# The Smart Bed:
The Ideal Platform for Improved Health and Better Care

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Executive Summary

We spend 1/3 of our lives in bed, resting. When we are sick or hospitalized we recuperate in bed. Why isn’t the bed more intelligent, given the amount of time we are in it? Imagine the power of gathering health information continuously and cost-effectively in such a consistent environment – a place that every one of us is physiologically required to be in a large portion of our lives. The bed is the ultimate setting to collect biometric data for improved healthcare.

Accurate electronic monitoring of biometric information is a routine part of health care delivery. However, health monitoring currently consists of a byzantine collection of invasive, single-function solutions, most of which are incompatible with each other due to closed proprietary medical systems. Examples include connected telemetry devices such as heart rate monitors, pulse oximeters, blood pressure cuffs, and so on.

Conventional hospital beds with remote monitoring capabilities are complex and cumbersome, and cost as much as $30,000, putting them beyond the reach of most senior living communities and residential settings. Patient monitoring devices connected to a patient with intrusive wires issue loud alerts and often lead to “alarm fatigue”.

Modifying these costly beds and invasive monitoring devices could provide a much better experience for patients and ease the burden on caregivers responsible for managing these complicated beds and multitude of devices. Since most health monitoring occurs while a person is in bed, an intelligent “Smart Bed” is the ideal platform for improved health and better care.
Evolution of the Smart Bed

Smart Beds have evolved from simple electronically operated hospital beds to touch-free, intelligent, and connected monitoring systems that can work in any setting.

The concept of the Smart Bed originated when single-function capabilities were added to hospital beds. A trained caregiver could electronically manipulate the shape and functions of these beds. Any intelligence the beds possessed was mostly limited to tracking bed positions and providing local or remote alarms if pre-set configurations changed. This first generation of smart bed was more about the bed than the patient. It did not provide crucial biometric data about the patient, such as heart rate and breathing rates. Caregivers usually gathered this information via single-function monitoring systems that they had to attach directly to the patient in some way.

The new generation of Smart Bed technology, pioneered by BAM Labs and its partners, provides 24x7 touch-free, non-intrusive monitoring of biometric health data and trends. It offers an “invisible” platform that does not require invasive wires or electrodes to be connected to the patient. It offers the power of the Cloud and caregiver applications to analyze and display health data in a user-friendly format via a mobile device or computer anywhere in the world. People can use this Smart Bed technology in any setting to monitor their own health, accumulating life-long data on health trends. Family caregivers can now remotely monitor their loved ones’ health via mobile devices or the internet.

This innovative touch-free Smart Bed technology provides interpretive capabilities through bio-signal processing, enabling a breakthrough in new types of healthcare solutions. It provides a powerful medical-grade solution for monitoring key health trends, preventing pressure ulcers, and helping to reduce falls. BAM Labs’ Cloud based solution provides a versatile platform that can evolve to accommodate future applications for conditions such as arrhythmias and apneas.

BAM Labs and its partners are making the Smart Bed the ideal healthcare platform for every body in every healthcare setting, from hospital to assisted living to the home.
Three Critical Problems in Health Monitoring

There are three critical health-monitoring problems associated with bed-bound patients: the need to track vital sign data (heart and breathing rates), patient motion to prevent pressure ulcers, and patient presence in bed to reduce falls from unplanned bed exits.

1) Continuous Tracking of Vital Signs
Health care professionals find great value in 24/7 vital sign trend monitoring — if the data is manageable. There is no shortage of devices and sensors collecting data, but they often generate reams of unfiltered data that may or may not be relevant to a physician or nurse. The challenge for technology providers is to offer a connected care solution that includes powerful data processing and a friendly user interface to present relevant data.

The California Healthcare Foundation produced a seminal report in 2011 titled, The Connected Patient: Charting the Vital Signs of Remote Health Monitoring. As noted by the author, Jane Sarasohn-Kahn, M.A., M.H.S.A.: “In the United States, nearly 18 percent of hospital patients are readmitted within 30 days of discharge. By some estimates, as many as three in four of these events could be prevented with improved post-hospitalization care...according to the Centers for Medicare and Medicaid Services, over half of readmitted patients received no follow-up care in the 30 days after hospitalization. Nearly one-fifth of Medicare beneficiaries discharged from a hospital are rehospitalized within 30 days, and 34 percent are rehospitalized within 90 days. The Medicare program alone could save $12 billion a year from readmissions if remote patient monitoring were widely used in homes....”

For patients needing continuous vital sign trend reporting, being hooked up to tubes, straps, and probes is very unpleasant and often impractical. Now, a touch-free Smart Bed system is available to unobtrusively collect around-the-clock vital data trends on the patient’s heart and breathing rate, motion, and bed presence. This significant amount of continuous data needs to be documented to track trends, and is frequently transmitted to remote locations, such as doctor’s offices, home health care providers, and even family homes using secure internet Cloud technology and standard mobile devices to view the collected data. Could this elegant, affordable, and user-friendly solution save Medicare $12 billion by reducing readmissions? Perhaps.

