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# Improving Patient Safety Through Video Monitoring

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## Abstract

**Purpose:** Falls are a major safety issue in rehabilitation settings. Patients receive mixed messages—try to be as independent as possible, but don't do anything in your room without calling for assistance. Despite the use of multiple falls interventions at this facility, the fall rate remained high. To impact this rate, the facility implemented a video monitoring system. This system allows for patients at risk for falling to be monitored from a remote location. The monitor technician is able to speak to the patient directly and/or contact staff members to respond to the room, preventing a fall.

Design: Sequential cohort design.

**Method:** Fifteen video monitoring units were installed on high-risk units in a 115-bed inpatient rehabilitation facility. Total falls and falls rates were tracked and reported pre- and postimplementation.

**Findings:** Over a 21-month period prior to implementing the video monitoring system, the average hospital-wide rate of falls was 6.34 per 1,000 patient-days (SD = 1.7488). After a year of usage, that average has decreased to 5.099 falls per 1,000 patient-days (SD = 1.524). The reduction in falls was statistically significant. In addition, there have been significant cost savings by reducing sitter usage.

**Conclusions:** Video monitoring can improve patient safety by decreasing falls; decreasing sitter usage and cost; and improving patient, family, and staff satisfaction.

**Clinical Relevance:** Falls are a significant issue in rehabilitation settings, and current fall prevention strategies fall short of reducing fall rates. Implementation of new video monitoring technology can help reduce fall rates in inpatient rehabilitation settings.

Keywords: Falls; safety issues; cost reduction.

## Introduction

Falls are an important quality issue for all healthcare facilities, especially in rehabilitation. Rehabilitation patients are being taught during their therapy sessions to try to be as independent as possible but are restricted by safety measures and are instructed not to get up without assistance when they are in their rooms. Falls occur nationally in rehabilitation settings at a rate of 9.5%–23% (Lee & Stokic, 2008; Saverino, Benevolo, Ottonello, Zsirai, & Sessarego, 2006; Teasell, McRae, Foley, & Bhurdig, 2002). Predicting falls in this population is a challenge (Forrest, Chen, Huss, & Giesler, 2013; Forrest et al., 2012; Salamon, Victory, & Bobay, 2012) and therefore results in a majority of patients being labeled as high falls risk on assessment instruments. As a result, many patients are provided with a multitude of interventions including bed alarms,

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chair alarms, low beds, fall mats, and sitters, none of which have been proven to prevent falls. The usefulness of bed alarms is mitigated by frequent false alarms (Capezuti, Brush, Lane, Rabinowitz, & Secic, 2009), and the alarms themselves have not been demonstrated to be effective in reducing falls (Shorr et al., 2012). In a study by Harding (2010), sitter use was not effective in preventing falls. New interventions must be explored to prevent falls, especially as inpatient rehabilitation units and facilities will be required to report falls to Centers for Medicare & Medicaid Services via the IRF-PAI in 2016 (Centers for Medicare & Medicaid Services, 2015).

Video monitoring is a developing technology that may be effective in falls prevention. Video monitoring is defined as the use of in-room fixed or portable cameras with speakers and a trained technician to directly observe patients from a remote location. The video monitor technician (VMT) uses the video feed and two-way audio communication to intervene when observing potentially dangerous behaviors. Although video monitoring has been available since 2012, there is little literature to support its use. A case study at Denver Health in 2013 demonstrated a prevention of 57 falls (Jeffers et al., 2013). A recent publication by Burtson and Vento (2015) revealed that when compared to the use of sitters or restraints to prevent patient falls, video monitoring technology outperformed or equaled established benchmarks, although no statistically significant reduction in falls was reported. There have been no studies published on the use of video monitoring in rehabilitation units or facilities.

In 2014, the facility became aware of this technology and began its video monitoring program. The purpose of this study was to compare the rates of falls before and after implementation of a video monitoring system, in addition to quantifying the costs saved as a reduction in falls and one-to-one sitter usage. It was hypothesized that fall rates would be significantly lower after installation of the system, both hospital-wide and on the brain injury unit where the majority of the cameras are located.

#### Methods

#### Setting

The referenced facility is a 115-bed freestanding inpatient rehabilitation facility in upstate New York. The hospital includes four inpatient units housing patients with diagnoses of neurovascular injury, brain injury, orthopedic joint replacement, and cardiac and pulmonary diseases. The focus of this project was on the 31-bed brain injury unit as historically a majority of falls occurred on this unit, although the mobile camera units could be moved throughout the building as needed.

