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Change in Falls and Sitter Cost Post Implementation of Remote Centralized Video Monitoring in Hospitalized Adult Patients

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Dedication

I would like to dedicate this project to my husband, family, friends and work family. First, to my husband, I would not be where I am today without your continuously love and support. You were always there for me during this three-year journey and I couldn't have done this without you. Second, to my family, I would not have the drive or dedication to complete this program if it wasn't for my parents. As a child, I watched both of my parents go back to continue their education when my brother and I were little. To my brother, who is on the journey to obtain his PhD, your continuous support and encouragement has helped me get where I am today. Third, to my friends, thank you for understanding when I had to say no to things and thank you for always being there to lift me up. Lastly, to my work family, I thank you for being so understanding and patient with my work schedule. Also, thank you for giving me this chance to grow in my career.

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Abstract

PURPOSE: Falls are the leading cause of injury in hospitalized patients. Patient sitter programs are proven to be an effective way to reduce falls in hospitalized patients. Innovative technologies have been examined that provide a safe and cost-effective way to reduce sitter costs and prevent falls. An innovative technology option is a remote centralized video monitoring system containing one video monitoring technician watching and verbally redirecting multiple patients at one time using mobile cameras. The purpose of this project is to evaluate the implementation of a remote centralized video monitoring system for adult patients in the acute care hospital setting. METHODS: The study design is a comparative descriptive retrospective and prospective chart review to examine changes in sitter cost, fall rates, and fall with injury rates in the 3 months before and 3 months after implementing a remote centralized video monitoring system. RESULTS: The study identified no statistically significant difference in the prevalence of falls or falls with injury when video monitoring was used as compared to when in-room sitters were used. There was statistically significant lower cost per patient day with video monitoring. The remote video monitoring system will pay for itself in nine months of in-room sitter cost. CONCLUSION: Although there was no reduction in fall rates between in-room sitter and the remote centralized video monitoring, the fall rates were the same. Therefore, a remote centralized video monitoring system is equal to in-room sitters when comparing fall rate. The remote video monitoring system can dramatically reduce cost for healthcare systems and provide safe patient care.

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Introduction

Accidental falls with or without injury are the most commonly reported patient safety incident in the acute care setting. Most inpatient falls occur in the acute care setting due to new medications, an unfamiliar environment, or illness (Chu, 2017). Falls are a major safety concern for hospitalized patients and are the leading cause of injuries in hospitalized patients (CDC, 2016). According to the Agency for Healthcare Research and Quality, up to 1 million hospitalized patients fall annually and 33% of these falls result in patients sustaining injuries (2017). In the United States, approximately twenty percent of patients in the acute care setting experience a fall during their hospital stay (Sand-Jecklin, Johnson, & Tylka, 2016). The Center for Medicare and Medicaid Services lists falls as one of the top ten sentinel events and will not reimburse hospitals if a fall occurs (Chu, 2017).

Inpatient falls can result in serious physical and emotional injury, poor quality of life, increased length of stay in the hospital, admission to a long-term care facility, and increased healthcare cost (Pi et al, 2016). Hospital-acquired conditions that could result from a fall include fracture, joint dislocation, head injury, or crushing injury (Burtson & Vento, 2015). Fall-related fracture is one of the most common injury of elderly patients, which results in an increase of morbidities and mortality. Injuries from a fall may eventually result in many long-term bedfast complications, including pressure ulcer, hospital-acquired pneumonia, urinary tract infection, and lower extremity venous thromboembolism, and even disability or deaths, especially in patients with comorbidities (Pi et al., 2016).

Inpatient falls create an increased financial burden to the hospital as well as result in additional morbidities and mortality risk (Votruba, Graham, Wisinski, & Syed, 2016). According to the Joint Commission (2015), on average, one patient fall can add six days to a hospital stay. The estimate the cost of a fall is between $14,000 (Joint Commission, 2015) and $17,000 (CDC,2013) per patient. In 2015, $30 billion dollars were spent on falls each year in the U.S. and this amount is estimated to increase to $54 billion by 2020 (Sand-Jecklin, Johnson, & Tylka, 2016). In response to these risks, hospitals have used one-on-one in room patient care sitters as an intervention to reduce in-patient falls.

Background

A one-on-one in room patient care sitter is a trained hospital employee who observes a patient in their room for any activity that would cause the patient harm. In-room sitters are commonly used for patients who have a history of falls, confusion, delirium, agitation, personality or mood disorders, substance abuse, elopement risk, non-compliant or those patients who are suicidal (Davis, Kutash, Whyte, 2017). In-room patient care sitters are usually patient care assistants that have been removed from their caregiver role on the unit. The process of removing patient care assistants from their roles on the unit to be an in-room patient care sitter may create staffing challenges.

One-on-one in room patient sitters have shown to be an effective intervention to reduce inpatient falls but the one-on-one in room patient sitters come with a financial cost (Burtson & Vento, 2015). One-on-one in room patient sitter programs can cost a hospital up to $1.3 million a year (Sand-Jecklin, Johnson, & Tylka, 2016). One-on-one sitter programs can be costly for healthcare organizations to implement and maintain. Therefore, healthcare organizations need a more cost-effective solution to one-on-one sitter programs.

An alternative to the one-on-one in room patient sitter program is a remote centralized video monitoring system. A remote centralized video monitoring system is comprised of mobile cameras stationed in selected patient rooms that would require a sitter and a remote centralized video monitoring technician observing the patient remotely. The mobile cameras have a two-way speaker system that allows the remote video monitor technicians to communicate with patients and remote video monitoring technician can only view live feed. A remote centralized video monitoring technician has the capability to observe up to twelve patients at one time (Burtson & Ventro, 2015).

Since 2013, remote centralized video monitoring systems have been successfully implemented in acute care settings in units ranging from non-monitored medical surgical floors to intensive care units. A remote centralized video monitoring has shown reduce sitter costs up to fifty percent in the acute care setting (Burtson & Vento, 2015; Sand-Jecklin et al., 2016). Remote centralized video monitoring systems have been shown to reduce falls and sitter costs for organizations. Remote centralized video monitoring reduced falls to below the National Database of Nursing Quality Indicators within the hospital (Jeffers et al., 2013; Vortruba et al., 2016; Burtson & Vento, 2015) and no corollary increase in falls were seen (Votruba et al., 2016). The reduction of patient care sitters and avoidance of patient falls could offset the cost of the remote video monitoring equipment (Johnson, 2017). As an example, Burston and Vento (2015) found that the return on investment from using a remote centralized Video Monitoring system was 29 times the initial investment costs two-year post implementation.

