequate diagnosis or treatment.**

Globally, nearly **1 billion adults** suffer from obstructive sleep apnea but up to **80% of moderate to severe cases go undiagnosed.**

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Sleep Health Disparities

Poor sleep, and clinical sleep disorders, don't affect everyone equally. They often mirror and magnify existing social and health inequities.

Race & Ethnicity

African Americans report shorter, lower-quality sleep than white Americans, even after adjusting for income and education, reflecting systemic and environmental inequalities.

Socioeconomic Status

Poor sleep is more common among lower-income individuals due to financial stress, irregular schedules, and unsafe environments.

Gender

Women have more trouble falling asleep than men. Middle-aged men are more prone to sleep-disordered breathing (34%); women more often report insomnia and fragmented sleep (17% with OSA).

Age

Natural age-related changes in sleep architecture and circadian rhythms can make sleep less restorative, with 50–60% of older adults facing sleep issues. Medical disorders, like cognitive impairment and chronic pain can also interfere with sleep in older people.

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The Health Cost of Poor Sleep

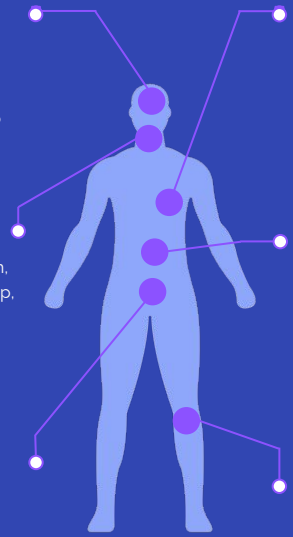
The impact of poor sleep does not exist in isolation. Sleep disruption has cascading effects throughout the body's systems, contributing to short and long-term determinants of health.

Immediate Impacts

The adverse effects of sleep deprivation occur rapidly and can be measured objectively; **slower reaction times, impaired memory , impaired cognitive performance, weaker immune responses, impaired carbohydrate tolerance, and increased risk of errors of judgement**"

These impacts create a broader **social and economic ripple effect;** people with insufficient sleep are more likely to require medical care and are at greater risk of accidents, both on the road and in the workplace. The economic toll is significant; **insufficient sleep costs up to $400 billion a year in the US, driven not only by long-term health impacts and mortality, but also by absenteeism and reduced performance.**

Long-term Health Consequences



Neurodegenerative Diseases

Poor sleep is linked to a higher risk of Alzheimer's, Parkinson's, MS, and Huntington's, and may even be predictive; sleeping six hours or less in midlife increases dementia risk. These neurodegenerative conditions also disrupt sleep, impacting quality of life and safety.

Mental Health

Poor sleep is associated with depression, anxiety, autism, and schizophrenia. These conditions further disrupt sleep, creating a cycle that worsens symptoms, raises comorbidity risk, and impairs cognition and emotional regulation.

Women's Health

Hormonal fluctuations cause sleep disturbances that affect 30% of pregnant women, 41% of postpartum women, and up to 30% of menopausal women. These are linked to increased risks of depression, anxiety, and cognitive decline, including dementia in later life.

Cardiovascular Diseases

Sleep disturbances have systemic effects that contribute to the development of hypertension, coronary artery disease, heart failure, and arrhythmias. Those who sleep less than 6 hours per night are 20%-32% more likely to develop hypertension than people who get 7-8 hours of sleep.

Diabetes & Obesity

Individuals sleeping less than 7 hours per night are at higher risk of obesity, while those with obesity are more likely to experience various sleep disturbances. For diabetes, too little sleep is linked with Type 2 Diabetes; sleep disorders increase the risk of insulin resistance and worsening disease complications.

Physical Health & Pain

Pain is both a cause and a consequence of sleep deficiency. Up to 88% of people with chronic pain experience sleep disruptions or insomnia, while at least half of those with insomnia report chronic pain.

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Intercepting the Cycle

Sleep Quality as a Strategic Intervention

Research reveals that **sleep and health are locked in a powerful cycle: poor sleep worsens health outcomes, while existing health problems disrupt sleep.**

This self-reinforcing loop contributes to chronic disease progression, but it also opens the door to intervention.