2) Pressure Ulcers (Bedsores)
Pressure ulcers are devastating to patients and a costly issue in every healthcare setting. Effective and timely repositioning is required to prevent pressure ulcers and preclude unnecessary returns to acute care, or to a higher level of care within a post-acute setting. Pressure ulcers not only threaten the life of the patient, but also clog the health care system and drive up costs. Numerous studies have documented the cost and frequency of pressure ulcers and the corresponding impact on lost revenue.
Three Critical Problems in Health Monitoring (cont.)

A 2007 study concluded that an average of 16.7% patients develop pressure ulcers in skilled nursing facilities (SNF). The cost of treating each pressure ulcer in a SNF costs an average of $1,284 to $4,647, and around $25,000 in a hospital. In a 100-bed facility treating 500 patients annually, costs could exceed $300,000 per year. 17.6% of residents admitted to a SNF without a pressure ulcer present on admission (POA) were discharged back to an acute setting within 30 days. However, with a pressure ulcer POA, the re-hospitalization rate almost doubles to 34.7%. In either scenario, the patient’s well-being is compromised and the cost to the healthcare institution and third-party payers can be financially catastrophic. A settlement in the western United States yielded a $12.8 million award to the plaintiff for a pressure ulcer that developed in a SNF.

The cost and frequency of these pressure ulcers can be influenced by many factors, including patient setting and operational excellence. Better turn management can significantly reduce costs, revenue can be recaptured, and, most important, patient outcomes can be greatly improved.

3) Unscheduled Bed Exits (Patient Falls)

Another serious health care problem is bed exits – particularly unplanned and unassisted. Thirty-five percent of elderly individuals have experienced one fall per year, and 40% of those falls resulted in an expensive visit to an emergency room. Half of all residents in a Long Term Care facility fall each year. The average hospital stay following a fall is 13.9 days. The cost of hospitalization for these falls, including an average 13.9-day stay, is $17,734. When other costs are included, the average cost of a fall is $19,000. Facilities are, on average, responsible for just 5% of these falls, but the costs are dramatic. Lost revenue during these events is more than $3,000. Falls by elderly residents are anticipated to cost $43.8 billion by 2020.

Healthcare providers need a better solution to predict, detect, and prevent unscheduled bed exits.

Any patient who leaves the bed without notice creates a health and financial liability. Caregivers also need to be alerted when a patient has not left the bed for a significant amount of time to engage in prescribed physical activity. Healthcare professionals know that proactively keeping a patient up and active leads to faster recovery and better health. Reducing the number of falls also helps maintain a consistent revenue stream for nursing homes by ensuring the safety of current patients. A more stable census helps control the high cost of acquiring new patients.
How Smart Bed Technology Addresses The Problems

BAM Labs’ FDA-registered TLC Smart Bed System empowers caregivers to easily and efficiently monitor essential health information wirelessly, anytime and from anywhere. Without touching the individual, the TLC System’s reusable, under-mattress bed sensor captures biometric trend data and transmits it via a small wifi network device to BAM Labs’ HIPAA-compliant cloud-monitoring platform. Here the data is processed for analysis and reporting of heart rate trends, respiration rate trends, body movement, bed exits and position changes. Clinicians, professional caregivers, and authorized family members can easily and securely monitor this information via user-friendly applications on any internet connected device such as PCs, Macs, Android phones, Apple iPhones, iPads, and the iTouch. IT leaders are pleased that the information can be integrated with EMR/EHR systems via an open architecture. Automated data collection helps reduce caregiver liability, enables patients to stay in one place longer, and reduces transfers to other more expensive care settings.

Captures Vital Sign Information for Better Health Management

Smart Bed technology can detect heart rate trends, breathing rate trends, and motion to proactively identify health issues and the impact of new medications. Because quality of sleep can be an early indicator of dementia and serious health conditions — including adverse reactions to medications, depression and stress — the TLC System also monitors nightly sleep quality by comparing sleep duration, restlessness, nightly heart rate and breathing rate to long-term trends and medical standards.

Improves Repositioning to Prevent Pressure Ulcers

The TLC System has been proven to reduce the incidence of pressure ulcers by over 80% within 30 days of implementation. Turns can be scheduled by patient, and the TLC System automatically alerts caregivers when a turn is due or has been missed. Turns are automatically validated and recorded through motion events matched with caregiver notations.

Prevents Falls from Unscheduled Bed Exits

The TLC System’s easy-to-read icons alert care staff to patient agitation and motion, encouraging them to get to the patient quickly before a fall occurs. These alerts can also prevent incontinence events. The TLC System also tracks in-bed duration to encourage up and active rehabilitation programs. In a study of senior residents using the TLC System at a Care Home By RNs residential care facility, no falls or new bedsores were recorded.

Statistics

Over a six month period across multiple facilities, the TLC System reduced falls by 43% while improving validation of position changes by 155%
Who Benefits from Smart Beds?

