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The Effectiveness of Continuous Video Monitoring In Reducing Inpatient Fall Rates

Yunhee Cruse
yc246@umsystem.edu

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Yunhee C. Cruse

B.S.N., Goldfarb School of Nursing, Barnes-Jewish College of Nursing, 2010
B.S. Ed., Daegu National University of Education, South Korea, 1993

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Advisory Committee

Nancy Magnuson, DSN, APRN, PCNS, FNP-BC
Chairperson

Susan Dean-Baar, PhD, RN, CENP, FAAN

Amber Bailor, MSN, MBA, BSN

Abstract

Problem: Falls are one of the most frequently occurring safety events in hospitalized patients, resulting injuries that can be devastating and burdensome. Patients in neuro-telemetry unit are at greater risks for falls due to their conditions. The continuous video monitoring (CVM) program was implemented to reduce fall rates in the neuro-telemetry unit. This project was to examine the effectiveness of CVM program in reducing fall rates.

Method: A pre- and post-implementation observational evaluation was conducted. By reviewing retrospective data from January 1, 2020 to January 31, 2021 for pre-implementation period and from March 1, 2021 to October 31, 2021 for post-implementation period, fall rates were compared and common risk factors of falls were identified.

Results: A one tailed t-test was performed to determine the effectiveness of CVM. The result was not significant ($t(14)=0.59$, $p=0.33$), but there was 12.7% reduction of fall rates during the post-implementation period. No injury from falls occurred in patients who were on monitor and injury rates of both pre-and post-implementation periods were much lower than the national average. Confusion was the most common risk factor of falls and having 2 or more risk factors was a good indicator of falls.

Conclusion: Despite the statistical insignificance, CVM is safe and effective in preventing falls as evidenced by clinically significant reduction of falls by 12.7%. CVM may be useful in reducing costs and preventing other safety events. Hospital should refine of CVM protocol and provide education, and training on an ongoing basis.

Introduction

Falls are one of the most frequently occurring safety events in hospitalized patients and can result in devastating injuries, a longer hospital stay, and increased cost of care (Agency for Healthcare Research and Quality [AHRQ], 2021; LeLaurin & Shorr, 2019; Morris & O'Riordan, 2017; Najafpour et al., 2019). Approximately 700,000 to 1 million hospitalized patients fall each year and more than one third of those falls result in injuries (AHRQ, 2019). Serious injuries that may result from a fall are fractures, lacerations, and internal bleeding, some of which can lead to death (AHRQ, 2021; LeLaurin et al., 2019). Additionally, injuries from a fall require additional treatments and an average of 6.3 days of prolonged hospital stay in some patients (The Joint Commission [TJC], 2015). The average cost of a fall with an injury is estimated as $14,000 (TJC, 2015) and since 2008, the additional costs for injuries sustained from falls are not reimbursed by the Centers for Medicare and Medicaid Services (AHRQ, 2019). Even falls without an injury can have serious consequences such as anxiety and distress in patients, families, and healthcare staff in addition to a negative cycle of fear of falling, inactivity, and loss of strength and independence in patients (AHRQ, 2019).

A fall is defined as an unintentional descent to the ground or floor or other lower level (World Health Organization, 2021). Fall rates range from 1.3 to 8.9 falls/1,000 patient days in acute care hospitals in the United States (AHRQ, 2021) with higher rates occurring in units that focus on eldercare, neurology, and rehabilitation (AHRQ, 2019). However, almost one third of inpatient falls can be prevented (AHRQ, 2021).

To reduce fall rates and the subsequent consequences, hospitals have implemented a variety of fall prevention strategies, such as fall risk screening tools,

hourly rounding, bed alarms, call lights, and bedside sitters, which are predominantly the responsibility of nursing staff. However, many of these tools and strategies increase the burden on nursing staff or have proven to be ineffective (Cournan et al., 2016; Jellet et al., 2020; Morris & O'Riordan, 2017; Votruba et al., 2016). In an effort to find a more effective and efficient method of fall prevention, CVM has been examined in recent years. CVM is a technology that uses in-room fixed or portable cameras with speakers and trained video monitor technicians (VMT). VMTs directly observe patients from a monitor room with the ability for two-way communication between patients and VMTs and the ability to alarm the assigned staff to patients exhibiting fall risk behaviors or when a fall occurs (Cournan et al., 2016; Quigley et al., 2018).

