

Patient Safety Tip of the Week

September 13, 2022

Smart Socks and Robots for Fall Prevention?

Fall prevention in both the hospital setting and the community is an important patient safety endeavor. Many have felt that technology would provide the solutions we are desperately looking for. But, to date, technology has failed to make much of an impact. Bed/chair pressure sensors, designed to alarm when a patient attempts to get out of bed or out of a chair, were widely touted as a fall prevention intervention. But randomized, controlled trials of bed/chair pressure sensors ([Shorr 2012](#), [Sahota 2014](#)) failed to demonstrate a reduction in patient falls. In fact, a systematic review and meta-analysis of clinical trials of in-hospital use of sensors for prevention of falls ([Cortes 2021](#)) actually found an increase of 19% in falls among elderly patients who are users of sensors located in their bed, bed-chair, or chair.

Bed pressure sensors have even had some unintended consequences. In our June 19, 2007 Patient Safety Tip of the Week [“Unintended Consequences of Technological Solutions”](#) we gave an example where a hospital purchased a new bed pressure alarm system intended to alert staff when a patient attempted to get out of bed. It turned out that on some units there were not enough electrical outlets for both the new bed alarms and the nurse call buttons. So, a decision was made in some cases to swap out these two devices. You can guess what happened: nursing staff responded to the “out-of-bed” alarm only to find the patient lying on the floor with an injury because he tried to get out of bed after no one responded when he pushed the nurse call button!

Enter the newest technologies...“Smart socks” and robots!

Moore et al. ([Moore 2022](#)) published results of a prospective study of **smart socks** to prevent falls in hospitalized patients. The smart socks contain pressure sensors which detect when a patient is trying to stand up. The system also uses a wireless connection to a monitoring device at the nurses’ station, and Smart Badge notification devices worn by the nurses. When the Smart Socks detect an attempt to stand up, the 3 closest nurses to the alarming room receive an alert through their badge. Once a nurse with a badge then enters the patient’s room, the alert is automatically deactivated. If none of the 3 nurses enter the room within the first 60 seconds, then it will escalate to the next 3 closest. At a total of 90 seconds, the system proceeds to an “all call” and alerts all Smart Badges logged on to the alarming unit. If staff are getting a patient out of bed for therapy, or a

bathroom visit, or any other activity, the alarms can be suspended via an in-room tablet before getting the patient out of bed.

We really like that alarm concept. In our many columns on alarm fatigue and alarm management, we have stressed the importance of alerting only those with a “need to know” but having an escalation capability in case no one heeds the alarm promptly. And, clearly, this alarm is a “good” alarm in that it is “actionable”, unlike so many other alarms that do not lead to any actions, and has a very low “false alarm” rate.

The study took place in neurological and neurosurgical based units at a major academic health center. Patients 18 years or older who were determined to be at risk for falls were eligible. During 13 months of data collection on 569 enrolled patients (mean age of 59.5 years), zero falls happened. That calculated to a fall rate of 0 falls per 1000 patient-days compared to a historical rate of 4 falls per 1000 patient-days at the study site that was observed in the general patient population that consisted of both patients with and without fall risk.

They also monitored nurse response times. During the study period, 5010 alarms were associated with the Smart Socks system. Only 11 of these were reported to be false alarms, so 99.8% of the alarms were true patient standing events. **Median nurse response time to each alarm was 24 seconds**, with a range of 1 second to nearly 10 minutes.

Despite the impressive results of this study, we still consider the conclusions to be preliminary. This was not a randomized, controlled trial. Comparison with historical controls is always subject to bias from unrecognized confounding factors. (Note also that the historical fall rate was on a population that also included some patients not at risk of falls.) Also, when the study began, a sample size of 2500 patients was estimated provide at least 70% power to detect a 25% reduction in the fall rate. But, largely because of the COVID-19 pandemic, they enrolled only 569 patients. Also, the fact that patients in the study were hospitalized for a median of 2 days suggests to us that few would have been a very high risk for falls.

In prior work with the smart socks system in patients at high risk for falls, Baker et al. ([Baker 2021](#)) reported on 567 patients in a single-arm clinical trial and 949 patients in an observational study in med-surg units at two hospitals. In the clinical trial, fall rate was reduced from 4 to 0 per 1,000 patient-days ($p < 0.01$). In the observational study, fall rate was reduced from 4 to 1.3 per 1,000 patient-days ($p < 0.05$).

Obviously, the next step before smart socks technology gets widely adopted would be for a true randomized, controlled trial. Remember, the bed/chair pressure alarms were also heralded early on as “the next best thing” in fall prevention. But they fizzled out when randomized, controlled clinical trials were done. But the smart socks system, with its unique alarm distribution pattern, certainly sounds exciting.

And, after we had already begun writing today's column, there was a report about a **robot that can predict and catch seniors before they fall** ([Verma 2022](#)). This robot, developed in Singapore, looks like a motorized wheelchair, with guard rails that come up to a person's hip and are outfitted with sensors to judge when a person begins to go off balance. Users are strapped into a harness. When they are starting to tip, the robot engages to keep them from falling.