The use of remote centralized video monitoring also prevented elopement, intervened with patient interfering with medical devices, and monitors seizure activity (Vortuba et al., 2016; Jeffers et al., 2013). Moreover, patients and family are satisfied with the use of remote

centralized video monitoring (Jeffers et al., 2013). Therefore, remote centralized video monitoring system can be successfully implemented in all adult inpatient nursing units within a healthcare system.

Review of Literature

A review of the relevant literature was conducted using CINAHL, PubMed, Cochrane Library, ClinicalKey, and Google Scholar databases (Table 1). Keywords included falls, falls prevention, tele sitter, remote video monitoring, video monitoring, in-room sitter, patient companion and sitter. There has been little peer-reviewed research on the effectiveness of a remote centralized video monitoring system compared to in-room sitters for patient safety.

There are six peer reviewed studies that have evaluated the effects of a remote centralized video monitoring system on fall rates (Table1; Table 2). Four out of the six studies showed a reduction in fall rates and fall with injury rates (Goodlett et al., 2009; Jeffers et al, 2013; Sand-Jecklin et al, 2016; & Votruba et al, 2016) and two studies showed no difference in fall rates or falls with injuries rates (Burtson & Vento, 2015; Davis, Kutash, & Whyte, 2017). Votruba et al. (2016) reported that video monitoring was a safe intervention and it was more effective that in-room sitters in decreasing falls in one hospital on three medical-surgical units over a nine-month period. One New Orleans hospital implemented video monitoring to relieve a staffing crisis in the wake of Hurricane Katrina (Goodlett et al., 2009). Researchers in this study found the use of video monitoring could be an acceptable alternative to in-room sitters in reducing falls in hospitalized patients (Goodlett et al., 2009). While Davis, Kutash and Whyte (2017) reported that video monitoring showed no statistically significant difference in fall rates or self-harm events when compared to in-room sitters in one hospital on two medical-surgical units over four years. Overall, it was found that remote video monitoring could decrease fall rates in the

inpatient setting, but no studies have researched the implementation of a remote centralized video monitoring system in a multiple hospital system.

Out of the six studies reviewed, only three studies examined the costs associated with remote video monitoring (Table 1, Table 2). Davis, Kutash, and Whyte (2017) showed a statistically significant lower cost per patient days with remote video monitoring when compared to in-room sitters, $500,000 in the first year. However, this study did not take in account the cost of the remote centralized video monitoring equipment, set-up and software installation. Another study showed the facility to reduce sitter cost from $960/day for patients to $240/day for patients (Goodlett et al., 2009). Burton and Vento (2015) showed a reduction in 16 FTE's and an estimated savings of $771,919 in the first year of implementing a remote centralized video monitoring system. Overall, more research needs to be completed on the cost analysis of implementing a remote video monitoring system in a multihospital system.

Purpose

The purpose of this project was to evaluate the effectiveness of implementing a remote centralized video monitoring system for adult patients in the acute care hospital setting. The specific aims were to:

1. Examine changes in sitter hours, fall rates, and fall with injury rates three months before and three months after implementing a remote centralized video monitoring system
2. Conduct a cost-effectiveness analysis to compare the direct financial costs of using a remote centralized video monitoring system to a sitter program

3. Compare the cost of one-on-one in-room sitters over three months to the cost of the remote centralized video monitoring program using one monitor technician to monitor 12 patients

Theoretical Framework

The Donabedian Quality of Care Framework was used as a theoretical framework for this project. The Donabedian Quality of Care Framework examines healthcare services and evaluates quality of healthcare (Donabedian, 1988). Donabedian framework relating to the quality of care consists of three categories: structure, process, and outcomes (Donabedian, 1988). Structure describes the resources through which healthcare is delivered, including hospital buildings, staff, financing, and equipment. Process represents the transactions between patients and providers in the healthcare system. Finally, outcomes refer to the effects of healthcare on the health status of patients. This model is used to evaluate how structure and process influence outcomes (Avanian, 2016). This project utilized Donabedian's Quality of Care framework to evaluate how a remote centralized video monitoring system compared to one-on-one in room sitters influences patient outcomes and cost.

Methods

Design

This study used a comparative descriptive design to compare the use of a one-on-one in-room sitter with a video monitor technician, and it included two parts. The first part was a retrospective chart review to examine sitter cost, fall rates and falls with injury from August 1, 2018 to October 31, 2018, three months prior to the implementation of a remote centralized video monitoring system. The remote centralized monitoring system was implemented at an

integrated healthcare system during December 2018. The second part included a prospective chart review to examine sitter cost, fall rates, and falls with injury rates from January 1, 2019 to March 31, 2019, three months after implementing a remote centralized video monitoring system. Outcome variables included patient demographics, admitting diagnosis, length of stay, admitting hospital, reason for sitter use, ordering provider service, fall rates, fall with injury rates, and number of sitter/remote video monitor technician hours.

Setting

The study was conducted across a healthcare system comprised of four adult hospitals. Hospital A is a 605-bed acute care hospital with special emphasis on advanced diagnostics and surgical procedures. Hospital B is a 432-bed acute care hospital specializing in cardiac, cancer, surgical, pulmonary, neurology, orthopedic, vascular, emergency and diagnostic care. Hospital C is a 373-bed community hospital offering inpatient and outpatient medical surgical care, full diagnostic services and 24-hour emergency care for men, women and children. Hospital D is a 127-bed community hospital offering a wide range of inpatient, outpatient, diagnostic, orthopedic, cardiovascular, neurological and neurosurgical, cancer care and intensive care services. The centralized monitor hub was located at Hospital D and three mobile cameras were located at the four different hospitals. The units where the mobile cameras were utilized included non-monitored medical surgical, monitored medical surgical, progressive care, and intensive care units.

Sample

The sample consisted of inpatients who required the use of a one-on-one in-room sitter during the months of August 1, 2018 to October 31, 2018 or who were monitored using the

remote centralized video monitoring system during the months of January 1, 2019 to March 31, 2019. Inclusion criteria were the charts of patients who: a.) required the use of an in-room sitter or remote centralized video monitoring system, b.) were 18 years of age or older, c.) had a recent history of falls or identified to be at an acute risk for falls by the Morse Fall scale, d.) demonstrated impulsive behavior (examples: aggression, erratic, etc.) e.) were experiencing drug or alcohol withdrawal, f.) were suffering from delirium, restlessness, or acute or chronic confusion (examples: dementia, Alzheimer's disease, etc.), g.) were identified as general safety concerns (examples: inappropriate behaviors of patient, suspected contraband, suspected medication diversion or self-medication, pulling at lines/drains/tubes), and h.) were experiencing behavioral disorders (examples: elopement risk, escalating behaviors, or eating disorders). Exclusion criteria included: a.) less than 18 years old, b.) suicidal ideation, c.) physical restraint utilization, or d.) did not require the use of a one-on-one in-room sitter or the remote centralized video monitoring system.