Patients on neuro-telemetry units are at a higher risk for falls due to weakness on one side, confusion, delirium, medications, devices, and other comorbid conditions (AHRQ, 2019). The purpose of this project was to evaluate the effectiveness of CVM intervention for patients residing on a neuro-telemetry floor in reducing fall rates. This project used the Plan-Do-Study-Act (PDSA) cycle as a guide. The aims of the project were to determine the effectiveness of CVM in fall rate reduction and to identify risk factors for falls by examining fall events during the post-implementation period in order to improve CVM program. Primary outcome measures of this project included fall rates pre- and post-implementation of CVM, number of falls occurring in patients who are on CVM and patients who are not on CVM, number of falls with and without injury, and common risk factors of falls. The study question of this project was: How did implementation of CVM impact the rate of fall events for patients residing in the neuro-telemetry unit at a mid-sized hospital located in the Midwest?

Review of Literature

A review of literature was conducted focusing on CVM for fall rate reduction in hospitalized patients. The following databases were used to search for the relevant literature: UMSL library, Cochrane library, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), Medline, PubMed, Google Scholar, and EBSCOhost. The key search terms used were “fall”, “fall rate”, “fall prevention”, “hospitalized patient”/”inpatient”, “video monitoring”, and “telesitter”. The search settings were refined to only include peer reviewed journals that were research articles, published between 2016 and 2021, and written in English. Studies focused on pediatric patients and settings other than hospitals were excluded. This yielded 218 full text articles. Each article was reviewed for the inclusion and exclusion criteria and 30 articles were selected for further review of relevance. Then each article was reviewed through full text reading using the inclusion and exclusion criteria and 7 articles were determined to be relevant for the review of literature.

Across the literature CVM was found to be effective in reducing falls in hospitalized adult patients and an effective and less expensive alternative to bedside sitter use.

To review the evidence of beside sitter effectiveness and alternative methods in reducing falls in hospitalized patients, Greeley et al. (2020) conducted a systematic review of 20 studies. The results revealed a very low level of evidence of bedside sitter effectiveness in reducing falls in acute care hospitals and moderate evidence to support alternative methods in reducing the use of sitters without increasing falls (Greeley et al., 2020). Most importantly, video monitoring was found to have the strongest evidence as

an alternative to sitter use compared to other alternatives (Greeley et al., 2020). One interesting finding indicated high rates of harm to sitters by patients or visitors. Limitations included the quantity and quality of studies included in the review and no discussion about the acceptance of sitter alternatives by patients/families in the included studies (Greeley et al., 2020).

Several studies investigated CVM as an intervention to reduce falls in hospitalized patients as well as cost of sitters. Votruba et al.(2016) conducted a prospective, descriptive study of 5041 patient discharges and found CVM was safe and more effective than sitters in reducing falls with a remarkable 35% reduction in falls with CVM intervention. Additional findings showed a 10% decrease in monthly patient companion hours and a slightly lower fall rate among patients selected for CVM compared to those who did not receive the CVM intervention. Despite the large sample size, limitations of this study included implementation of other fall prevention strategies during the study period and a questionable validity of the results due to using CVM for other purposes besides fall prevention.

In a quasi-experimental, 4x8 design series study with non-randomized, consecutive sampling, Davis et al. (2017) found no significant differences in the number of falls between in-room sitters and CVM but saw a decreasing trend in fall rates after implementing CVM and a significant decrease in sitter overtime hours and costs. Limitations included the primary researcher being responsible for implementing CVM at the facility, the data collection through voluntary reporting process, and fall prevention program at the facility being revised during the study period (Davis et al., 2017). Of note, the technology used in this study did not have the ability to intercommunicate with

patients and notify other staff for interventions and the monitor staff was responsible for responding to patients attempting to get out of bed, which may have interfered with the desired outcomes.

Another investigation focusing on rehabilitation patients was conducted (Cournan et al., 2016). The findings of this sequential cohort study demonstrated a significant fall rate reduction in the study unit and a significant hospital-wide fall rate reduction after the implementation of CVM (Cournan et al., 2016). Additionally, staff reported satisfaction with the CVM system and no patients had more than one fall after implementation of CVM (Cournan et al., 2016). A longer study period and careful preparation through equipment set-up, staff training, and ongoing decision making for qualification for CVM by the nurse manager and primary care nurses contribute to the study strength. Limitations include limited monitor units leading to some patients who were appropriate for being monitored not receiving intervention and limited generalizability due to the small sample size and location (Cournan et al., 2016).