Emerging Evidence: Sleep Quality Intervention as a Therapeutic Gateway

Neurology

With sleep disturbances linked to elevated Alzheimer's biomarkers (Aβ42/40 and Tau-pT181), a prospective intervention using CPAP to improve sleep quality led to **significant reductions in Aβ42/40 ratio and Tau-pT181 levels, as well as improvements in cognition and mood.** These findings position sleep improvement as a promising upstream approach to delaying neurodegenerative change.

Obesity

In a 12-month behavioral intervention, **improvements in sleep health remained significantly associated with greater fat loss, even after accounting for obstructive sleep apnea.** As OSA dampened the effects of behavioral changes, the results highlight sleep quality as a critical but often overlooked lever in obesity management.

Mental Health

A meta-analysis of 65 RCTs found that **improving sleep quality** (primarily through CBT-I and clinician-led behavioral interventions) **produced significant reductions in depression, anxiety, stress, and rumination.** The dose-response relationship underscores sleep as a foundational mechanism for improving and sustaining mental health.

What This Means: Sleep as a Therapeutic and Preventive Target

Sleep quality is a modifiable factor with therapeutic potential. Recognizing it as a point of intervention allows healthcare stakeholders to act earlier in the disease process, with opportunities to **prevent, slow, or even *reverse* chronic health trajectories.** This positions sleep not only as a clinical concern for sleep specialists, but also as an important **cross-cutting strategy for preventative care**, relevant across a wide range of disciplines. **By looking at improving sleep quality as a way to improve health outcomes, you can look further upstream at sleep quality to prevent disease.**

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Consumer Demands Meets Tech Innovation

The sleep wellness landscape is undergoing a significant transformation, driven by increasing scientific validation, a cultural reframe of sleep as an essential pillar of health, and the rise of healthcare consumerism.

Amid growing consumer demand for personalized, clinically validated solutions, advances in AI-powered technologies, and real-time interventions, sleep technology is emerging as a gateway to holistic, data-driven health optimization, moving beyond mere awareness toward tangible, measurable outcomes.

Yet, a crucial gap remains: consumers are gaining access to more sleep data but not consistently achieving better health results. While consumer awareness and understanding creates demand, meaningful change requires solutions with actionable, impactful interventions, supported by rigorous clinical validation.

A Cultural Rebranding of Sleep

Over the last decade, as wellness takes center stage, sleep is being culturally redefined. Once seen as expendable, it is now understood as a vital driver of health, performance, and recovery. The old mindset that glorified sleep deprivation has faded.

Carlos Nunez , Chief Medical Officer, Resmed

"For years, getting by on minimal sleep was worn as a badge of honor. Only recently have we begun to recognize, both through personal awareness and mounting scientific evidence, just how detrimental poor sleep is to our health."

High-profile leaders now credit quality sleep for sharper decision-making, while institutional bodies like the American Heart Association and American Diabetes Association have added sleep to their health guidelines, signaling a broader shift in how sleep is valued.

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Sleep rises as a central focus in the growing wellness industry

$1.8 Trillion
Global Wellness Market

The global wellness market is expanding rapidly, **valued at an estimated $480 billion in the U.S. alone,** with annual growth rates of 5–10%.

#1
Wellness Concern Among Millennials

Millennials rank sleep as their highest wellness concern, with **Gen Z placing it second** only to general health. When choosing sleep products, they prioritize proven efficacy, scientific credibility, and healthcare professional recommendations.

Despite prioritization, investment needs remain

Despite saying they prioritize sleep, Millennials and Gen Z still **spend more on appearance, fitness, and nutrition products.**

#5
Ranking of Sleep Among Wellness Categories Spend

And awareness itself brings new challenges: **sleep anxiety is an emerging wellness issue** fueled by economic uncertainty and pandemic-era disruptions.

40%
GenZers Experience Sleep Anxiety

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Where Sleep Meets Tech

Despite the investment gap in sleep health, the rapid evolution of sleep technology is poised to meet rising consumer demand. **Two unique characteristics** make sleep especially **well-suited for digital engagement.**

The Immediate Feedback Loop

Unlike with many health behaviors where progress is slow or invisible, sleep is profoundly felt; when a person makes a change, they sense the result. Technology can amplify this natural feedback, transforming subjective feelings into objective data that reinforces positive changes.

The Unconscious Monitoring Challenge

Sleep presents a unique measurement problem: it occurs while we're unconscious. Issues like apnea or disrupted cycles often go unnoticed, making them difficult to address. Smart devices help bridge this gap through passive, continuous monitoring, offering visibility into what we can't observe.

