

# New Patient Mobility Monitoring Technology Significantly Reduces Rates of Hospital-Acquired Pressure Injuries

## An Analysis of Data Collected from Over 10,000 Patients

### Abstract

Hospital acquired pressure injuries (HAPIs) are serious, costly, and preventable conditions that affect more than 2.5 million patients each year and drive up the cost of healthcare in the United States by up to \$11B annually.<sup>1</sup> The standard of care to prevent pressure injuries is to turn patients every two hours, day and night. Even though this standard has been accepted since Florence Nightingale first introduced it during the Crimean War, pressure injuries continue to plague our healthcare system. However, institutions that have deployed the Leaf Patient Monitoring System, a tool which allows caregivers to more effectively manage patient turning protocols, have experienced significant decreases in rates of pressure injuries. An analysis involving over 10,000 patients reveals the strong protective effect of the Leaf System — patients prescribed Leaf are far less likely to develop devastating pressure injuries during their hospitalizations.

## Background

Pressure ulcers, also called pressure injuries, are painful and life-threatening complications that occur when immobile patients spend too much time in a single position. This problem is widespread, affecting more than 2.5 million patients each year in the U.S. and costing the nation's healthcare system up to \$11B annually.<sup>1</sup> Critically ill patients are at greatest risk for developing pressure injuries because they are immobile, have reduced tissue perfusion, and often require mechanical ventilation and hemodynamic support.<sup>2</sup>

Pressure injuries became a high-profile issue in 2008, when the Centers for Medicare and Medicaid Services discontinued reimbursement for the treatment of facility-acquired pressure injuries, labeling them as preventable complications and characterizing them as “never events.” As a result, hospitals were forced to absorb the cost of pressure injuries, which on average exceed \$10,000 per injury.<sup>3</sup> Given that pressure injuries impact both clinical and financial outcomes, there is a very real need to improve prevention methods.<sup>1, 4</sup>

Pressure injuries form when there is prolonged pressure, particularly over bony prominences like the sacrum, coccyx, heels and occiput. The sustained pressure compresses tissue, which impairs blood flow and can lead to localized tissue damage and cellular death. Pressure injuries are generally first visible as areas of red or irritated skin, but they can quickly develop into open and extremely painful wounds if the pressure is not alleviated.<sup>5</sup>

The current standard of care to prevent pressure injuries is to turn patients at least every two hours, around the clock. Turns also need to be large enough to provide adequate pressure offloading and sustained for long enough to allow tissues time to recover from the pressure insult. Studies have found that adherence to patient-turning protocols is very low, varying from 38% to 66%, and that a significant number of patients simply are not turned or moved as often as recommended.<sup>6, 7, 8</sup> Turn protocol adherence is even lower in intensive care units, typically no higher than 51%.<sup>9, 10</sup>

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The Leaf System has been deployed in hospitals across the United States, throughout a variety of care settings.

## Mobility is Medicine

It is important to recognize that turning and mobilizing hospitalized patients is good medicine. The complications of immobility are well established and potentially devastating. Studies have consistently demonstrated that immobilized patients are more likely to experience a variety of complications:

- **Cardiovascular:** Increased risk for deep vein thrombosis and pulmonary embolisms. Increased risk of gravitational equilibrium and orthostatic hypotension.<sup>12</sup>
- **Respiratory:** Greater chance of hospital-acquired pneumonia and impaired pulmonary function.<sup>10-13</sup>
- **Neurologic:** Greater danger of developing delirium, anxiety and pain.<sup>14</sup>

- **Gastrointestinal:** More potential for paralytic ileus/constipation and altered digestion.<sup>15</sup>
- **Musculoskeletal:** Deconditioning, muscular atrophy, and loss of coordination and balance.<sup>16</sup>

But, as with all good medicine, therapeutically beneficial turning and mobility requires three things: Providing care for the right patient, at the right time, at the right dose. This means:

### 1. Turning/mobility protocols need to be customized to the patient's individual care needs.<sup>5</sup>

- Patients at risk for complications of immobility should be prescribed a mobility protocol.
- Mobility protocols should be personalized, not one-size-fits-all.