A quasi-experimental pre and post study with a targeted sample of hospitalized patients at high risk for falling was conducted to investigate the association between the use of CVM and reduction of falls and the use of observational sitters for fall prevention in patients at high risk for falls (Sand-Jecklin et al., 2016). The study of 1,508 cases of CVM resulted in 28.5 % reduction of fall rates (Sand-Jecklin et al., 2016). Furthermore, no injuries occurred among video monitored patients who fell while some type of injuries occurred among 6 unmonitored patients and there was 23.2% reduction in sitter hours (Sand-Jecklin et al., 2016). Additional data revealed overhead paging of staff to patient rooms was the most efficient VMT intervention of response to high-risk patient behaviors

(Sand-Jecklin et al., 2016). Study limitations include lack of data related to unmonitored patients who fell, no data collection on staff response time to VMT notification of risky behaviors and the impact of staff response time on the incidence of falls, and no specific fall rate for monitored patients (Sand-Jecklin et al., 2016).

Sand-Jecklin et al. (2019) conducted a descriptive study to evaluate the monitoring process and to standardize the monitoring practices for dissemination of knowledge. The results of surveys for nursing staff and patients/family members and structured interviews for VMTs, using a convenience sample, highlighted CVM as being effective in preventing falls, and a positive perception of CVM by patients/families while a need for improvement in explaining the purpose of using CVM and how patient privacy was protected to patients and families was identified (Sand-Jecklin et al., 2019). Other findings included the overhead paging of staff to the patient rooms being preferred, patient impulsivity and quick movement as a contributing factor for falls, the need for increased communication and additional information about monitored patients, and discontinuation of CVM by nursing staff's judgment (Sand-Jecklin et al, 2019). Despite high response rates of surveys, the small sample size with a convenience sampling, and the descriptive and subjective data limit generalizability of the study findings (Sand-Jecklin et al., 2019)

Noticing small sample sizes and limited monitors in previous studies and an absence of studies on staff response time to alarms, Quigley et al. (2018) conducted a descriptive study of patient-engaged video surveillance (PEVS) to investigate outcomes on falls and other adverse events (Quigley et al., 2018). Data was collected on15,021 patients from the national data reporting system over a 10-month period on the same

PEVS and revealed the effectiveness of PEVS in reducing fall rates, 92% reduction of total number of required full-time monitoring staff, and no more than one fall in the same patient occurred (Quigley et al., 2018). The large sample size and the same intervention and training program for nursing staff and monitoring staff in all hospitals added strength to the study. Limitations were identified as uncontrolled unit types and acuity, making the risk adjustment based on the acuity during analysis impossible, and inability to compare the top 3 observed adverse events due to no available data for those not using PEVS (Quigley et al., 2018).

Most studies reviewed were a quasi-experimental or a descriptive design. Overall, CVM was found to be an effective intervention or as effective as using sitters for fall rate reduction in hospitalized patients as well as it resulted in cost savings for hospitals. Majority of the studies did not include a definition of a fall and the definitions that were included in two studies had differences, indicating a need for a clear, standardized definition of a fall. Some common future implications were further studies on CVM usage for patient safety issues including falls (Cournan et al., 2016; Quigley et al., 2018; Sand-Jecklin et al., 2016) and process and practice guideline development of CVM (Sand-Jecklin et al., 2016; Sand-Jecklin et al., 2019).

The PDSA cycle was used as the evidence-based theoretical framework for this project. A plan to evaluate the CVM program (Plan) was developed and the data were collected (Do). The data were analyzed and reflected on (Study) and changes were recommended for continuous improvement(Act).

Methods

Design

This project used a pre- and post-implementation observational evaluation design. The data were collected retrospectively by reviewing the event reporting system and System Analysis Program (SAP) system. The retrospective data containing both quantitative and descriptive data were reviewed and documented from March 1 to October 31, 2020 for the pre-implementation period and from March 1 to October 31, 2021 for the post-implementation period.