"Sleep stands out in the wellness movement because its effects are immediate and tangible: people often feel the impact of changes right away. This daily feedback, especially when enhanced by technology, empowers consumers to engage more actively with their health."

Karen Lee
Neurology & Sleep Medicine Specialist, Mass General Brigham

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Technological Innovation

Momentum in Motion

1/3
Of Americans have used sleep-tracking devices

78%
Find the tools helpful

68%
Have changed their behavior based on insights

37%
Express desire for additional sleep products & services

The technology itself is rapidly advancing. Modern devices integrate advanced sensors and clinically validated algorithms, with over 20 FDA clearances for sleep-related products signalling growing credibility.

Notably, consumer tech giants rather than MedTech leaders are driving this shift, bringing medical-grade features into consumers hands.

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Even as Technology Advances, Critical Gaps Remain

Despite this momentum, four critical unmet needs prevent sleep technology from reaching its full potential, creating frustration for consumers and missed opportunities for healthcare impact.

Action Gap

Many solutions provide metrics on sleep stages, disruptions and bio-signals, often with tips or recommendations. However, they typically **place the burden on the user** to make changes to their sleep habits, **lacking real-time, impactful intervention**. Relying on user motivation to take action risks leaving sleep data as another unread dashboard.

Personalization Deficit

Personalized recommendations are expected, not optional; with consumers wanting advice **tailored to their unique sleep patterns.** Although AI makes individualized guidance more feasible, the complexity of sleep makes it difficult to deliver true personalization.

Evidence Demand

Consumers don't just want convenience, they want **clinically validated solutions.** In the sleep realm, **endorsement by a medical institution and doctor recommendations** are some of the most influential purchasing factors. Adoption of and adherence to sleep technology standards is also of utmost importance.

50% of consumers cite clinical effectiveness as a key factor

Health System Disconnect

Beyond specialists, **healthcare practitioners (HCPs) do not consistently ask about sleep**. Furthermore, **consumer-grade data often don't reach clinical settings, where validated data are essential,** leaving sleep tech viewed more as a wellness tool than a clinical asset.

49% of consumers report that their doctors do not proactively ask about sleep quality

Brian Sauer
Founder and CEO, GEM HEALTH

"Awareness of sleep issues is at an all-time high, driven by increased access to data. But recognition alone doesn't guarantee action or improvement - many people still lack the tools or support to effectively address poor sleep, and access to treatment options have remained largely unchanged."

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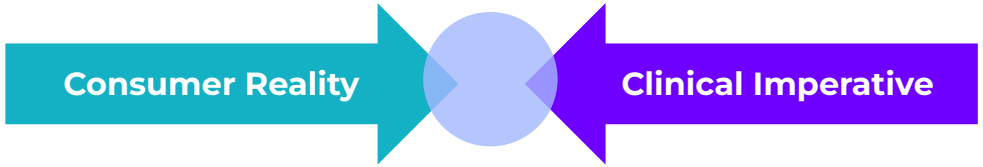
When Enthusiasm Meets Clinical Rigor

A New Healthcare Dilemma

While consumers enthusiastically embrace sleep innovation, and arrive at clinical appointments armed with months of sleep data, sleep scores, and specific questions about their sleep patterns health systems face a complex validation dilemma. **The fundamental tension lies between the engagement-first approach of consumer technology and the accuracy-first requirements of clinical medicine.**



As this self-advocacy becomes the norm, the health system must evolve to meet patients where they are, without compromising clinical rigor or evidence-based care.

Pedram Navab
Sleep Specialist,
Hoag Voltmer Sleep Center

"We're seeing significant patient demand for sleep technology guidance. Patients frequently present with consumer devices, seeking clinical validation of their utility. This trend reflects both increased marketing awareness and genuine consumer interest in sleep improvement solutions."

The Call to Action

The question is no longer if consumers will use sleep technology, that adoption is already underway. The real challenge is how quickly validated, scalable solutions can bridge the gap between consumer engagement and clinical care, turning enthusiasm into measurable health outcomes.

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Delivering Improved Sleep with Technology

While traditional sleep assessment has relied on episodic clinical evaluations with inherent limitations, we are witnessing a paradigm shift toward continuous, real-world monitoring that not only measures but can actively help to improve sleep.