A total of 463 patients met inclusion criteria for the study. The total number of patients who required the use of in-room sitters during August 1, 2018 to October 31, 2018 was 202 and the total number of patients who used remote centralized video monitoring during January 1, 2019 to March 31, 2019 was 261. Of those patients, 191 were excluded from the study due to the use of physical restraints. Therefore, the sample population included 272 patients, 114 who required in-room sitters and 158 who required remote centralized video monitoring.

Data Collection

Approval from the University of Kentucky Institutional Review Board (IRB) and the Healthcare System's Office of Research and Administration was obtained prior to data collection. The first part of the data collection was a retrospective medical record review and the

second part of the data collection was a prospective medical record review. The health care system's research office compiled a list of medical records meeting inclusion criteria from the system's electronic database that was then given to the primary investigator.

For the retrospective chart review, the data specialists at the Healthcare System's office of Research and Administration provided the primary investigator with the original list of patient medical record numbers for those patients that are 18 years and older that required a one-on-one in-room sitter from August 1,2018 to October 31, 2018. For the prospective chart review, the data specialists at the Healthcare System's Office of Research and Administration provided the primary investigator the original list of patient medical record numbers who are 18 years or older requiring the use of a remote centralized monitor technician from January 1, 2019 to March 31, 2019. The data specialists will also provide the primary investigator the sitter hours and sitter cost for in-room sitters from August 1, 2018 to October 31, 2018 and for centralized monitor technicians from January 1, 2019 to March 31, 2019.

Each medical record was assigned a unique identifier that was de-identified to maintain confidentiality and necessary data for the study were documented on a separate spreadsheet. All de-identified data is stored on a password protected drive maintained by the Healthcare System. The collected demographic variables included age, gender, and race while outcome variables included hospital where admitted, admitting diagnosis, length of stay, ordering physician, sitter hours, sitter cost, reason for sitter use, fall rates and fall with injury rates.

Data Analysis

Statistical analysis was performed by using the computer software program SPSS, version 24. Descriptive statistics including frequency distribution, means, and standard

deviations were used to describe patient demographics. The two-sample t-test was used to compare age distributions between patients who had an in-room sitter compared to remote centralized video monitoring. The chi-square test of association was used to examine differences in race, hospital, admitting diagnosis, ordering physician, inclusion criteria, reason for sitter use, fall and fall with injury between patients who used an in-room sitter compared to remote centralized video monitoring. The Mann-Whitney U-test was used to examine differences between in-room sitter and remote centralized video monitoring length of stay. A p level of 0.05 was used for statistical significance throughout. Sitter hours were added up for the three-month time frame between in-room sitters and remote centralized video monitoring. Sitter cost was added up for the three-month timeframe for in-room sitter and for the remote centralized video monitoring technicians cost was added up for the three-month timeframe and divided by 12, since one remote video monitor technician can observe twelve patients at one time. Remote video monitoring technician costs were also calculated by timeframe due the remote video monitoring unit being staffed with one monitor technician for twelve patients 24/7.

Results

Population Demographics

The sample population included 272 patients, 114 patients who required in-room sitters and 158 patients who required remote centralized video monitoring. The mean age for patients who required an in-room sitter was 68.3 (SD=17.4), with 46.5% being male and 53.5% being female (Table 3). Caucasian patients represented the largest ethnic group of the in-room sitter sample (72.8%) followed by African Americans (26.3%), and Hispanics (0.9%) (Table 3). Hospital A utilized the most in-room sitters at 44.7% followed by Hospital B at 28.1%, Hospital C at 17.5% and Hospital D at 9.6% (Table 3).

The mean age for patient who required the remote centralized video monitoring was 70 (SD=15.6), with 46.8% being male and 53.2% being female (Table 3). Caucasian patients represented the largest ethnic group of the centralized video monitoring sample (81.6%) followed by African Americans (15.8%), Asian (1.3%) and Hispanics (1.3%; Table 3). Hospital C utilized the most remote centralized video monitoring at 29.7% followed by Hospital D at 27.8%, Hospital B at 22.2% and Hospital A at 20.3% (Table 3). There was no statistically significant difference between patient demographics, including age, sex, and race, between the use of in-room sitters and the remote centralized video monitoring. There is statistically significant difference between hospitals that utilized in-room sitters compared to remote centralized video monitoring.

Sample Characteristics

The median length of stay (LOS) for patients who required an in-room sitter was 6.8 days (IQR= 3.0-11.8 days; Table 4). The most frequent admitting diagnosis for patient who required in-room sitters was neurologic disorders at 28.1% followed by pulmonary disorders at 14.0% and gastrointestinal disorders at 12.3% (Table 4). Most patients qualified for more than one inclusion criteria for the use of in-room sitter or centralized video monitoring. Acute or chronic confusion was the most frequent inclusion criteria at a rate of 80.7% of patients who required an in-room sitter, following safety concerns at 78.9%, history of falls or high MORSE fall score at 49.1% and delirium at 16.7% (Table 5). The following documented reason for utilization of an in-room sitter was fall at home at a rate of 45.6% of patients, followed by delirium (31.6%), pulling at lines/drains/tubes (13.2%) and alcohol or drug withdrawal (5.3%; Table 6; Figure 1). The most frequent service who ordered an in-room sitter was the hospitalist group at a rate of 82.5%,

following unknown/nursing order at 12.2% (Table 4). Hospital A and hospital B hospitalist groups ordered the most in-room sitters (Figure 2).

The median LOS for patients who required the remote centralized video monitoring was 6.3 days (IQR= 3.8-10.7 days; Table 4), which compared to the LOS of in-room sitters. The most frequent admitting diagnosis for remote centralized video monitoring was neurologic disorders at 35.4% followed by pulmonary disorders at 21.7% (Table 4). History of falls or high MORSE fall score was the most frequent inclusion criteria at a rate of 84.8%, following acute or chronic confusion (84.0%), safety concerns (58.9%) and impulsive behavior (31.6%; Table 5). The following documented reason for utilization of the centralized video monitoring was fall at home (57.0%) following pulling at lines/drains/tubes (23.4%), alcohol/drug withdrawal (10.8%) and delirium (4.4%; Table 6; Figure 1). The most frequent service who ordered remote centralized video monitoring was nursing (86.1%), following hospitalist group (12.7%; Table 4). Hospital D and Hospital C nursing staffs ordered to most remote video monitoring for patients (Figure 3).