Setting

This project occurred in a 25-bed neuro-telemetry unit at a mid-sized hospital in the Midwest. The hospital is a nonprofit, tertiary acute care hospital for adults, one of 8 hospitals in a healthcare system serving surrounding communities. With 487 beds, over 500 clinicians and approximately 2,300 employees, it offers a wide range of services including a comprehensive stroke center, a level I time critical diagnosis STEMI center, and the only level II trauma center in North St. Louis County of the state.

Sample

A convenience sample consisting of all adult patients aged 18 years and older who had a fall/falls while admitted to the neuro-telemetry unit during the study periods were included. Patients under the age of 18 years old during the study periods were excluded.

Approval Process

Initial approval from the Institutional Review Board (IRB) of the organization was obtained on December 16, 2021, however, the Compliance and Research Business Review of the organization tabled the project due to a concern of a possible breach of

confidentiality from data to be collected. The CVM program did not restart in January, 2022 as planned. The project was revised to only include retrospective data. Final approval from the IRB was obtained on February 16, 2022 with RBR approval on February 22, 2022 from the organization. Approval from the University of Missouri-St. Louis IRB was obtained on March, 18, 2022. Benefits of this project included increased awareness of fall risks in patients by staff, increased utilization of technology, and improved patient safety. As it only used de-identified patient information, the risks were minimal.

Data collection/Analysis

Quantitative data of number of falls, number of falls with/without injuries for both pre- and post-implementation periods, number of falls in patients who were on CVM for post-implementation period, and monthly patient days were collected. De-identified descriptive information of fall events was collected by reviewing the event reporting system records. In addition, several common risk factors were collected for patients who had a fall during the post-implementation period. Data were recorded and stored in a passcode-protected file. Data were analyzed for monthly fall rates, using the number of falls per 1,000 patient days and the total number of falls with injuries for pre- and postimplementation periods, the total number of falls occurred in patients who were on CVM and patients who were not on CVM, and the frequency of common risk factors. Data were further analyzed to find out the significance of CVM in reducing fall rates. The data analysis methods used were descriptive statistics and an independent t-test. All activities were conducted by the student.

Procedure

After the approvals were obtained from the organization's IRB and RBR and the University IRB, retrospective fall data were collected for the pre- and postimplementation periods and were analyzed. And risk factors for falls during the postimplementation period were collected by reviewing fall events from the postimplementation period and analyzed.

Results

There were 85 falls reported to the event reporting system during the study period, 44 during the pre-implementation period and 41 during the post-implementation period. The monthly fall rates were calculated by using a formula, number of fall/1,000 patient days, and the results are shown in Figure 1, Appendix A. Patient age, gender, and the shift of fall events were unable to be obtained. There was only one fall with injury during the pre-implementation period whereas there were 3 falls that resulted in injury during the postimplementation period but none of those injuries occurred in patients who were on CVM (see Figure 2, Appendix B). Among 41 falls during the post-implementation period, 3 falls (82.9%) occurred in patients who were not on CVM and only 7 falls (17.1%) occurred in patients who were on CVM (see Figure 2, Appendix B). Most falls happened in patient rooms (n=37, 90.2%), followed by bathroom (n=3, 7.3%) (see Figure 3, Appendix C) during the post-implementation period. There were 63.4% of patients in bed or chair prior to falling, either getting out of bed (48.8%) or chair without assistance (9.8%) or trying to reach for a personal item (4.9%) and 19.5% of patients were ambulating without assistance/assistive device (see Figure 4, Appendix D).

An independent sample 1-tailed t-test was conducted to examine whether the mean difference of fall rates between the pre- and post-implementation of CVM was

statistically significant or not. The fall rate of pre-implementation of CVM (M=8.66, SD=2.58, n=8) was hypothesized to be greater than the fall rate of post-implementation of CVM (M=7.69, SD=3.88, n=8). This difference was not statistically significant, $t(14)=0.59$, $p=0.33$ (one-tail), however the fall rates decreased by 12.7% during the post-implementation period.