This evolution from passive tracking to intelligent intervention represents a fundamental breakthrough, moving beyond data collection to deliver measurable health outcomes through environmental optimization. As more solutions, like smart bed technology, demonstrate clinical-grade accuracy in natural sleep environments, it creates new possibilities for health management, from individual illness prevention and detection to population health improvement.

The convergence of advanced sensing, AI-driven personalization, and seamless clinical integration holds great potential to establish sleep health as a cornerstone of modern healthcare delivery.

John Lopos
CEO,
National Sleep Foundation

"Sleep is the common thread that runs through so many major health domains. Technology can be the tool--the needle--that connects them"

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Standards for Sleep Health Assessment

From Clinical to Real World

With *quality* sleep foundational to overall health, a significant transformation is now occurring as sleep assessment moves from episodic clinical evaluation to continuous real-world monitoring. This provides contextual understanding, enabling detection of subtle trends overtime.

Polysomnography (PSG)

Gold Standard with Limitations

PSG has long served as the gold standard for sleep assessment, capturing brain activity, eye and muscle movements, heart rhythm, breathing, and body position. However, limitations exist:

- The unfamiliar laboratory environment creates a "**first-night effect**"
- Captures **only one or two nights** of sleep
- **High costs and specialized equipment** restrict accessibility
- Requires **expert interpretation** of complex data
- Attached sensors can **themselves disrupt** natural sleep
- **Limited availability** of assessment facilities restricts access

These constraints highlight the need for accurate, longitudinal sleep assessment in natural environments.

Continuous Passive Monitoring

Various technologies facilitate this approach, including smart beds, wearables, smartphone- based monitoring applications, and ambient sensors, offering distinct advantages over episodic assessment.

Ecological Validity	Data collected in natural environments more accurately reflects typical sleep patterns
Longitudinal Insights	Enables detection of trends, patterns, and anomalies over extended periods
Non-invasive Measurement	No electrodes required, improving long-term adherence
Personalized Baselines	Establishes individual sleep norms, capturing physiological, activity and environmental data
Real-time Response	Enables real-time intervention based on individual and cohort learnings over time

Eve Van Cauter
University of Chicago

"Smart bed technology offers significant research advantages because it allows research participants to serve as their own control in baseline versus post-intervention comparisons, using consistent measurement tools in their natural sleep environment, a methodologically robust approach that strengthens scientific validity."

Standards for Sleep Health Assessment

From Clinical to Real World

Both objective and subjective data is important for sleep quality assessment. Continuous monitoring technology from smart bed technology has been shown to correlate with self-reported multi-dimensional sleep data, indicating a low-burden method for assessing behavioural sleep variables.

RUSATED Model for Sleep Health

Dr. Daniel Buysse's **RUSATED model** offers a multidimensional approach to sleep health assessment, evaluating six dimensions:

- **R(U)- Regularity:** Consistency in sleep-wake timing
- **S-Satisfaction:** Subjective assessment of sleep quality
- **A-Alertness:** Daytime wakefulness and cognitive function
- **T-Timing:** Alignment with circadian rhythms
- **E-Efficiency:** Proportion of time in bed spent sleeping
- **D-Duration:** Total sleep time relative to individual needs

This framework acknowledges that sleep quality extends beyond simple duration metrics to include consistency, timing, and subjective experience.

Smart mattress technology, developed by Sleep Number, which facilitates longitudinal continuous data collection, and real-time intervention, has been validated using the RU-SATED model. A study showed correlation between objective sleep measures captured by the technology, and self-report measures captured by the multidimensional RU-SATED model. The strongest alignment was found in sleep regularity and efficiency dimensions.

Daniel Buysse, M.D.
Professor of Psychiatry,
University of Pittsburgh
School of Medicine

"The RUSATED model reframes sleep health by shifting focus from just what we can measure to also consider what we can manage, prioritizing actionable behaviors like sleep duration, regularity, and timing. It's a practical guide to improving sleep through what we can actually control."

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The Real-time Intervention Advantage

From Accurate Measurement to Effective Interventions

While tracking sleep data has become increasingly common, the true breakthrough lies not in measurement alone but in **real-time intervention that dynamically improves sleep, without burdening the patient.** This paradigm shift represents a fundamental evolution in sleep health technology, from passive observation to proactive enhancement.