There was no statistically significant difference between LOS between patients who required the use of an in-room sitter versus centralized video monitoring. There was statistically significant difference between the following inclusion criteria: history of falls or high MORSE fall score, impulsive behavior, delirium and safety concerns. The statistical significance between impulsive behavior, delirium and safety concerns shows patients who required an in-room sitter met those inclusion criteria more than patients who required the use of remote video monitoring. Patients who required the use of remote video monitoring met the inclusion criteria of history of falls or high MORSE fall score more than patients who required an in-room sitter. There were no statistically significant differences between the following inclusion criteria: drug or alcohol withdrawal, restlessness, and behavior disorders. The reason for ordering an in-room sitter

compared to the remote centralized video monitoring were shown to be statistically significant indicating a fall at home, pulling at lines/tubes/drains and alcohol or drug withdrawal were more frequently reasons for ordering the remote video monitoring system compared to an in-room sitter. There were statistically significant differences between the services who ordered in-room sitters versus centralized video monitoring. The hospitalist group at Hospital A ordered the most in-room sitters. The nursing staff ordered the most remote centralized video monitoring at Hospital C and Hospital D.

Fall Rates

Of 114 patients who required an in-room sitter, 11.4% had a fall during their hospital stay and no patients had a fall with injury (Table 7). Of the patients who required the use of the remote centralized video monitoring, 10.8% had a fall during their hospital stay and no patients had a fall with injury (Table 7). Of the 158 patients who required the use of the remote centralized video monitoring, 12.7% required an in-room sitter during their stay. There was no statistically significant difference between fall rates and fall with injury between the use of in-room sitters and the remote centralized video monitoring. The national fall rate is 3.5 falls per 1000 patient days and 26.1% of falls resulting in injury (The Joint Commission, 2018). This healthcare system does not compare with the national fall or fall with injury rate, since the healthcare system had zero falls with injury over a three-month timeframe.

Sitter Hours and Cost

The total number of in-room sitter hours for 114 patients from August 1, 2018 to October 31, 2018 was 8,714 hours (Table 8). The market value hourly cost for an in-room sitter is $11.16 per hour. The total cost of in-room sitter for the healthcare system is $96,304.24 for three months

and the estimated total cost of in-room sitter for a year is $385,216.96 (Table 9). The total number of remote centralized video monitoring technician hours for 158 patients during the months of January 1, 2019 to March 31, 2019 was 9,519.05 (Table 8). The market value hourly cost for a monitor technician is $14.88 per hour to monitor 12 patients at one time. The total cost of remote centralized video monitor technicians is $11,803.62 for monitoring 9,519.05 hours (Table 9). Since the remote centralized video monitoring unit has to be staffed 24 hours a day/ seven days a week, total remote video monitoring technician hours were also calculated per the timeframe of the study, 92 days or 3 months. Therefore, to staff the remote centralized video monitoring unit for 92 days it would cost $32,855.04 (Table 8). The estimated potential yearly savings from implementing the remote centralized video monitoring system would be $256,653.73 (Table 9). The total cost of the remote centralized video monitoring technology for the healthcare system is $301,868,68 including twelve mobile cameras, software, wiring, training, monitors, cable lines and integration into EPIC. The Remote centralized video monitoring system would pay for itself in 13.5 months.

Discussion

This study was aimed at evaluating the effectiveness of a remote centralized video monitoring system for adult patients in the acute care hospital setting compared to an in-room sitter program. Of the three objectives evaluated in this study, none of the objectives were found to have statistically significant difference. However, some major key findings were discovered between patients who required the use of an in-room sitter and patients who required the use of remote centralized video monitoring that were not in the purpose of this study including reason for ordering an in-room sitter/remote centralized video monitoring, variations among hospitals within the healthcare system, and reduction in in-room sitter cost.

Fall rates

The objective of examining fall rates and falls with injury rates showed to have no statistical significance, however it showed that in-room sitters and remote centralized video monitoring are equivalent in fall rates. Patients who utilized an in-room sitter, 11.4% had a fall during their hospital stay, when compared to 10.8% of patients who utilized the remote centralized video monitoring system. No patients were shown to have sustained a fall with injury during this study. These results compared to two of six studies that have been previously published in peer-reviewed articles who showed no statistical significance in fall rates or fall with injury rates when compared to in-room sitters (Burtson & Vento, 2015; Davis, Kutash, & Whyte, 2017). Therefore, implementation of a remote centralized monitoring system in hospitalized patients is just as safe for patients when compared to in-room sitters in fall rates.

Sitter Cost and Sitter Hours

The remote centralized video monitoring not only compared to in-room sitters with fall rates but also showed a large reduction in sitter cost and in-room sitter needs. The remote centralized video monitoring system cost the healthcare system $32,140.80 for a 3-month timeframe compared to the cost of in-rooms sitters for a 3-month timeframe of $96,304.24. Based off the cost-savings, the remote centralized video monitoring system would pay for itself in 13.5 months of in-room sitter cost and provide the healthcare system a cost-savings of $256,653.73 per year in sitter cost. This cost reduction compares to three studies examined the costed associated with remote video monitoring (Burton & Vento, 2015; Davis, Kutash & Whyte, 2017; and Goodlett et al., 2009). Since these three studies were only researching one hospital, it is important to note that this study showed cost-savings over a four-hospital healthcare system.

In-room sitter hours were less when compared to the remote centralized video monitoring technician hours, but a remote video monitoring technician has the capability to watch up to twelve patients at one time compared to an in-room sitter who can only watch one patient at a time. Also, it was shown that during the three months of evaluating the remote centralized video monitoring system, only 12.7% of patients failed the remote video monitoring system due to increased re-direction requiring the use of an in-room sitter. Therefore, the remote video monitoring system reduced the use of in-room sitters during the months of January 2019 to March 2019. Healthcare systems spend a significant amount of money on the cost of in-room sitters every year. By investing in a centralized video monitoring system, healthcare systems can save money and provide the same safety for patients when compared to in-room sitters in regard to falls.

Reason for Ordering In-Room Sitter/ Remote Video Monitoring Technician

The reason for ordering a sitter between the utilization of in-room sitters and centralized video monitoring showed a statistically significant difference. The top three documented reasons for sitter use for in-room sitter were fall at home (45.6%), delirium (31.6%), and pulling at lines/drains/tubes (13.25%). The top three documented reasons for sitter use for the remote centralized video monitoring were fall at home (57.0%), pulling at lines/tubes/drains (23.4%), and alcohol or drug withdrawal (10.8%). The majority of both samples used an in-room sitter or remote centralized video monitoring for patients with a history of falls to prevent injury, but remote centralized video monitoring was also used for preventing patient's removing or pulling at intravenous lines, post-operative drains, chest tubes, and oxygen tubing. By preventing patients from pulling at necessary medical equipment, patients were able to receive the necessary medical treatment. Also, alcohol or drug withdrawal patients were the third most frequent reason

for the remote centralized video monitoring system. Many patients who had alcohol or drug withdrawal were monitored by the remote centralized video monitoring system and remote video monitoring technicians were able to report to the nurse if any suspicious activity occurred in the patient's room, if family members were bringing the patient suspicious items or if suspected contraband was found. Also, remote video monitoring technicians reported suspected medication diversion or self-medication. More research is needed on the centralized video monitoring system and reducing length of stay or adverse events from patients pulling at lines/tubes/drains and more research needs to be completed on preventing adverse events in the alcohol or drug withdrawal patient population.