Smart Beds benefit people in any setting. Affordable, touch-free, non-intrusive monitoring of biometric data, with Internet Cloud connectivity for storage and rapid analysis of long-term data, delivers advanced benefits to acute care settings, post-acute care environments such as skilled nursing and long term care facilities, senior living centers, and even individuals in their home.

1) Acute Care Environments
In hospitals and other acute-care settings, only a small fraction of beds are usually equipped with remote monitoring capabilities, primarily for the most acutely ill patients. Now, all patient beds and caregivers in hospitals and other acute-care settings can gain from the new Smart Bed technology. Intelligent under-mattress biometric sensors eliminate the need to repeatedly sterilize monitors and remove the cuffs and wires normally associated with vital sign monitors. Caregivers are no longer burdened by the constant preparation and “hooking up” of monitors to patients. The friendly data reporting format supports a team approach allowing all staff to see patient information. Caregivers can receive timely alerts at the nurse’s station or via smartphones and tablets anywhere in the hospital regarding vital sign trends, body movement, and bed presence. In addition, a patient’s information can be securely accessed by doctors and other authorized members of a patient’s care network in remote locations.

2) Post-Acute Environments: Skilled Nursing and Senior Living Communities
The same Smart Bed benefits that accrue to acute-care settings are extended to post-acute care settings such as senior living communities, long term care facilities and skilled nursing facilities where it may be more difficult to provide 24x7 bedside care.

“The TLC System helps keep our residents safe while protecting their dignity, enabling us to provide treatment and care with respect. Automated recording of bed exits, time out of bed, and position changes can reduce the paperwork burden on caregivers and provides easy to read management reports about the activities of residents which help ensure our rehabilitation, pressure ulcer and fall prevention programs are maximized.”

- Alex Candalla, Executive Director of The Terraces of Los Gatos
Who Benefits from Smart Beds? (cont.)

The new Smart Bed technology enables caregivers to monitor patient status or receive discreet timely alerts while making their rounds, working in the nursing station, or even taking a break. Skilled nursing and senior-living center directors will appreciate the continuous online documentation of treatment to track the real-time health status of their residents. When family members call, the director can view current data on individual patients via any mobile device, such as an iPhone or iPad. In addition, the Smart Bed system's vigilant monitoring of repositioning and bed presence can dramatically reduce the return of patients to acute care and stabilize the resident population. This solidifies the revenue stream for these communities and facilities, helps maintain or enhance Federal (CMS) and State compliance ratings, and enhances their invaluable reputations.

“BAM Labs’ TLC System enables caregivers to collect patient data, so we can implement person-centered care based on patterns and trends specific to the individual, which is far more valuable than dealing with a one-time episode.”

- Dayna Hurst, RN and Campus Director at Sisters of the Holy Names

3) Home Environments

Surveys show that aging adults wish to remain at home – to “age in place” – even when managing multiple chronic conditions. This puts a great burden on the families taking care of their loved ones. The introduction of Smart Bed technology for personal use in any home promises to alleviate much of the burden by enabling families to affordably provide their loved ones with 24x7, touch-free remote health monitoring. Anyone can monitor a family member’s health trends from anywhere, eliminating much of the anxiety caused by living at a distance from their relative.

For professional home care and home health providers, Smart Bed technology provides an affordable, easy to use connection to their clients. Deteriorating health trends can be spotted sooner and validated through continuous online data reporting. Imagine identifying an adverse reaction to medication through sleep trend data before symptoms present themselves to visiting caregivers. Staff can become more efficient, allocating their time across more patients and clients, while providing a higher level of informed care. Ownership and management can monitor patient and client health levels – and staff performance – remotely, to determine how to better serve patients and clients.

“BAM Labs’ TLC System enables us to remotely monitor residents ranging from trends in their heart rate and respiratory rates to bed exits and bed turns. A smart monitoring device without wires is a big plus and an exciting new development that puts Care Homes by RNs at the forefront of smart residential care homes.”

- Ron Ordona
  MSN, RN for Care Home by RNs

People of all ages and health conditions will want to take advantage of this extraordinary new technology to begin tracking health and sleep patterns at their own homes. All of us will be able to capture a lifelong database of our own biometric data across a lifetime to continuously improve health.

Conclusion: The Smart Bed is the Ideal Health Platform for Every Body

Silicon Valley innovator and Smart Bed technology pioneer BAM Labs was founded with the realization that empowering people and their caregivers with access to more, better and timely information about their health through an effortless platform – sleep – would lead to better health and better care.

BAM Labs’ TLC Smart Bed System can help people “age in place” by extending their lives with better preventative health monitoring in the setting of their choice. Indeed, every body can benefit from this continuous, non-invasive health monitoring of vital biometric information. It enables people of all ages and health status to steward their own personal health. In the future, we can expect that nearly everyone, from birth to the end of life, will wake up each day to a friendly medical report on the state of his or her health. BAM Labs and their industry leading partners are pioneering this revolution in healthcare by making the Smart Bed the ideal healthcare platform for every body in every healthcare setting, from hospital to the home.
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