The consumer sleep technology market has historically been dominated by tracking devices that **provide data, and tips, but without real-time intervention.**

In contrast, **adaptive response** technologies represent a transformative approach by integrating directly into the sleep environment, such as the bed, and **automatically responding to individual sleep needs** through environmental modifications.

These technologies, such as Sleep Number's closed-loop smart mattress system, have potential to eliminate the critical gap between data collection and sleep improvement.

Feature	Basic Sleep Trackers	Adaptive Response Technologies
Data Collection	Passive monitoring	Continuous monitoring with contextual analysis
Response Capability	Static; requires user action	Dynamic, automatic adjustments during sleep
User Effort	High; requires interpretation and manual changes	Minimal; effortless experience
Personalization	Limited to recommendations	Adaptive responses to individual needs
Clinical Validation	Often limited or absent	Rigorously validated against established standards
Health Impact	Indirect through behavior change	Direct through real-time environmental optimization

The Real-time Intervention Advantage

From Accurate Measurement to Effective Interventions

Smart bed technology can dynamically modify environmental factors known to influence sleep quality, enabling real-time intervention.

Environmental Manipulation

The Science of Sleep Optimization

Temperature Regulation: Smart mattresses incorporate precise temperature-array sensors, enabling intelligent temperature adjustments throughout the night that align with the body's natural sleep cycle.

Firmness Customization: Adjustable firmness settings respond to body position changes throughout the night, providing optimal spinal alignment and pressure relief, minimizing disruptions caused by discomfort, and reducing partner disturbance from movement.

Position Optimization: Advanced pressure sensors detect sleep position changes and can initiate subtle adjustments to maintain optimal body alignment. For individuals with position-dependent conditions like OSA or acid reflux, these adjustments can significantly improve sleep quality.

Measurable Improvements Through Real-time Intervention

Temperature Intervention: Proprietary smart temperature technology has been shown to increase restful sleep duration. Sleep Number Climate360® sleepers get 52.5 minutes more restful sleep per night.*

**Based on average SleepIQ® data from 10/01/24 – 01/31/25 of 6,000 sleepers using SmartTemp™ program.*

Menopause Relief: Personalized temperature programs that optimize in-bed microclimate have the potential to improve sleep quality in menopausal women. Effective programs typically provide cooling throughout the sleep session, except before wake-up.

Snoring Reduction: Research has shown that an intervention using beds with a body lifting mechanism demonstrated a 22% -67% drop in snoring episodes during sleep, with the higher percentage attributed to higher angle changes in body position.

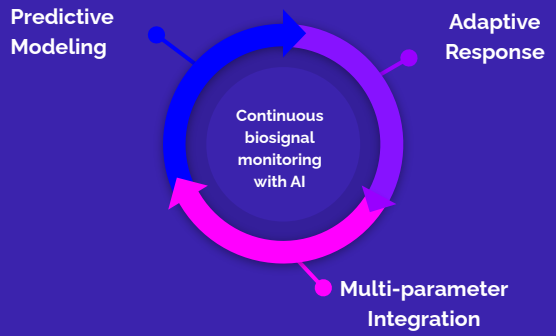
Continuous Biological Monitoring

The Basis for Precision Sleep Health

The power of continuous monitoring emerges when advanced AI and machine learning algorithms transform raw data into personalized interventions, facilitating **preventive interventions to maintain good health**.

While point-in-time clinical assessments provide snapshots of sleep health, continuous biosignal monitoring during sleep reveals the complete narrative.

- **Pattern Identification:** Detection of cyclical variations and subtle anomalies invisible to episodic monitoring.
- **Contextual Understanding:** Correlation of sleep with lifestyle factors and health status over time.
- **Personalized Baselines:** Establishment of individual normative values reflecting personal physiology.
- **Early Warning Systems**: Recognition of deviations that may indicate emerging health concerns.



Judith Owens
Director of Sleep Medicine,
Boston Children's Hospital

"Bringing detailed physiologic sleep data into the home enables longitudinal monitoring, allowing us to track trends over time and understand how life events or illness influence sleep, and how sleep, in turn, impacts overall health."