Variations Across Hospitals

The variation across hospitals between the utilization of in-room sitters and remote centralized video monitoring showed a statistically significant difference in service who ordered and hospital the in-room sitter/centralized video monitoring system. The hospitalist group showed the heaviest use of in-room sitters (82.5%) and nurses used the remote centralized video monitoring most heavily (86.1%). The hospitalist group at Hospital A was shown to have ordered the most in-room sitters within the healthcare system. The Nursing was only responsible for 12.2% of in-room sitters. The nursing staff at hospitals C and D ordered the most remote centralized video monitoring within the healthcare system. The policy for in-room sitters and centralized video monitoring at the healthcare system where this study was performed states that no order is needed for either one of these safety measures. Therefore, education needs to be administered to the nursing staff and providers that in-room sitters or remote centralized video monitoring does not require an order and nurses can utilize their judgement. Also, providers need to be educated on the remote centralized video monitoring unit.

Another variance across hospitals was which hospital used the most in-room sitters and remote centralized video monitoring. Hospital A utilized the most in-room sitters (44.7%) and all four hospital used the remote centralized video monitoring system equally. Hospital C utilized the remote centralized video monitoring unit the most at 29.7%, while hospital A utilized the remote centralized video monitoring unit the least at 20.3%. The remote centralized video monitoring system was most likely utilized at all four hospitals equally due to each hospital having three cameras. This information provides the healthcare system it can provide education to hospital A regarding the centralized video monitoring unit uses and purpose. This information provides the healthcare system with knowledge of which hospital would utilize more cameras in the future.

Limitations

Several limitations were identified in the design of this study. Since data were extracted by means of retrospective and prospective chart review, accuracy was highly dependent on the documentation skills of the provider, nursing staff, in-room sitter and remote centralized video monitor technician. Therefore, information could have been missed if it was not documented. It was unable to be determined if the fall occurred prior to patient requiring a sitter/remote centralized video monitoring, while the patient had a sitter/remote centralized video monitoring or after the patient had a sitter/remote centralized video monitoring due to lack of documentation. Another limitation to this study, is the high number of patients that were excluded from the study due to restraint utilization. Also, the study only examined patients in four adult hospitals over a three-month time span. Next, this comparison study was not conducted within the same season. In-room sitters were examined during the fall and the remote video monitoring system was examined in the winter/early spring. Patient census could have

affected the study population. Lastly, it was not possible to determine how many patients each remote centralized video monitoring technician was observing at one time. Since, the centralized video monitoring technicians could observe up to 12 patients at one time, it will be assumed that each monitor technician was observing 12 patients.

Recommendations for Future Research

This study has highlighted several implications for future research. More research needs to be completed in monitoring adverse events from patients pulling at lines/tubes/drains and more research needs to be completed in monitoring adverse events in the alcohol and drug withdrawal population. With the high rise in heroin and substance abuse, the remote centralized video monitoring system may help prevent overdoses in the hospital setting, but more research needs to be completed. Also, future research needs to be completed on the high restraint utilization in this healthcare system. Additional research needs to be performed to determine nursing staff response times for the alarms set off by the remote video monitoring technician. Another recommendation for future research is surveying the nursing staff on their thoughts of the remote centralized video monitoring system compared to in-room sitters. The nursing staff are at the front lines of using this technology and their thoughts should be evaluated. Also, provider education for the remote centralized video monitoring system needs to be evaluated.

Conclusion

The purpose of this study was to evaluate the implementation of a remote centralized video monitoring unit at a major healthcare system. The remote centralized video monitoring system cost the healthcare system significantly less and demonstrated comparable fall rates when compared to in-room sitters. The remote centralized video monitoring system would pay for

itself within 13.5 months. Clinically significant outcomes include hospitals who utilized the most in-room sitters as compared to remote centralized video monitoring, service lines who ordered sitter compared to remote centralized video monitoring, inclusion criteria and reason for sitter or remote centralized video monitoring use. More research is needed on the use of the remote centralized video monitoring unit in patients pulling out lines/tubes/drains and in the alcohol or drug withdrawal population in preventing suspected contraband, suspected medication diversion or self-medication in this population. Therefore, the remote centralized video monitoring system could be used in the place of in-room sitters in high risk fall patients or patients who present to the hospital with a fall in place of an in-room sitter.

Table 1: Literature Review Table				
Author, YEAR	**Study Design Study Purpose**	**Sample Characteristics & Setting**	**Main Findings**	**Level of Evidence**
Burton, P. & Vento, L. (2015)	-Quality Improvement Study -Purpose: Implementation of video monitoring and research cost outcomes	-2 inpatient hospitals in California over 2 years	-23.9% reduction in sitter hours -$771,919 estimated savings in one year and $1,718,823 estimated savings in two years with video monitoring -No change in fall rates from national benchmark	Level V, B
Davis, J., Kutash, M., & Whyte, J. (2016)	-Quasi-experimental-nonrandomized -Purpose: To determine the prevalence of falls and self-harm using in-room sitters compared to video monitoring and associated costs	-2 adult medical surgical units over 4 years	-No statistically significant in fall rates or self-harm events when video monitoring is compared to in-room sitters -Statistically significant lower cost per patient day with video monitoring	Level II, B
Goodlett et al., (2009)	-Quality improvement study -Purpose: To reduce falls	-34 bed nursing home in New Orleans, over 12 months -417 patients observed by video monitoring	-Falls rates decreased by 6% after implementation of video monitoring, not statistically significant - Sitter cost decreased from $960 for 4 patients to $240 for 4 patients	Level V, B
Jeffers, S., et al., (2013)	-Quality improvement study -Purpose: To implement centralized video monitoring	-525 bed acute care hospital in Denver, CO, over 18 months	- After 3 months, 57 falls were prevented with a potential savings of $24,225 - Over 18 months, $2.02 million saved in deferred cost savings from fall cost -Prevented 7 oxygen disruptions and 20 IV catheter pulls	Level V, B
Sand-Jecklin, K., Johnson, J., &	-Quasi-experimental pre-post design	-2 medical surgical units in an acute care hospital	-2.8 falls per 1000 patient days reduction with video monitoring, statistically significant	Level II, B