#### Equipment

After researching several video monitoring products and visiting other acute care facilities that have implemented video monitoring, the funding to implement a video monitoring system was secured. The facility purchased 15 cameras, 10 fixed in-room ceiling mounted, and five portable units. The portable cameras with speakers allowed for the monitoring of patients in any room within the facility. A sign stating "video monitoring in progress" is hung outside of every room that is monitored. The cameras do not record.

A video monitoring room was established, which contains a 42-inch monitor, desk, phone, computer, and chair. This room is in a quiet location, separate from the nursing station, to minimize distractions. The VMT monitors up to 15 patients at one time. The software divides the monitor into 15 smaller segments, one for each room being monitored. The VMT can zoom in and move the camera 360 degrees to observe the patients in all aspects of the room, except the bathroom. VMTs are trained to look for behaviors in patients that might lead to unsafe actions. When an unsafe behavior is observed, the technician speaks to the patient via the system, asking them to remain seated or to ask if they need something. If the patient does not respond to the monitor technician's requests, the VMT calls a patient care technician (PCT) via a cordless phone to report to the patient room. If the patient is in imminent danger of falling, a Stat Alert Alarm, which is built into the system, is sounded by the VMT to notify staff to respond immediately. All staff at the facility have been trained to respond to the stat alarm immediately. To track the frequency of interventions required by patients, the VMT keeps a log of how many times he/she needs to verbally intervene, send a staff member to the room, or set off the stat alarm for each monitored patient.

#### Training

Training for the system was provided by the manufacturer over a time period of weeks. Policies and VMT job descriptions were created. Patient care technicians were identified and trained as VMTs. Video monitor technicians were trained on all aspects of the monitoring equipment, including focusing and zooming camera angles, voice activation, and privacy screens. All clinical staff received training on the rationale for the monitoring equipment and the use of privacy screens and stat alarms.

#### Monitoring Criteria

The next step was to identify which patients would be eligible for monitoring and those that should be excluded. Although there are many different fall scales, no one scale consistently or accurately predicts fall risk in this population. In analyzing the facilities data for the preceding 3 years, the current falls risk scale exhibited inadequate sensitivity and specificity in discriminating between fallers and nonfallers. Vassallo, Pointer, Sharma, Kwan, and Allen (2008) demonstrated that clinical observation was more accurate than two fall risk assessment tools in a rehabilitation setting. Therefore, it was determined that the nurse manager's clinical judgment in collaboration with the primary nurse would be used to determine if a patient was appropriate for video monitoring.

A review of the literature identifies history of falls, gait instability, agitation, confusion, urinary incontinence, and frequency and the use of sedatives and hypnotics as common factors for falls (Oliver, Daily, & Martin, 2004). As the patient population in this facility is rarely on sedatives and hypnotics and a majority had gait instability, these factors were not considered as it was felt that they would not discriminate between a potential faller and nonfaller. Factors considered include alertness, impulsiveness, limited awareness of limitations, impaired bladder/ bowel management, and cognitive impairments. Neither physician order nor patient/family consent is required, as sitters do not require consent and video monitoring is

equivalent to a distant sitter and the cameras do not record. Patients determined to be appropriate for video monitoring include those who are restless, agitated, impulsive, and forgetful or unaware of their limitations. As the nursing staff has become more advanced in using the system, they have developed skills to quickly assess a new admission and are able to determine the need for monitoring. Patients that are not appropriate for monitoring include those who are pulling at tubes/devices, those who are so restless and agitated requiring undivided attention, and any patient that is suicidal. In these patients, it was determined that staff could not respond quickly enough to the patient's needs and a sitter would be required. The nurse manager reviews the VMT log to determine the number of interventions each patient has had. If a patient has been showing a steady decrease in the need for VMT interventions, they may be removed from the monitoring program.

#### Analysis

Average monthly fall rates pre- and postimplementation of the video monitoring system were compared using two-sample *t* tests. The comparison of falls rates hospitalwide before and after the introduction of video monitors uses a longer span of time than the comparison for the brain injury unit, as unit-by-unit data were only available for 8 months before installation. Total falls and rate of falls were also compared specifically for patients on the brain injury unit who were placed on video monitors versus patients on that same unit who were not. This analysis was included to provide the most detailed appraisal of the cameras' effectiveness, as not every room on the brain injury unit contains a video monitor. The number of staff interventions via the monitor talk-back capabilities is reported as averages per 24-hour period.