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Continuous Biological Monitoring

The Basis for Precision Sleep Health

The progression from wellness monitoring to diagnosis and treatment represents the culmination of continuous biological monitoring. This integration of continuous monitoring with AI/ML models and clinical pathways establishes a new paradigm that transcends the boundaries between consumer wellness and healthcare to create a seamless **ecosystem optimizing sleep health across the entire spectrum of human needs - from maintaining healthy sleep patterns in well individuals, to identifying and treating sleep disorders or other medical conditions when warranted.**

Prevention	Continuous Detection	Risk Stratification	Care Pathway Integration	Treatment Monitoring
Detects early warning signs of poor sleep and intervenes to improve sleep quality.	Identification of potential sleep disorders through pattern analysis	Assessment of severity based on comprehensive biosignal analysis	Seamless connection to appropriate clinical resources	Continuous evaluation of intervention effectiveness in real world environment

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Brian Sauer
Founder and CEO,
GEM HEALTH

"Just by getting better quality sleep, by treating sleep apnea, it can reduce high blood pressure. Improving sleep has a high correlation to improving health and is critically important not only to someone's health today, but health in the future as you're preventing other potential downstream impacts."

John Lopos
CEO,
National Sleep Foundation

"The obvious question as more data are generated from different sources is what do we do with these data? There have to be standards and consistent platforms for collection and analysis that help us get back to the user in some meaningful way."

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$400 billion
Estimated annual economic impact in the US from poor quality sleep.

15 times
More likely to experience accidents when sleep deprived.

1.2 million
Working days lost due to insufficient sleep annually in the US.

$226 billion
To be gained annually in the US if those who sleep less than 6 hours a night increase to 6-7 hours.

Judith Owens
Director of Sleep Medicine,
Boston Children's Hospital

"As a healthcare provider, having access to more comprehensive sleep data allows you to look at the real-world impact of treatments, whether its a prescribed medication or a behavioral program. This leads to more informed decisions, greater use of effective strategies, and less use of ineffective or even harmful ones. Ultimately, that translates into better patient outcomes and stronger financial ROI."

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The Value Proposition of Improved Sleep

The value of improved sleep extends far beyond traditional return-on-investment metrics, touching every aspect of human wellness and organizational performance.

Quality sleep serves as a foundational pillar of overall health, with evidence demonstrating its **critical role in extending healthspan** - the period of life spent in good health, rather than merely lifespan. Forward-thinking companies are embracing sleep wellness as a strategic priority, driven by economic incentives.

- **Health Cost Reduction**: Employers and healthcare providers see direct financial benefits when improved sleep quality prevents or reduces severity of comorbid conditions.
- **Safety Improvements**: Sleep-deprived individuals are 15 times more likely to experience accidents, including workplace incidents and automotive crashes.
- **Productivity Gains**: Optimized sleep enhances creativity, ethical decision-making, and interpersonal communication.

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The Next Frontier: Connected Sleep Health Ecosystem

Market conditions are coming into alignment. Consumer expectations, clinical credibility, personalization standards, and technological capabilities are converging.

A potential new frontier is emerging; one where continuous, real-world sleep data become fully integrated into healthcare, a truly connected ecosystem, where intelligent, interconnected systems continuously analyze data and deliver automated, individualized interventions.

Yet to realize this vision, systemic gaps must be addressed: from insufficient medical education and outdated clinical protocols, to reimbursement models and access inequalities.

The Next Frontier: Integration with Healthcare

Healthcare routinely monitors blood pressure, cholesterol, and glucose through regular testing. Yet, despite affecting a multitude of the most common chronic conditions, **it is not standard to routinely assess sleep**. Digital and remote technologies enable the shift of more inclusive health assessments from the clinic to the home, helping to transform sleep into a broader, fundamental element of everyday healthcare.

Current Standard

- No routine sleep assessment
- Reactive approach after symptoms appear
- Episodic sleep lab studies (1-2 nights)
- Limited accessibility and high costs
- Disconnected from daily healthcare

Future Vision

- Continuous home-based monitoring
- Integrated ecosystem of connected devices
- Proactive intervention and optimization
- Real-time environmental adjustments
- Seamless integration with health records
- Prevention-focused care delivery

Carlos Nunez
Chief Medical Officer, Resmed

"People spend only a tiny fraction of their time in clinical settings; most of their lives unfold at home, at work, in their communities, and during sleep. The healthcare industry must acknowledge this reality and fully embrace real-world evidence as a vital component of understanding and improving health."