### 2. Turns should be provided in a timely fashion.

- Turns should be provided as often as necessary to prevent complications.
- Credit should be given for any adequate patient self-turns.

### 3. Turning/mobility interventions need to be “dosed” appropriately.

- Each turn must be large enough (i.e. turn angle) to provide adequate pressure offloading.
- Each turn must be sustained long enough to provide adequate tissue reperfusion time.

## Leaf System Optimizes Patient Repositioning in a way that was Previously Not Possible

Patient turning protocols have existed for more than 100 years. However, despite their apparent simplicity, these protocols are difficult to implement because there has historically been no instrument to monitor patient movement and help provide adequate turn dosing – until the Leaf System was introduced.

The Leaf System helps reduce the incidence of pressure injuries by ensuring 1) adequate turn frequency, 2) sufficient turn magnitude (“turn dose”), and 3) adequate tissue reperfusion time between turns.

Traditionally, turning protocols have only focused on patient turn frequency. Leaf reduces pressure injury rates by not only optimizing patient turn frequency but by also ensuring that turns are large enough to provide adequate pressure offloading and sustained for long enough to allow tissues time to recover from a recent pressure insult.



#### Turn Frequency

Ensure that turns are provided as often as necessary, but not more often than necessary.



#### Turn Angle

Ensure that turns are of sufficient magnitude (turn angle) in order to provide adequate pressure offloading



#### Reperfusion Time

Ensure that pressurized tissues are given enough time for reperfusion between turns.

## Abundant Evidence: The Leaf System Works

Analyses of the Leaf System by several institutions revealed two things: First, adherence with patient turn protocols significantly increases at hospitals once they begin using the Leaf System. Second, the number of pressure injuries is significantly reduced in institutions using the Leaf System.

Nurses can focus on the specific patients who need their attention and not unnecessarily disturb those who do not.

The Leaf System improves the efficacy and efficiency of turning protocols by notifying nurses when a specific patient must be repositioned, and the system ensures patients are repositioned sufficiently to allow for adequate tissue offloading and reperfusion. Nurses can focus on the specific patients who need their attention and not unnecessarily disturb those who do not.

Studies have confirmed the clinical effectiveness of Leaf monitoring in a variety of settings. Researchers have also 1) assessed nursing attitudes about patient repositioning with and without the Leaf System,<sup>17, 24</sup> 2) studied the impact of turn adherence on the probability of hospital-acquired pressure injuries<sup>28</sup>, and 3) assessed the impact of using technology to aid in turn protocols, including in critically ill patients.<sup>18, 19, 22, 23, 29</sup>

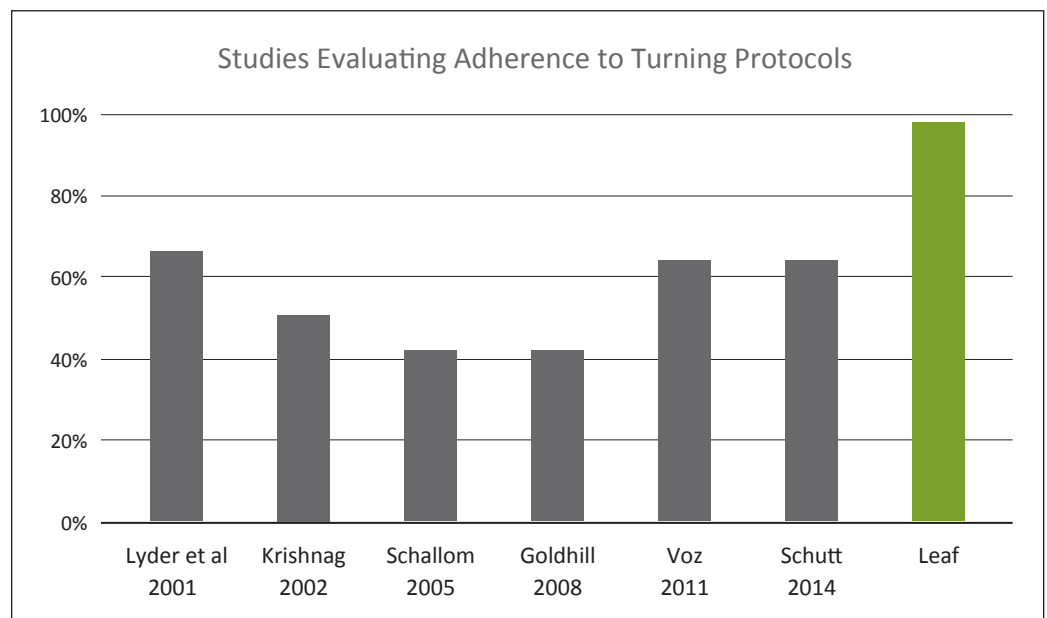
All of these analyses — which have been presented at a variety of medical conferences — demonstrate that the Leaf System makes it easier for nurses to efficiently manage patient turning protocols, improves institutional adherence with these protocols, and improves nursing workflow and sense of teamwork, which all translates into a significant reduction in rates of pressure injuries.