Five risk factors of falls among 34 patients who had a fall/falls while they were not on CVM during the post-implementation period were examined, including four patient specific factors and one system-specific factor, staffing status, to identify common risk factors. 75.8% of patients were at high risk or moderate risk of falls, 44.8% and 31.0% respectively, with 5 missing fall risk assessment scores (see Table 1, Appendix E). One patient was at no risk of falls according to the fall risk assessment score. As shown in Table 1, 51.5% of patients were confused, 44.1% of patients had sensory impairments, either visual or hearing or both, and 35.3% of patients had a history of falls. And 26.5% of falls occurred when there was inadequate staffing, defined by increased patients to nurse ratio more than 5:1, charge nurse having patients assigned and/or having less than 2 nursing assistants. In addition, 72.4% of patients had 2 or more risk factors among 5 factors examined.

Discussion

The hospital implemented CVM in 6 inpatient units including the neuro-telemetry unit in 2021 as a quality improvement pilot program to reduce fall rates. The program was in place from February 14 to November, 18, 2021 and was to restart in January, 2022 at first and then April, 2022, but it has not been resumed due to other pressing matters in the hospital. The hospital provided education to staff via an online course and VMT

training to the beside sitters prior to the implementation of CVM but continuing education and reinforcement of CVM use was lacking as well as the ownership for continuing education. During the post-implementation period, the unit experienced ongoing staffing issues as it lost most of core staff over time, it was staffed by external staff who did not have education on CVM use, and patient care technicians were utilized as 1:1 patient sitters. And CVM was very much underutilized by nursing staff as they were not fully engaged in the program early on.

The implementation of CVM did not significantly reduce fall rates in the neuro-telemetry unit; however, it is remarkable there was 12.7% reduction of fall rates after implementation of CVM . When considering a small pool of data from one unit, the fall rates may have been significantly different if data from all units were analyzed.

Most falls occurred in patients who were not on CVM. Even though 3 fall injuries (7.3%) occurred during the post-implementation period while only 1 injury (1.3%) occurred during the pre-implementation period, the percentage of injuries was much lower than the national average of over 33%. Staffing shortage was a contributing factor for two of 3 falls, however, no fall injuries occurred in patients who were on CVM.

Most falls during the post-implementation period happened while patients were not on CVM but only 5 patients were placed on CVM even after a fall event. Continuing Education and training of staff for CVM use is imperative to increase utilization of CVM for fall prevention.

Twelve factors were to be examined as potential common risk factors of falls among patients who had a fall/falls while they were not on CVM during the postimplementation period but only 5 of them were available to be reviewed due to the

restricted data access. Among 5 risk factors, confusion was the most common risk factor, followed by a high fall risk assessment score using Hester Davis Scale (HDS) and sensory impairment nearly in a half of patients. Patients with confusion did not call for assistance when getting out of bed to going to the bathroom. Even though patient were at high risk for falls, some of patients did not have adequate interventions such as putting the bed alarm on and nearly one third of patients had a moderate HDS score. Even though staffing shortage was the least common risk factor, it may have contributed to falls due to longer response time to bed alarms or CVM alarms by staff in some patients. CVM needs to be considered for patients who have 2 or more risk factors as majority of falls happened in patients who had 2 or more risk factors of falls.

There were several limitations in this project. Due to the small sample size from one specific unit of inpatient hospital, the result is not generalizable. There were limited factors evaluated as risk factors of falls. Because the data for risk factors for the pre-implementation period were not available, the analysis on risk factors was limited as the comparison between pre- and post-implementation periods could not be made. Even though there was a remarkable difference in the number of falls between patients who were on CVM and not on CVM, the comparison cannot be made due to limited data. Lack of homogeneity in patients was another limitation because it is unclear if patients included were all neuro-telemetry patients, especially during 2020 due to COVID-19. CVM was underutilized by staff, limiting the potential effects of CVM.

The hospital should refine the CVM protocol through continuing evaluation and provide education and training to all staff prior to reimplementation of CVM and on an ongoing basis. Integration of identified common risk factors in the criteria for CVM and

continuous identification of common risk factors will help staff in decision making for VM and prevent falls.

Future projects on CVM intervention in other units and/or other hospitals and in a larger scale will be useful to determine the effectiveness of CVM in preventing inpatient falls. A project that compares the fall rates between patients who are on CVM and not on CVM to evaluate the impact of CVM on fall rates. And studies on other uses of CVM in improving patient safety and reducing cost, such as reduction of sitter hours and prevention or intervention of other adverse events, such as removal of medical devises and seizures, will be beneficial.