John Lopos
CEO, National Sleep Foundation

"Over the next five to ten years in the consumer and clinical spaces, there are going to be more companies collaborating over compatible platforms to integrate data from daytime and nighttime to tell a full health picture that's related to sleep. That's a promise of digital health and I think it's a challenge and a call to action for the tech companies."

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The Next Frontier

Integration with Healthcare

With newer generation physicians more focused on holistic health approaches, healthcare institutions are beginning to reconsider sleep's role not as an afterthought, but as a key health measure in its own right.

Consumer adoption of digital sleep technologies is creating a powerful feedback loop: **as users recognize the connection between sleep and daily functioning, they bring these data to healthcare providers, potentially driving clinical interest.** Furthermore, it **compels employers, and subsequently insurers** to consider validated technologies for members - a model that has been observed in mental health coverage in recent years.

Stephen Lupe
Director and Section Head Behavioral Health, Cleveland Clinic

"The newer generation of physicians is driving a shift in mindset, recognizing that improving health requires looking beyond traditional clinical factors to consider the full context of a person's life."

Despite this momentum, **the integration of sleep into routine care remains incomplete**. Most clinical workflows still rely on outdated or episodic sleep assessments, missing the opportunity to leverage the continuous, real-world data now available through smart beds and connected devices. Sleep remains one of the least measured, and therefore least managed, determinants of health in clinical settings. **Unlocking its full potential will require closing the data loop**: translating high-quality longitudinal sleep insights into actionable healthcare interventions. Doing so could redefine sleep not just as a wellness trend, but as a **scalable, foundational tool for improving population health and lowering system-wide costs**. This has potential to shift public health metrics and create more sustainable healthcare systems focused on prevention rather than treatment alone.

The Next Frontier

Integration with Healthcare

The benefits of unlocking the full potential of sleep technology extends beyond the HCP and patients, addressing gaps for pharmaceutical companies, and presenting compelling value proposition for payers.

The pharmaceutical sector is beginning to recognize sleep data's transformative potential for drug development and differentiation. Sleep monitoring technology addresses a critical gap by enriching subjective, patient-reported quality-of-life measures with objective, quantifiable endpoints that regulatory bodies and healthcare systems value. Sleep data can be used to demonstrate that medications not only treat symptoms but measurably improve patient outcomes when combined with optimized sleep. Optimizing sleep helps to reduce variability in clinical outcomes caused by poor sleep. The recent FDA approval of GLP-1 medications for sleep apnea treatment exemplifies this shift, opening pathways for new uses and indications based on these enriched data sets.

Payers are fundamentally motivated by clinical outcomes and healthcare cost reduction. Sleep interventions need to, and can, demonstrate both: measurable clinical improvements and reduced healthcare utilization costs. The key for payers lies in evidence showing that sleep optimization prevents expensive downstream interventions - emergency department visits, hospital admissions, and progression of chronic conditions.

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"Sleep data offers pharma the opportunity to transform subjective quality-of-life endpoints into objective, measurable outcomes. If we can show that improving sleep enhances patient outcomes with our medications, that creates tremendous value - both for getting better drugs to patients and for demonstrating real clinical differentiation to payers."

"If you can show improved clinical outcomes and decreased healthcare cost utilization through sleep interventions, you have a winner with payers. That's the holy grail everyone talks about but few achieve."

Director of Market Access, Neurology,
Top 10 Global Pharmaceutical Company

"Validated clinical data is a fundamental requirement for payers, showing not just sleep improvements, but improved clinical outcomes as a result of improved sleep. These improvements must lead to considerable ROI. Only then will it be prioritized by payers."

Charles Stemple,
Former Medical Director, Humana

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The Next Frontier

Integration with Healthcare

The growing demand for digital, connected sleep health devices is also revealing key barriers that must be addressed to realize its full potential.

Key Challenges to Healthcare Integration

The Education Gap

Formal medical education on sleep is still lacking. Currently medical students receive about 2 hours of sleep medicine content in total, leaving most providers unprepared to interpret or recommend sleep solutions.

Research Dissemination

Despite ample research, awareness among HCPs is still lacking. There is a need for enhanced dissemination of existing research connecting sleep to health outcomes, and increased collaboration between industry and academia.

Reimbursement Uncertainty

Insurance coverage related to digital sleep technology is limited, restricting patient access and system adoption. Studies explicitly connecting clinical findings to financial ROI are needed to encourage payer coverage of connected sleep solutions.