Seven key analyses clearly demonstrate the measurable benefits provided by the Leaf System:

### 1. Leaf Improves Turn Protocol Adherence

A non-randomized, prospective empirical study<sup>19</sup> on a 39-bed medical unit with 139 subjects found that turn adherence rose to 98%, from a baseline of 64%. The increase in adherence was even more significant in patients in isolation rooms. Their adherence rose to 99%, compared to the baseline of 48%.

As the chart at the right shows, six major studies have found that, without Leaf, turn protocol adherence ranges between 42% and 66%. The Leaf System dramatically improves adherence to patient turning protocols.<sup>19</sup>



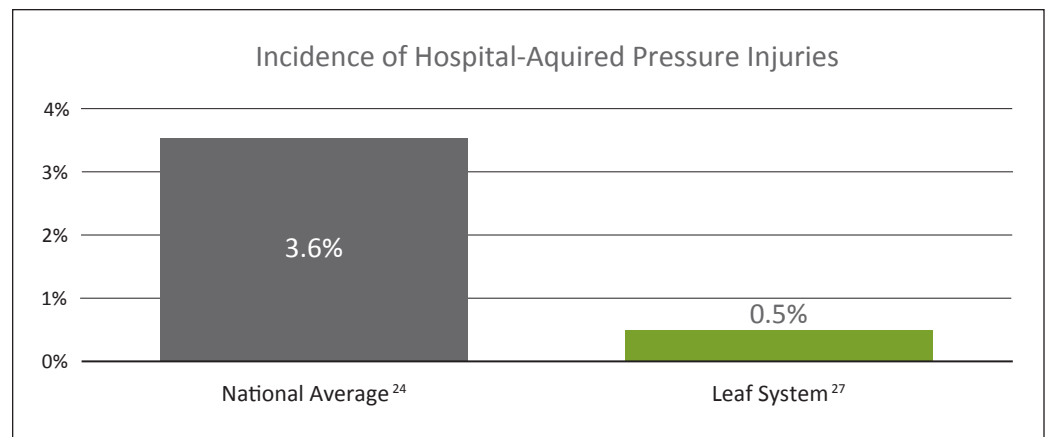
After analyzing more than 4,000 patients over 350,000 hours, it became evident that when a patient's turn protocol adherence dropped below 85%, the risk of pressure injury went up by over five times.

## 2. Leaf Predicts the Risk of Pressure Injuries

A study involving 11 nursing units at four acute care hospitals<sup>27</sup> found that turn protocol adherence was highly correlated to pressure injury risk. After analyzing more than 4,000 patients over 350,000 hours, it became evident that when a patient's turn protocol adherence dropped below 85%, the risk of pressure injury went up by over five times. By keeping a patient's turn protocol adherence consistently above 85%, an institution significantly reduces the risk of developing a positioning-related pressure injury.