# Results

Falls on the brain injury unit decreased in the months after the introduction of the cameras, averaging 10.26 falls per 1,000 patient-days before installation, while averaging 6.87 falls per 1,000 patient-days over the year of use. This reduction was statistically significant, t(18) = 2.647, p = .016(see Table 1). The hospital-wide total falls was reduced from a prevideo rate of 6.34 falls per month (SD = 1.75) for the 21 months preceding video installation to 5.09 falls per month (SD = 1.52) for the 12 months in which the cameras have been operating. This reduction was also statistically significant, t(31) = 2.043, p = .0496. Video monitor technicians average 95 interventions every 24 hours via the monitor's communication system. There were 28 falls by patients on video monitors over a total of 3,641 patient-days, as compared to 37 total falls for

 Table 1 Pre- and postvideo t-test results

	Prevideo		Postvideo			
	М	SD	М	SD	t Test	р
Brain injury unit rate	10.26	1.87	6.87	3.27	2.647	.016
Brain injury unit totals	7.875	1.642	5.417	2.811	2.222	.039
Whole hospital rate	6.336	1.749	5.099	1.524	2.043	.0496
Whole hospital totals	16.667	4.351	14.083	3.965	1.692	.101

nonmonitored patients over 5,788 patient-days during that same 12-month period. This calculates out to an average monthly rate of 7.63 falls per 1,000 patient-days for video monitored patients and 6.70 falls per 1,000 patient-days for all nonmonitored patients on the brain injury unit. This difference was not statistically significant.

Location of the falls within the facility was also analyzed. As the video monitors only monitor the patients while they are in their rooms, it was hypothesized that the proportion of in-room falls would decrease with the use of the video monitors. In fact, analysis showed that the proportion of in-room falls increased to 77% of falls after implementation compared to 72.4% prior, but the number of hallway falls decreased from 20 to 3. Before the implementation of the monitors, patients were placed in the hallway so that nursing staff could "monitor" them; after the implementation of the monitors, these patients were returned to their rooms. This change in practice accounts for increase in falls in patient rooms. Further analysis revealed that, after implementation, no patient fell more than once.

#### Discussion

After 12 months of operation, the video monitoring system has been effective in reducing falls hospital-wide, specifically evidenced by a significant reduction in the falls rate on the brain injury unit. Historically, the brain injury unit has been the site of the highest fall rates in the hospital, and reducing that rate was the primary goal of the installation of the cameras. Only a small proportion of the total inpatient beds were able to be monitored (15 of 115), which may explain the lack of a drop of greater magnitude in the hospital-wide falls rate. Eight of the 10 mounted units were placed on the brain injury unit, in addition to the mobile units frequently placed there, comprising roughly a third of all beds on the unit at a given time and therefore having a greater effect on the falls rate.

In the year preceding the installation of the system, there were 97 falls on the brain injury unit, as compared to 65 during the year using the cameras. It is reasonable to attribute this reduction in 32 falls to the video monitors, as conditions on the unit have otherwise remained consistent. Calculating an average cost per fall is difficult given the sheer variety and severity of outcomes, but even in the case of falls without injury, hospital costs attributable to additional tests and staff hours can easily reach several thousands of dollars. A conservative estimate of cost savings for this facility due to the reduction in falls and fall-related injuries is \$40,000 for the 21-month period. Furthermore, the hospital realized considerable cost savings from the video monitor initiative as a result of staffing changes. In the 12 months of operation, the hospital has saved roughly \$186,120 on one-to-one sitters. Total costs for the video monitoring system have been recouped in the 12 months of continued use of the system.

Staff response to the video monitoring system has been strongly favorable. In response to an online staff survey, 81% of respondents indicated either a generally or strongly favorable reaction to the video monitors. Respondents interpreted the prompt "Are the video monitors intrusive?" in varied ways. A total of 91% of responders felt it was not intrusive, 4% indicated they felt the monitors were a privacy intrusion, and 5% answered that the monitors were physically intrusive and took up too much space in the patient rooms (presumably they were referring to the mobile units and not the permanent ceiling mounted cameras).