Tylka, S. (2015)	-Purpose: to examine fall rates and in-room sitter hours	-6 months, pre-implementation and 6 months post-implementation	- 23.2% reduction in sitter hours with video monitoring	
Votruba, L., Graham, B., Wisinski, J., & Syed, A., (2016)	- Prospective descriptive implementation study -Purpose: to implement video monitoring	- 3 inpatient units in a 350-bed urban Magnet hospital, over 9 months - 828 patients	- Statistically significant reduction in falls, 35% reduction - Decrease in 1:1 sitter usage - Prevented patients from pulling at lines/tubes/drains and oxygen devices	Level V, B

Table 2: Synthesis Table to summarize findings

Variables of interest (outcomes)	**Burton, P. & Vento, L. (2015)**	**Davis, J., Kutash, M., & Whyte, J. (2016)**	**Goodlett et al., (2009)**	**Jeffers, S., et al., (2013)**	**Sand-Jecklin, K., Johnson, J., & Tylka, S. (2015)**	**Votruba, L., Graham, B., Wisinski, J., & Syed, A., (2016)**
Fall rates	No change	No change	↓ b	↓ c	↓ b	↓ b
Sitter Cost	↓ c	↓ b	↓ c	NE	NE	NE
Sitter Hours	↓ c	NE	NE	NE	↓ c	↓ c
Pulling at lines/tubes/drains and oxygen devices	NE	NE	NE	↓ c	NE	↓ c

LEGEND: ↑ = INCREASED, ↓ = DECREASED, NE = Not Evaluated
[a] higher-level evidence; [b] statistically significant findings; [c] statistical significance not reported

Table 3: Demographics of patients who required In-room sitters compared to the remote centralized video monitoring system			
	In-room Sitter (n= 114) Mean (SD) n (%)	RCVM (n=158) Mean (SD) or n (%)	p
Age, years (mean, SD)	68.3 (17.4)	70.0 (15.6)	0.098
Sex			0.955
Male	53 (46.5%)	74 (46.8%)	
Female	61 (53.5%)	84 (53.2%)	
Race			0.12
Black	30 (26.3%)	25 (15.8%)	
Caucasian	83 (72.8%)	129 (81.6%)	
Hispanic	1 (0.9%)	2 (1.3%)	
Asian	0 (0%)	2 (1.3%)	
Hospital			<0.001
Hospital A	51 (44.7%)	32 (20.3%)	
Hospital B	32 (28.1%)	35 (22.2%)	
Hospital C	20 (17.5%)	47 (29.7%)	
Hospital D	11 (9.6%)	44 (27.8%)	
Notes: Remote Centralized Video Monitoring (RCVM), Standard Deviation (SD) Significant at the $p<0.05$ value			

Table 4: Characteristics of patients who required In-room sitters compared to the Remote centralized video monitoring system			
	In-room Sitter (n= 114) Median (IQR) n (%)	RCVM (n=158) Median (IQR) or n (%)	p
Length of Stay	6.8 Days (3 – 11.8 days)	6.5 days (3.8- 10.7 days)	0.977
Admitting Diagnosis			0.291
Gastrointestinal	14 (12.3%)	11 (7.0%)	
Cardiac	8 (7.0%)	13 (8.2%)	
Pulmonary	16 (14.0%)	20 (12.7%)	
Neurology	32(28.1%)	56 (35.4%)	
Sepsis	3 (2.6%)	9 (5.7%)	
Psychology	8 (7.0%)	6 (3.8%)	
Orthopedics	8 (7.0%)	7 (4.4%)	
Hematology/Oncology	9 (7.9%)	13(8.2%)	
Genitourinary	3 (2.6%)	5 (3.2%)	
Renal	8 (7.0%)	4 (2.5%)	
Other	5 (4.4%)	14 (8.9%)	

Service who ordered sitter			<0.001
Hospitalist Group	94 (82.5%)	20 (12.7%)	
Psychology	4 (3.5%)	2 (1.3%)	
Renal	1 (0.9%)	0 (0.0%)	
Pulmonary	1 (0.9%)	0 (0.0%)	
Nursing	14 (12.2%)	136 (86.1%)	
Notes: Remote Centralized Video Monitoring (RCVM), Interquartile Range (IQR) Significant at the p<0.05 value			

Table 5: Inclusion Criteria

Inclusion criteria	In-room (n= 114) n (%)	RCVM (n=158) n (%)	p
History of Falls or high Morse fall score	56 (49.1%)	134 (84.8%)	<0.001
Impulsive Behavior	62 (54.4%)	50 (31.6%)	<0.001
Drug or alcohol withdrawal	6 (5.3%)	12 (7.6%)	0.450
Delirium	19 (16.7%)	11 (7.0%)	0.010
Restlessness	2 (1.8%)	8 (5.1%)	0.150
Acute or Chronic Confusion	92 (80.7%)	131 (84.0%)	0.480
Safety Concerns	90 (78.9%)	93 (58.9%)	<0.001
Behavior Disorder	10 (.8%)	6 (3.8%)	0.085
Notes: Remote Centralized Video Monitoring (RCVM) Significant at the p<0.05 value			

Table 6: Reason for In-Room Sitter/ Remote Centralized Video Monitoring Use

Reason for sitter use	In-room (n= 114) n (%)	RCVM (n=158) n (%)	p
Fall at home	52 (45.6%)	90 (57.0%)	<0.001
Delirium	36 (31.6%)	7 (4.4%)	
Alcohol or Drug Withdrawal	6 (5.3%)	17(10.8%)	
Pulling at lines/drains/tubes	15 (13.2%)	37 (23.4%)	
Seizure Watch	1 (0.9%)	1 (0.6%)	
Elopement risk	4 (3.5%)	6 (3.8%)	
Notes: Remote Centralized Video Monitoring (RCVM) Significant at the p<0.05 value			

Table 7: Comparison of Fall Rates			
	In-room (n= 114) n (%)	RCVM (n=158) n (%)	p
Fall without injury	13 (11.4%)	17 (10.8%)	0.480
Fall with injury	0 (0.0%)	0 (0.0%)	N/A
Notes: Remote Centralized Video Monitoring (RCVM) Significant at the $p<0.05$ value			

Table 8: Sitter hours and cost of in-room sitter compared to remote centralized video monitoring			
	In-Room (n=114)	RCVM (n=158)	RCVM coverage for 3months
Total Hours	8,714 hours	9,519.05 hours	2,160 hours
Cost per Hour	$11.16	$14.88	$14.88
Total Cost	$96,304.24	$141,643.46/12 patients= $11,803.62	$32,140.80
Notes: Remote Centralized Video Monitoring (RCVM)			