## 3. Leaf Decreases Rates of Pressure Injuries

An analysis of over 5,000 patients from a variety of acute care settings investigated Leaf's impact on pressure injury rates. The analysis revealed that the average turn protocol adherence in patients monitored by Leaf was over 90%, almost double established literature benchmarks. This significant improvement in patient repositioning translated into dramatic reductions in pressure injury rates — patients protected by Leaf were over 7x less likely to get a pressure injury relative to the national average<sup>27</sup>.



## 4. Leaf Provides an Immediate Return on Investment

A 30-day, 49-patient study in a Level 1 trauma ICU found that use of Leaf technology increased turn protocol adherence to 94% and reduced hospital acquired pressure injuries by 85%. The research team concluded that the reduction in pressure injuries in just the first month alone provided savings of more than \$71,500 in non-reimbursable treatment costs.<sup>20</sup>

## 5. Leaf Increases Caregiver Efficiency

A process improvement project undertaken in a 27-bed medical/surgical unit with 69 monitored patients improved average turn protocol adherence to 90% because the data "provided evidence to exclude patients with high mobility/activity sub-scores from turn protocol." Data also suggested that clustering certain nursing tasks "improved staffing effectiveness and adherence."<sup>19</sup>

## 6. Leaf Helps Nurses Prioritize Patient Care

A nursing study aimed to investigate why patient repositioning is among the most frequently missed nursing care activities.<sup>22</sup> Fifteen nursing units in eight acute care hospitals were surveyed before and after the deployment of Leaf technology to determine what impact the monitoring system had on nurses' routines. An overwhelming number of nurses — 99% — said

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The Leaf System was then implemented in these nursing units. One month later, the same cohort of nurses was surveyed. After implementing Leaf, only 6% of nurses felt that timely patient turning was “difficult or very difficult.” Most nurses felt that Leaf made it easy to identify which patients required repositioning (86%), improved unit teamwork (75%), and helped to prioritize workflow (71%). After implementing Leaf, the average turn protocol adherence at the eight hospitals rose to 90%.

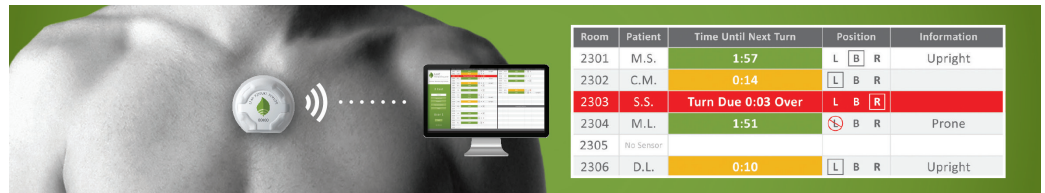
## 7. Leaf Helps Reduce Equipment Expenses

Frequent patient repositioning has been shown to be the most effective ways of preventing hospital-acquired pressure injuries. Interestingly, pressure-redistribution mattresses do not significantly impact HAPI rates.<sup>24, 25</sup> Despite this, specialty beds are often used as a substitute for good patient repositioning.<sup>2</sup> By ensuring optimal patient repositioning, the Leaf System can be used as a more cost-effective alternative to pressure redistribution mattresses. In fact, the Leaf System has been shown to reduce rental bed usage and expenses by over 75%.<sup>26</sup> Bed selection algorithms that incorporate Leaf can be used to drive more cost-effective usage of specialty support surfaces.

## How Leaf Works

The Leaf System is the first to track all the movement and activity of hospitalized patients—whether patients are bed-bound, chair-bound, or ambulatory.

The Leaf System continuously analyzes all patient movements to help ensure that prescribed turning or mobility goals are being met.