The robot has only been tested in small numbers of patients, who suffered from strokes, traumatic brain injuries and spinal cord injuries. The developer is working on 2 models, an at-home model (estimated cost \$3000-4000) and a hospital version with a camera and multiple sensors (estimated cost about \$20,000). Obviously, more testing is needed and then the robot would have to go through the regulatory approval process, but developers are targeting potential availability in two years. This device obviously is targeted at a different population than the population for the smart socks.

Our success at reducing falls seems to have plateaued in recent years. It's nice to see some new potential interventions on the horizon.

Some of our prior columns related to falls:

- April 16, 2007 [“Falls With Injury”](#)
- July 17, 2007 [“Falls in Patients on Coumadin or Heparin or Other Anticoagulants”](#)
- January 1, 2008 [“Fall Prevention”](#)
- October 7, 2008 [“Lessons from Falls...from Rehab Medicine”](#)
- November 18, 2008 [“Ticket to Ride: Checklist, Form, or Decision Scorecard?”](#)
- August 4, 2009 [“Faulty Fall Risk Assessments?”](#)
- September 22, 2009 [“Psychotropic Drugs and Falls in the SNF”](#)
- December 22, 2009 [“Falls on Toileting Activities”](#)
- January 2010 [“Falls in the Radiology Suite”](#)
- June 2010 [“Seeing Clearly a Common Sense Intervention”](#)
- May 29, 2012 [“Falls, Fractures, and Fatalities”](#)
- June 5, 2012 [“Minor Head Trauma in the Anticoagulated Patient”](#).
- January 15, 2013 [“Falls on Inpatient Psychiatry”](#)
- March 2013 [“Sedative/Hypnotics and Falls”](#)
- December 3, 2013 [“Reducing Harm from Falls on Inpatient Psychiatry”](#)
- June 2014 [“New Glasses and Fall Risk”](#)
- July 8, 2014 [“Update: Minor Head Trauma in the Anticoagulated Patient”](#)
- August 2014 [“Cataract Surgery and Falls”](#)
- November 4, 2014 [“Progress on Fall Prevention”](#)
- March 2015 [“Another Paradox: Falls Due to Walking Aids”](#)
- June 9, 2015 [“Add This to Your Fall Risk Assessment”](#)
- July 28, 2015 [“Not All Falls Are the Same”](#)
- October 2015 [“Patient Perception of Fall Risk”](#)

- October 27, 2015 “[Sentinel Event Alert on Falls and View from Across the Pond](#)”
- February 16, 2016 “[Fall Prevention Failing?](#)”
- March 14, 2017 “[More on Falls on Inpatient Psychiatry](#)”
- July 2017 “[Mobility vs. Falls](#)”
- February 2018 “[Global Sensory Impairment and Patient Safety](#)”
- February 20, 2018 “[Delirium and Falls](#)”
- March 2019 “[Newborn Falls](#)”
- July 2019 “[Increasing Mortality After Falls in Elderly](#)”
- January 14, 2020 “[More on Newborn Falls](#)”
- June 16, 2020 “[Tracking Technologies](#)”
- October 2020 “[Pre-op Testing Before Cataract Surgery Leads to What?](#)”
- August 23, 2022 “[Yes, There is a Proper Way to Assess Orthostatic Hypotension](#)”

References:

Shorr RI, Chandler AM, Mion LC, et al. Effects of an intervention to increase bed alarm use to prevent falls in hospitalized patients: a cluster randomized trial. *Ann Intern Med* 2012; 157(10): 692-699

<https://www.acpjournals.org/doi/10.7326/0003-4819-157-10-201211200-00005>

Sahota O, Drummond A, Kendrick D, et al. REFINE (Reducing Falls in In-patient Elderly) using bed and bedside chair pressure sensors linked to radio-pagers in acute hospital. *Age Ageing* 2014; 43(2): 247-253

<https://academic.oup.com/ageing/article/43/2/247/10785>

Cortes OL, Pinerros H, Aya PA, et al. Systematic review and meta-analysis of clinical trials: In-hospital use of sensors for prevention of falls. *Medicine (Baltimore)* 2021; 100(41): e27467

https://journals.lww.com/md-journal/Fulltext/2021/10150/Systematic_review_and_meta_analysis_of_clinical.23.aspx

Moore T, Kline D, Palettas M, et al. Fall Prevention with the Smart Socks System Reduces Hospital Fall Rates. *Journal of Nursing Care Quality* 2022; Published online August 19, 2022

https://journals.lww.com/jncqjournal/Abstract/9900/Fall_Prevention_With_the_Smart_Socks_System.18.aspx

Baker PA, Roderick MW, Baker CJ. PUP® (Patient Is Up) Smart Sock technology prevents falls among hospital patients with high fall risk in a clinical trial and observational study. J Gerontol Nurs 2021; 47(10): 37-43
<https://journals.healio.com/doi/10.3928/00989134-20210908-06>

Verma P. This robot catches grandma before she falls. Washington Post 2022; September 10, 2022
<https://www.washingtonpost.com/technology/2022/09/10/fall-prevention-robot/>



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