Table 9: Cost Analysis			
Yearly Cost for RCVM/ In-room Sitter			
Actual cost of RCVM technicians over 3 months	$32,140.80	Actual cost of in-room over 3 months	$96,304.24
Estimated yearly RCV Technician costs	$128,563.20	Estimated yearly cost of in-room sitters	$385,216.96
Potential yearly cost savings in sitter cost	**$256,653.73** ($385,216.96-$128,563.20)		
Total Cost of Equipment			
Total cost of RCVM equipment/training/software/etc.	$301,868.68	Cost of sitter equipment	n/a
*****RCVM system would pay for itself in 13.5 months*****			
Notes: Remote Centralized Video monitoring (RCVM)			

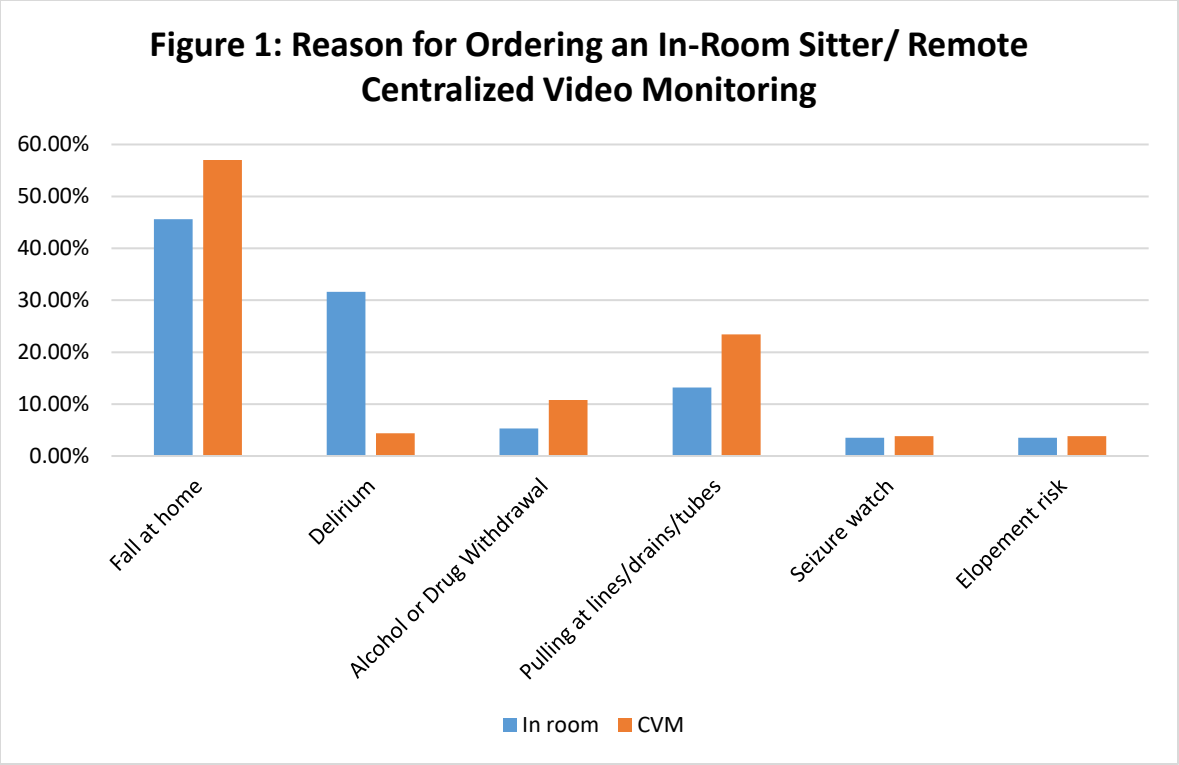
Figure 1: Reason for Ordering an In-Room Sitter/ Remote Centralized Video Monitoring
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Fall at home
Delirium
Alcohol or Drug Withdrawal
Pulling at lines/drains/tubes
Seizure watch
Elopement risk
In room
CVM

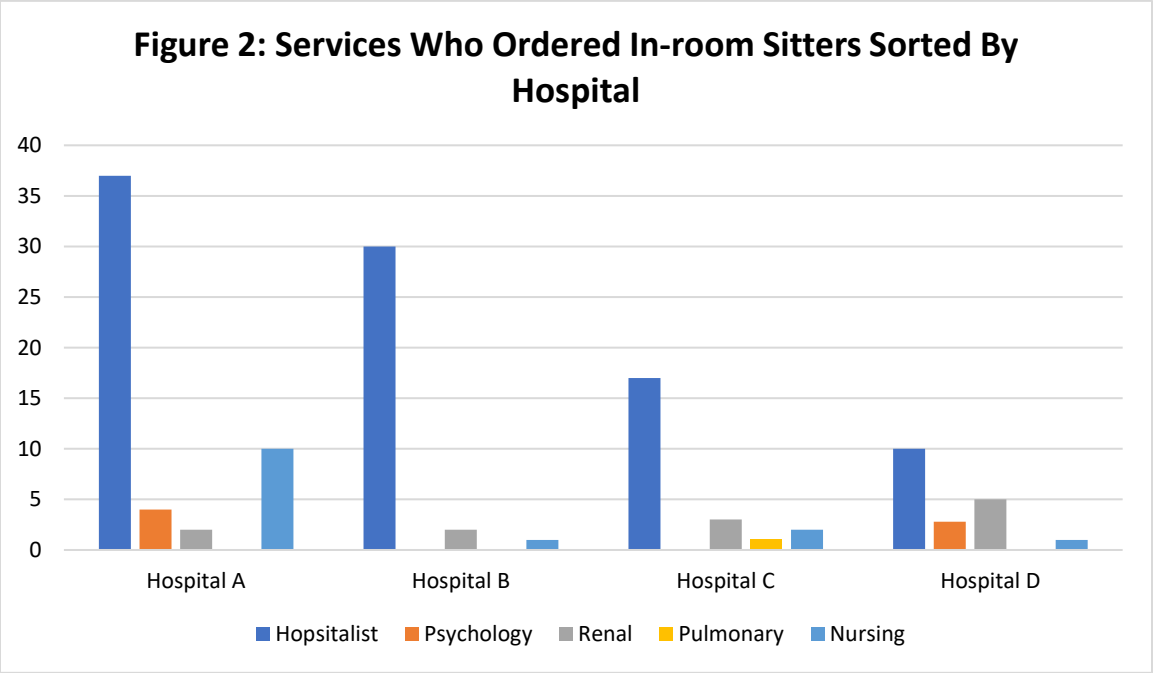
Figure 2: Services Who Ordered In-room Sitters Sorted By Hospital
40
35
30
25
20
15
10
5
0
Hospital A
Hospital B
Hospital C
Hospital D
Hopsitalist
Psychology
Renal
Pulmonary
Nursing