Conclusion

Falls are one of the most frequently occurring safety events in hospitalized patients, resulting in devastating injuries or serious physical and emotional consequences. One of the new fall prevention strategies used in hospitalized patients is CVM. This CVM program evaluation result indicated the use of CVM was not significant in reducing fall rates in inpatients. However, there was clinically significant 12.7% fall rate reduction during the post-implementation period. In addition, most falls occurred in patients who were not on CVM and no injuries occurred in patients who were on CVM. Confusion was identified as the most common risk factor of falls among patients who were not on CVM during the post-implementation period. And having 2 or more risk factors was a good indicator of falls.

Even though CVM did not result in significant reduction of falls in a small sample, CVM is a safe and effective fall prevention intervention evidenced by clinically significant 12.7% reduction of fall rate. CVM may be useful in reducing sitter costs and

preventing other safety events. Moving forward, the hospital should refine a CVM protocol reflecting the results of this evaluation and proper education and training of staff to improve the CVM program and reduce fall rates in inpatients prior to resuming CVM. More studies in a bigger scale are needed to further evaluate the effectiveness of CVM.

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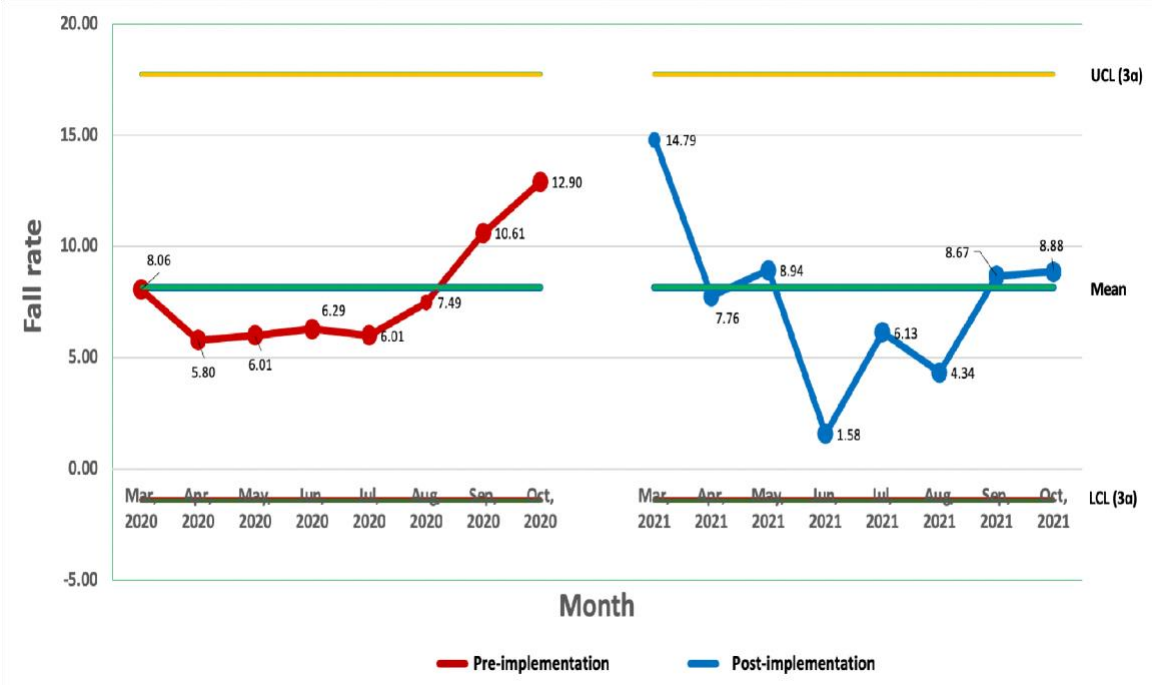
Appendix A