Workflow Disruption

Amid time constraints and growing HCP shortages, data must be easy to review and interpret, placing minimal burden on providers. Solutions should seamlessly integrate into existing workflows to support efficient care delivery.

Health Inequities

Access inequalities, such as the cost of solutions, are a barrier to widespread adoption among patients. Reimbursement models need to shift toward preventative care methods rather than focusing on treatment of conditions alone.

Daniel Buysse, M.D.
Professor of Psychiatry,
University of Pittsburgh School of Medicine

"Despite recognition of sleep's critical role in health, formal education on sleep remains limited within traditional medical training. As clinical knowledge expands but training durations remain fixed, clinicians face competing priorities. Offering accessible post-graduate education on sleep health can help close this gap; when available, the demand from clinicians is growing."

What Stakeholders Stand to Gain

Sleep is deeply tied to health outcomes. It's measurable and modifiable in ways that can advance clinical care, R&D, and public health.

What if we moved sleep into the core of clinical decision-making, chronic disease management, R&D agendas, and health policy? What value might be unlocked if providers, pharma, payers, and technology companies truly prioritize sleep as a strategic, preventative, and therapeutic target?

Patients & Consumers

Optimizing sleep provides a powerful opportunity to address challenges associated with menopause, mental health, obesity, recovery, and more. This transforms sleep into a **daily opportunity to improve health quality and longevity,** aided by innovative, adaptive response solutions that automatically adjust to individual needs.

Providers

Personalized sleep interventions provide a **new layer of clinical insight**, supporting **earlier identification of sleep-related drivers of illness and enabling more holistic, longitudinal care.** Intervening upstream in sleep reduces the need for more intensive interventions downstream, **aligning with Value-Based Care**, where provider incentives reward prevention and cost reduction.

Pharma

Targeting sleep as a modifiable factor helps pharma **reduce variability in clinical outcomes caused by sleep's influences on disease progression, drug response, and adherence**. This can **sharpen therapeutic differentiation and enhance real-world efficacy and tolerability**. Sleep also opens new innovation pathways, from non-habit-forming sleep aids to adjunct therapies for conditions like OSA, expanding pipelines and increasing the value of existing drugs.

Payers

Early intervention in sleep issues can **reduce downstream costs** tied to chronic conditions, ER visits, and poor medication adherence. By supporting sleep optimization tools, payers can **drive better population health outcomes and align with value-based care goals.**

Employers

Improving employee sleep is a cost-effective way to **boost productivity, reduce absenteeism, and counter the economic burden** of sleep issues like insomnia, which costs U.S. employers an estimated $3,000 per employee annually in lost productivity. For self-insured employers, the ROI is even stronger: **better sleep lowers healthcare claims tied to sleep disorders and related comorbidities, delivering both immediate operational gains and long-term savings.**

Government

Active sleep interventions offer a scalable way to address what has already been declared a public health crisis. Healthier sleep patterns across populations can **improve learning, reduce chronic illness, and lower healthcare spending**, while promoting social and economic resilience.

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Conclusion

Sleep Health

From Overlooked to Optimal

Sleep has evolved from a neglected wellness afterthought to a recognized core pillar of health - one that impacts 8 of the 10 most common chronic conditions and costs the U.S. economy $400 billion annually. Yet despite this recognition, sleep remains one of the least measured and least managed determinants of health.

The convergence is unprecedented - consumer demand is surging, technology has achieved clinical-grade accuracy, and real-time interventions are delivering measurable outcomes. A growing number of consumer form factors are used at home, including smart bed technology that now offers continuous, passive monitoring that automatically optimizes health in real-world environments. The question is how quickly stakeholders will embrace its potential.

Success requires coordinated action across stakeholders - healthcare providers integrating sleep data into routine care; pharmaceutical companies harnessing sleep data to develop and distinguish new medicines to help more patients; payers recognizing sleep optimization as a cost-effective intervention for population health; and technology innovators bridging the gap between consumer engagement and clinical validation.

Sleep health represents the next frontier in preventive, personalized medicine. Organizations that act now, whether through clinical integration, research partnerships, or policy development, could lead the transformation from reactive treatment to proactive health optimization.

It is time to adopt sleep as a fundamental aspect of preventive care and clinical practice.

The infrastructure exists. The evidence is clear. The strategic opportunity is significant.

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