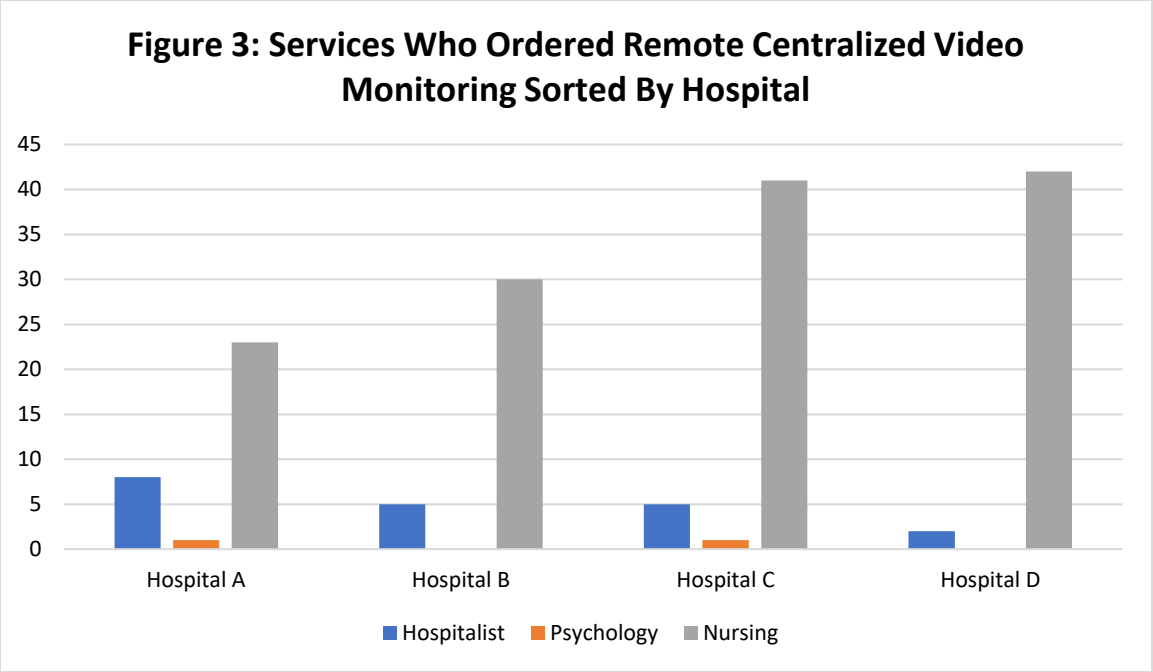
Figure 3: Services Who Ordered Remote Centralized Video Monitoring Sorted By Hospital
45
40
35
30
25
20
15
10
5
0
Hospital A
Hospital B
Hospital C
Hospital D
Hospitalist
Psychology
Nursing

References

Agency for Healthcare Research and Quality. (2017). *Falls.* Retrieved from https://psnet.ahrq.gov/primers/primer/40/falls

Ayanian, John Z. (2016). Donabedian's Lasting Framework for Health Care Quality. *The New England Journal of Medicine., 375*(3), 205-207.

Bradley, Kenesha. (2016). Remote Video Monitoring: A Novel Approach in Fall Prevention. *The Journal of Continuing Education in Nursing., 47*(11), 484-486.

Burtson, P. L., & Vento, L. (2015). Sitter Reduction Through Mobile Video Monitoring. *JONA: The Journal of Nursing Administration, 45*(7/8), 363-369. doi:10.1097/nna.0000000000000216

Center for Disease and Control (CDC). (2017). Retrieved from https://www.cdc.gov/mmwr/volumes/65/wr/mm6537a2.htm

Chu, R. Z. (2017). Preventing in-patient falls: The nurse's pivotal role. *Nursing, 47*(3), 25-30. doi:10.1097/01.NURSE.0000512872.83762.69

Davis, J., Kutash, M., & Whyte, J. (2017). A comparative study of patient sitters with video monitoring versus in-room sitters. Journal of Nursing Education and Practice, 7(3), 137-142.

Donabedian, A. (1988). The quality of care: how can it be assessed?. *Jama, 260*(12), 1743-1748.

Dunne, T. J., & Gaboury, I., & Ashe, M. C. (2014). Falls in hospital increase length of stay regardless of degree of harm. Journal of Evaluation in Clinical Practice, 20, 396-400.

Goodlett, D., Robinson, C., Carson, P., & Landry, L. (2009). Focusing on video surveillance to reduce falls. *Nursing2019, 39*(2), 20-21.

Hardin, S. R., Dienemann, J., Rudisill, P., & Mills K. K. (2013). Inpatient fall prevention: Use of in-room webcams. Journal of Patient Safety, 9(1), 29-35.

Jeffers, S., Searcey, P., Boyle, K., Herring, C., Lester, K., Goetz-Smith, H., & Nelson, P. (2013). Centralized Video Monitoring For Patient Safety: A Denver Health Lean Journey. *Nursing Economic$, 31*(6), 297-306.

Joint Commission. (2015). Preventing falls and fall-related injuries in health care facilities. *Sentinel Event Alert*, 55. Retrieved from https://www.jointcommission.org/assets/1/18/SEA_55.pdf

Melnyk, B., & Fineout-Overholt, E. (2015). Evidence-Based Practice in Nursing and Healthcare: A Guide to Best Practice (3rd Ed.) Lippincott, Williams and Wilkins.

Norton Healthcare. (2018). *About Norton Healthcare.* Retrieved from https://nortonhealthcare.com/about-us/

Pi, H. Y., Gao, Y., Wang, J., Hu, M. M., Nie, D., & Peng, P. P. (2016). Risk Factors for In-Hospital Complications of Fall-Related Fractures among Older Chinese: A Retrospective Study. *BioMed research international, 2016,* 8612143. doi:10.1155/2016/8612143

Sand-Jecklin, K., Johnson, J., Tringhese, A., Daniels, C., & White, F. (2019). Video Monitoring for Fall Prevention and Patient Safety: Process Evaluation and Improvement. *Journal of Nursing Care Quality, 34*(2), 145-150.

Sand-Jecklin, K., Johnson, J. R., & Tylka, S. (2016). Protecting Patient Safety. *Journal of Nursing Care Quality, 31*(2), 131-138. doi:10.1097/ncq.0000000000000163

The Joint Commission. (2015). Preventing falls and fall-related injuries in health care facilities. Sentinel Event Alert, 55. Retrieved from https://www.jointcommission.org/assets/1/18/SEA_55.pdf

The Joint Commission. (2018) "Temporal trends in fall rates with the implementation of a multifaceted fall prevention program: persistence pays off." The Joint Commission Journal on Quality and Patient Safety 44 (2), 75-83.

Votruba, L., Graham, B., Wisinski, J., & Syed, A. (2016). Video Monitoring to Reduce Falls and Patient Companion Costs for Adult Inpatients. *Nursing Economic$, 34*(4), 185-189.