The easy-to-use technology has three main components:

- **Patient Sensor:** A wireless, disposable sensor attaches to patients using an industry-leading, medical-grade adhesive. The sensor automatically recognizes when it is attached to a patient and immediately begins monitoring the patient’s position and activity.
- **Wireless Network and Data Server:** All patient movement data, including turns in bed, number of bed-exits, steps taken, distance traveled, time spent sitting, and time spent ambulating is transmitted wirelessly, via a plug-and-play wireless network, to any web-enabled device (i.e. wall displays, desktop computers, tablets, smartphones, etc.).
- **User-Interface:** The Leaf user-interface provides real-time, actionable information at a glance, with current patient position, turn priority, progress toward mobility goals, and alerts to actionable items clearly displayed in a visual manner that avoids contributing to nuisance alarms and alarm fatigue.

By maximizing patient mobility, patients will leave the hospital faster, healthier, and less likely to require readmission.

The Leaf System allows care providers to reliably monitor a patient’s current mobility status and overall progress. This monitoring tool enables more effective coordination of patient turning and mobility protocols, which streamlines workflows and improves staff efficiency. By maximizing patient mobility, patients will leave the hospital faster, healthier, and less likely to require readmission.

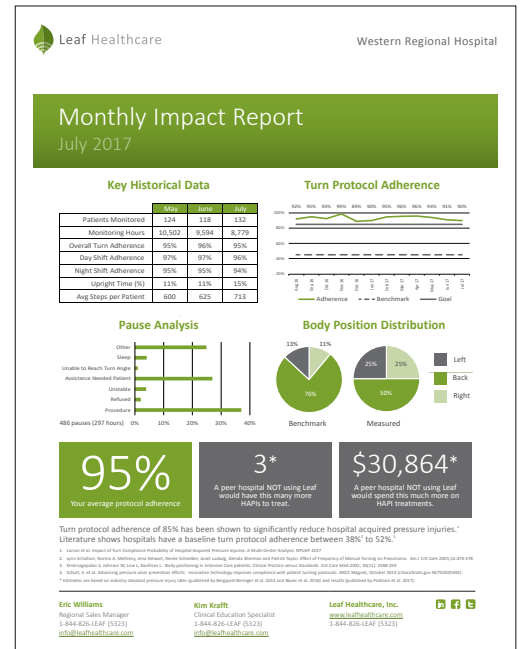
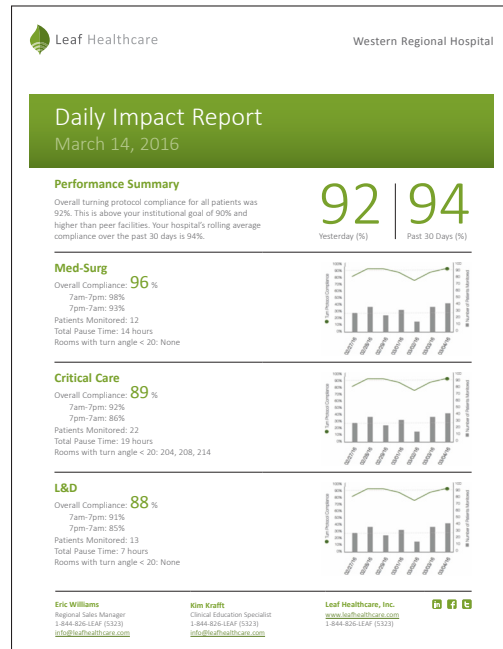
## Actionable Information

The Leaf System does far more than notify staff when a patient needs to be turned or mobilized. In addition to helping nurses optimize patient positioning, hospitals are also finding the data analytics that the Leaf System provides to be valuable.

The Leaf System automatically documents every patient’s turn history — including the time of a turn, the patient’s orientation and the duration of the turn. This offers a significant advantage over manual charting done by overworked nurses. Such manual charting is often light on details and, depending on the pace of a shift, often goes undone. Additionally, retrospective manual charting of mobility can sometimes be inaccurate or inconsistent with other patient care documentation, thus presenting a liability.