Figure 1

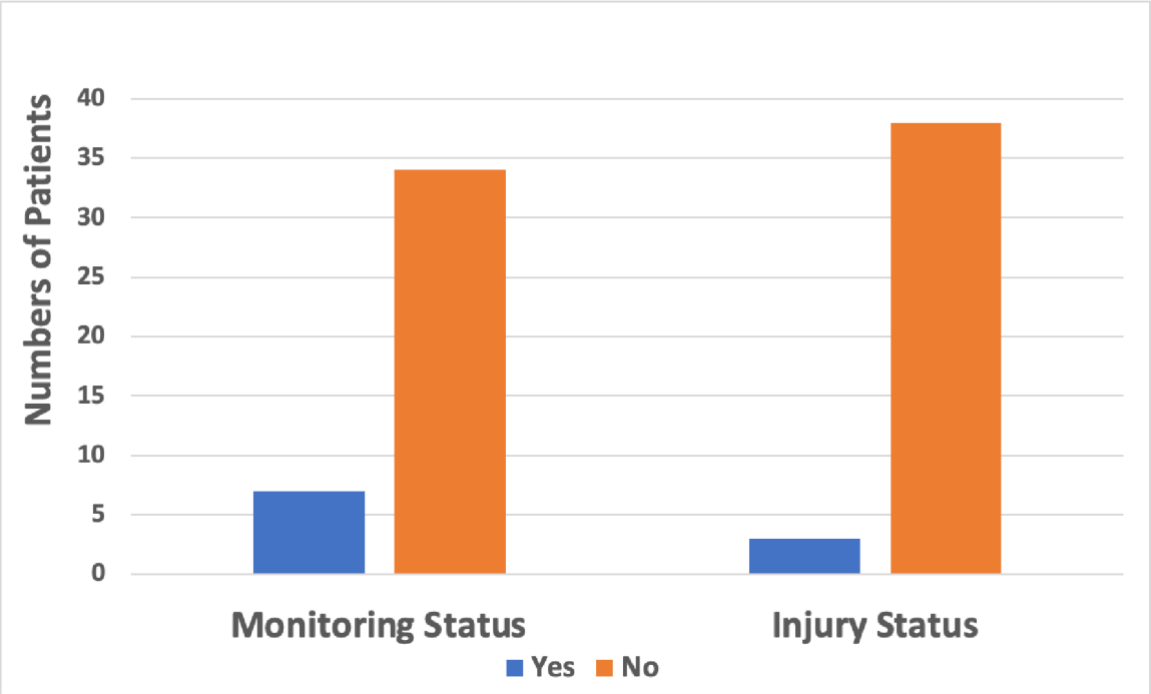
Fall Rates, Pre- and Post-Implementation of CVM



Appendix B

Figure 2

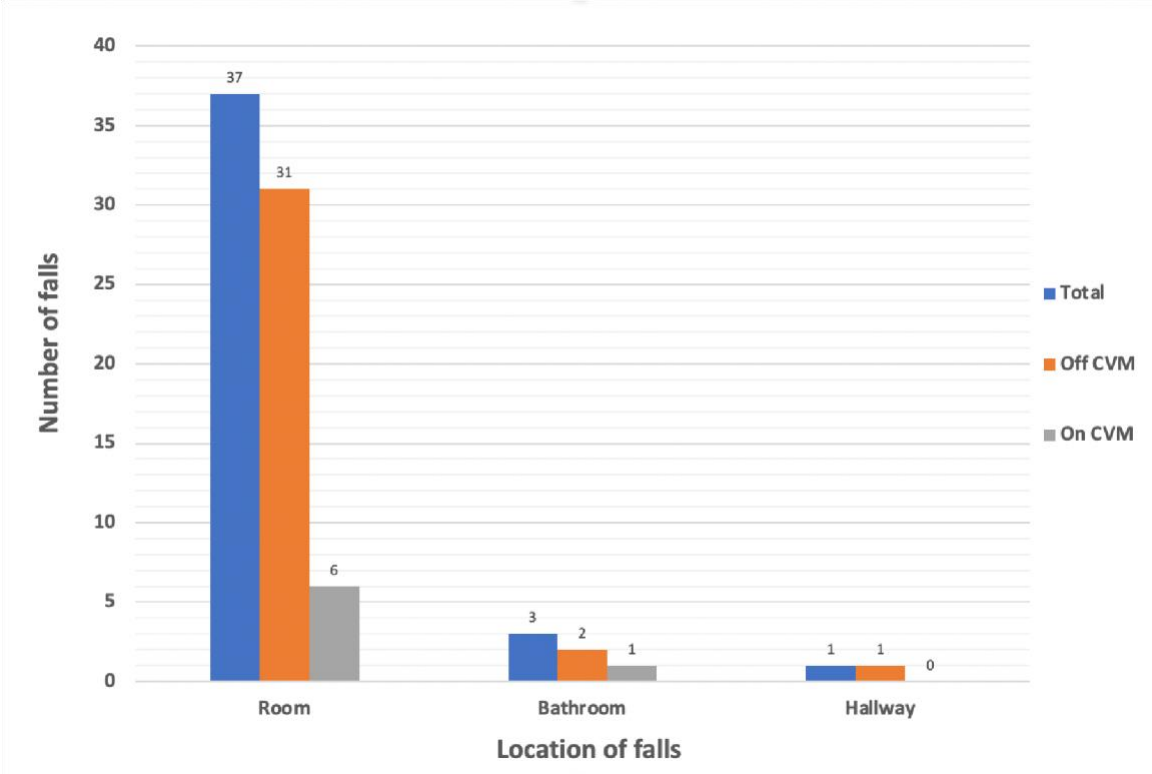
Monitoring Status and Injury Status during Post-CVM