The lack of a significant difference in falls rate for the video-monitored patients versus all others in the brain injury unit can be interpreted in two ways. On the negative side, it was expected that falls rate on video monitors would be significantly lower, as patients were under constant supervision and ideally all falls would be prevented. However, this finding could be interpreted more optimistically given that the patients at greatest risk of falling were placed on the monitors and their fall rate currently resembles the rate for lower-risk patients. Furthermore, falls statistics for patients on video monitors does not necessarily indicate that the event itself was witnessed on-camera. In most of the cases, the fall occurred in the bathroom or hallway, but for hospital records, this is considered an "on-video" fall. This last point highlights the necessity of remaining vigilant with high-risk patients at all times, as the video monitoring system is only one tool in a broader range of tactics used to keep patients safe.

Early discussions with the manufacturer would suggest that only patients who could respond to the voice commands of the VMT were appropriate for monitoring. This was found not to be accurate. Through our implementation, most of the monitored patients cannot follow the commands of the VMT due to the severity of their injuries or the presence of cognitive limitations. The facility has found that just the voice alone may be enough to interrupt the patient's thought process and delay the unsafe behavior long enough for staff to respond.

There are several advantages and disadvantages to this system. Cost of implementation is a barrier for many institutions. Portable cameras have both advantages and disadvantages. They are bulky and take up valuable space in the room but can be easily moved from room to room. The 10 fixed cameras/speakers take up less space, but fixed units do not allow for flexibility when placing patients. Multiple room changes may be required to accommodate the monitoring of the most at-risk patients, which can be time-consuming and have an impact on patient satisfaction. The ability for one staff member to monitor up to 15 patients at one time is an advantage over the use of sitters and therefore leads to cost savings. Families and patients also report the video monitor as being less intrusive than a sitter and may lead to less patient agitation. As with the use of all new technologies and processes, significant time must be allotted for staff training.

Some limitations to this work exist. The reduction in falls is directly related to the availability of the monitoring equipment, so there were times when patients determined to be appropriate for video monitoring were not receiving the intervention as there were only 15 cameras available. In addition, this was a small study in one facility, with a specific patient population. Additional studies are recommended to determine if findings can be generalized across all rehabilitation settings and populations.

## Clinical Relevance

Falls are a significant issue in rehabilitation settings. Patients are encouraged to be as independent as possible, yet are told not to do any activity without assistance when in their rooms. This mixed message combined with cognitive impairment leads to the increased risk for falls in this setting. Many current fall prevention strategies notify the staff that the patient has exited the bed or chair, which is often too late. The use of video monitoring allows the monitoring technician to see unsafe behaviors before the patient attempts to exit the bed or chair. This direct visualization and the ability to communicate directly with the patient is a proactive approach to falls management, leading to decreased falls and injury prevention.

# Conclusions

Although the video monitoring system is effective in reducing falls, the hospital continues to evaluate its continued use to provide the highest degree of patient safety. Further study is required to evaluate the relationship between the total number of monitored patients at a given time and the occurrence of "on-monitor" falls. Given that there is only one VMT operating the monitor station at a time, the full use of all 15 cameras is naturally more demanding than if only a proportion of the cameras are in use (given fluctuations in census or the particulars of the

# **Key Practice Points**

- Video monitoring is a nonobtrusive mechanism for preventing falls.
- Video monitoring can reduce falls in an inpatient rehabilitation setting.
- Video monitoring can reduce sitter costs in an inpatient rehabilitation setting.
- Video monitoring can be useful in reduction of falls in cognitively impaired patients.

patient group on any given day) and the number of patients over which the VMT may remain optimally vigilant is unknown. The basis on which patients are originally placed on video monitoring is also the subject of ongoing refinement. Unit nurse managers meet to discuss trends among patients for whom the monitors have been particularly successful in maximizing the effectiveness of the system.

Staff and families report satisfaction with the use of the video monitoring equipment. A significant number of VMT interventions occur each day. This anecdotal data along with the reduction in falls and sitter use were significant enough to convince leadership to invest in an additional 15 cameras that were installed in October 2015. Given the substantial costs associated with fall-related injuries and the reduction in falls following the introduction of the original 15 video units, it is expected that this further investment in technology will continue to provide financial value to the facility above and beyond the reduced costs of sitters, as well as providing greater safety for our patients and peace of mind for their families.

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