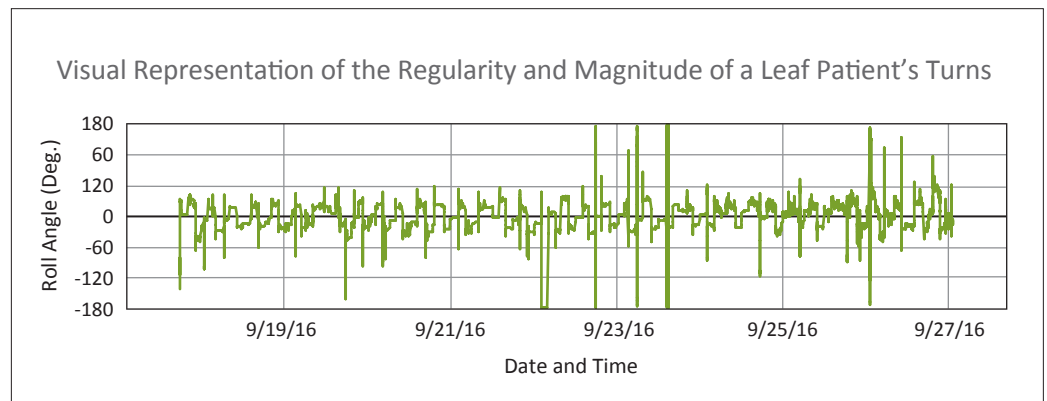
Daily Impact Reports by unit and shift reward and motivate staff to sustain the high levels of adherence to mobility protocols Leaf produces.

Monthly Impact Reports provide insights to facility-wide turning behaviors useful to administrators and managers striving to improve the efficiency and effectiveness of nursing care.



The Leaf System can provide detailed information about individual patients, or aggregated information by unit or facility. These reports not only demonstrate that patients were turned — but they also provide information regarding how well patients were turned and whether the turns were adequate to provide therapeutic benefit.

Extremely detailed individual patient reports documenting every position change, degree of change and mobility event prove invaluable for the root cause analysis of any incident. More often than not, this automatic detailed documentation can protect staff by demonstrating an incident was not mobility-related.



### This analytic functionality is useful in three ways:

- **Helps to optimize workflow.** The system can be used to prioritize high-risk patients, so that nursing staff focuses appropriately on patients who have the greatest need. Similarly, unit supervisors can determine whether there are differences in turn protocol adherence between shifts to help identify root causes and make changes to correct them. And chief nursing officers can quickly determine if the facility is adhering to its turn protocols and reaching its patient mobility goals.
- **Leaf helps with internal investigations of pressure injuries.** Although it's unlikely that a patient monitored by Leaf will get a pressure injury, if an unavoidable injury does occur, the Leaf documentation can be valuable. Most hospitals conduct a root cause analysis to determine why a patient developed a pressure injury. The detailed documentation provided by the Leaf System can help nurses and physicians to understand a detailed patient mobility history and identify potential mobility related causes of a patient's wound – and how best to avoid similar problems with other patients.
- **Leaf can help with litigation defense.** Many attorneys who specialize in pressure injury cases count on the fact that most hospitals do not reliably document patient turns. The result is costly settlements or court-imposed penalties. The Leaf System can provide detailed data to demonstrate that nursing staff did everything possible for a patient. By demonstrating the dynamics of a patient's care, hospitals can better defend themselves financially and reputationally.

## Conclusions

Frequent patient repositioning has been established as one of the most effective ways to prevent hospital-acquired pressure injuries. However, it has traditionally been difficult for nurses to keep track of patient position and ensure that patients are moving sufficiently. The Leaf System makes it easy to coordinate patient turning protocols efficiently and effectively. In addition, Leaf helps ensure that turns are dosed appropriately (i.e. turn angle) and maintained for a sufficient amount of time (reperfusion time).

By tracking turn frequency, turn dose, and reperfusion time, Leaf optimizes patient turning protocols in a way that was previously not possible. As illustrated by an analysis of more than 10,000 patients, Leaf's sophisticated approach to turn protocol management translates into significantly increased adherence to mobility protocols and significantly decreased rates of pressure injuries.



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### About Leaf Healthcare, Inc.

Leaf Healthcare creates wireless patient monitoring solutions for health care providers who are seeking more efficient and cost effective ways to improve patient safety and clinical outcomes.

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