Appendix C

Figure 3

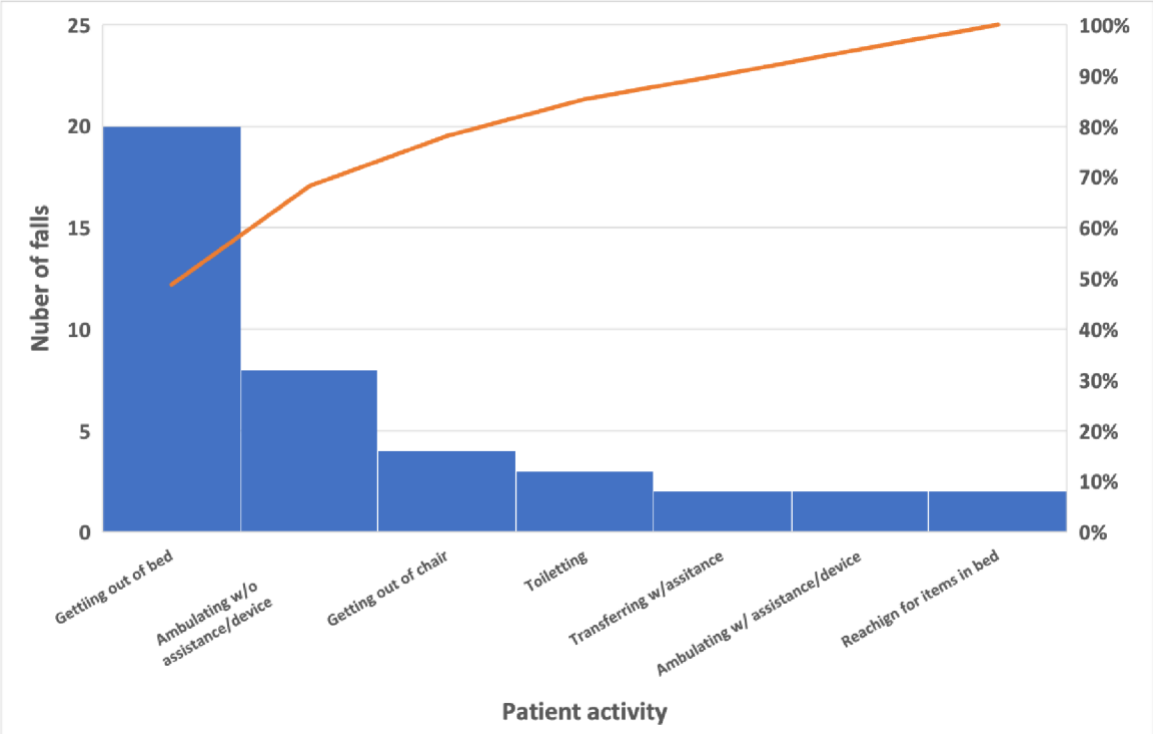
Locations of Falls during Post-CVM



Appendix D

Figure 4

Patient Activities Prior to Falls during Post-CVM



Appendix E

Table 1

Risk Factors of Falls in Percent among patients not on CVM during Post-CVM

Risk factors	HDS fall risk		History of falls	Sensory impairment	Confusion	Staffing not adequate
	Moderate	High				
Frequency	9	13	12	15	17	9
Percent (%)	31.0	44.8	35.3	44.1	51.5	26.5
Missing	5	5	0	0	1	0

Note: Mean number of risk factors was 2.31.