Quality Improvement for Bedrest Practice Following Outpatient Diagnostic Cardiac Catheterization Using Manual Pressure Sheath Removal

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Abstract

Background: The American College of Cardiology 2012 cardiac catheterization guidelines recommend bedrest for one to two hours for 4 to 5-French sheaths and two to four hours for 6 to 8-French sheaths. Research supports that raising the head of bed (HOB) to 60 degrees after one hour and ambulation after two hours of bedrest is safe for transfemoral diagnostic cardiac catheterizations with manual sheath removal. In winter 2018, an academic medical center piloted a quality improvement project to reflect this practice guideline. **Methods:** A 2017 database was used to retrospectively obtain control findings on the prior bedrest practice involving four-hours bedrest and HOB no greater than 15 degrees. The intervention group was a convenience sample and collected information on groin complications, discharge times, and patient satisfaction for all patients who met the reduced bedrest protocol criteria. Descriptive statistics, *t*-tests, and chi-square were used to analyze the data. **Results:** The control group had 2 hematomas and intervention group had no groin complications, $\chi(1) = 2.53$, $p = .11$. The length of stay in minutes was significantly different for the control group ($M = 283$, $SD = 55.3$) and intervention group ($M = 184$, $SD = 57$); $t(285) = 15.3$, $p < .01$. There were statistically significant increases in patient experience related to pain ($t(27) = -2.45$, $p = 0.02$) and procedural delay ($t(27) = -2.73$, $p = .01$). **Conclusions:** This cardiac catheterization department optimized its utilization of recovery space and procedural costs while improving patient satisfaction and maintaining safe outcomes.

Keywords: bedrest, cardiac catheterization, diagnostic left heart catheterization

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Introduction

A diagnostic left heart catheterization is a procedure that evaluates the coronary arteries, which involves injecting contrast to determine blood flow and degree of stenosis, but does not require further intervention, stenting, or anticoagulation therapy (Dal Molin et al., 2015). To perform this procedure, catheters and wires are advanced to the heart through a sheath, which is a long, wide bore, single lumen catheter with a wide plastic hub on the proximal end (Dal Molin et al., (2015). At the end of these diagnostic transfemoral cardiac catheterization procedures, the sheath is discontinued by applying manual pressure to access site for 10 to 15 minutes or using a closure device. Once hemostasis is achieved, all patients require some type of bedrest (Mohammady, Heidari, Akbari Sari, Zolfaghari, & Janani, 2014).

Postoperative bedrest is an important post procedure step to prevent several complications such as bleeding and hematoma formation at the access site; however, the length of time and position of patient varies vastly throughout different facilities (Dal Molin et al., 2015). In 2012, the American College of Cardiology (ACC) and American Heart Association (AHA) produced standards for cardiac catheterization, where they recommended bedrest for one to two hours after 4 or 5-French sheath removal and two to four hours after 6 to 8-French sheath removal (Bashore et al., 2012). Since the equipment and access techniques for cardiac catheterizations have improved throughout the years, it is important for cardiac catherization departments to analyze and update the head of bed position and length of bedrest to better reflect evidence-based practice.

Background and Significance

There is a large, academic medical center located in New York City (NYC) with an outpatient cardiac catheterization department that performs over 6,000 procedures annually (J. Sherrow, personal communication, June 6, 2017). In 2016, a total of 3811 of this department's procedures were diagnostic left heart catheterizations, which received no more than 500 units of intra-arterial (IA) heparin (J. Sherrow, personal communication, June 6, 2017). According to Sherrow (personal communication, June 6, 2017), there are several reasons these patients require a diagnostic left heart catheterization, including but not limited to: evaluation of coronary flow for angina, transaortic valve replacement (TAVR) work-up, and cardiac clearance for surgery or organ transplants. The diagnostic cardiac catheterization volume at this lab is rapidly growing, as reflected by 4466 total diagnostic catheterization procedures performed between January 1 and December 8, 2017 (J. Sherrow, personal communication, December 8, 2017).

Most of these cases are expected to use the femoral artery with a 4, 5, or 6-French sheath as access site because most of this hospital's attending physicians prefer to primarily use the femoral approach verse the radial approach (J. Sherrow, personal communication, June 6, 2017). Approximately 500 diagnostic left heart catheterizations were performed using the radial approach in 2016 (J. Coppola, personal communication, November 15, 2017). This femoral approach preference is related to the radial approach being a newer technique popularized only 10 years ago (Bianchi et al., 2017). Radial approach is considered technically more challenging than the traditional transfemoral technique because it involves the use of smaller guiding catheters and devices that requires greater caution in handling (Bianchi et al., 2017).

Once hemostasis is achieved, this hospital's current practice for patients post diagnostic cardiac catheterization with manual sheath removal requires patients remain to on bedrest in a

supine position with the head of the bed (HOB) no greater than 15 degrees for a minimum of four hours (J. Sherrow, personal communication, June 6, 2017). Hematomas and groin complications are monitored and reported to New York State as a quality indicator measurement for cardiac catheterization departments. In 2017, this department reported 54 hematomas in quality indicator measurement data however the type of procedure or closure methodology was not reported (J. Sherrow, personal communication, Dec 8, 2017).

Needs Assessment

There are several negative impacts on patient care because of the current practice of four-hour bedrest with HOB flat post diagnostic cardiac catheterization. Patients often complain of urinary retention and back pain in their patient satisfaction surveys (J. Sherrow, personal communication, June 6, 2017). According to Dal Molin et al. (2015), patients identify prolonged bedrest as the most difficult component of cardiac catheterization procedures and frequently complain of back pain and urinary retention while in this recumbent position. During the post procedure care phase, the nursing staff report that they spend a significant amount of time on repositioning patients, pain management, and encouraging urination using a urinal or bedpan. This time could be used more effectively by educating patients on post wound care, discharge instructions, and ways to decrease high risk behaviors for heart disease (Mohammady et al., 2014).

To prepare for cardiac catheterization, patients must not eat anything for six hours prior to their procedure. After the procedure, patients are hungry and want to eat but it is difficult to eat while lying completely flat. Patients on bedrest with the head of bed flat often choke or cough while eating, which places extra pressure on the groin site and increases the risk of bleeding (Dal Molin et al., 2015). As witnessed by this author, this inability to eat negatively impacts patient

satisfaction. As part of the discharge requirements, patients cannot go home until they are able to tolerate orals and void. Since many patients are unable to accomplish this until after the bedrest is complete, discharge times are further delayed.

This hospital's cardiac catheterization department is comprised of a six-bay holding area for prepping and recovering patients. There is inevitably a back-up in patient flow every day as a direct result of maintaining the four-hour bedrest policy post diagnostic catheterization for patients (J. Sherrow, personal communication, June 6, 2017). Due to this lack of space in the holding area, patient care is delayed because subsequent patients cannot be prepped for the start of their procedure. Further delays occur due to the inability to bring patients to the holding area post procedure. Once the holding area is full, the post-patients must occupy the procedure room longer until there is a safe location to provide post-care observations. According to Best, Pike, Grainger, Eastwood, and Carroll (2010), eliminating unnecessary bedrest time will enable catherization lab departments to perform more procedures within the same budget. If this hospital could safely decrease the bedrest time required, then these patients could ambulate sooner and return home earlier, thus resulting in more effective utilization of the holding area space. Four-hour bedrest after diagnostic cardiac catheterizations results in an increase in medical costs (Mohammady et al., 2014). By reducing the required bedrest time from four to two hours, every post bed will potentially double its occupancy. An added result of this earlier discharge would be improved patient satisfaction by addressing the most frequent complaints related to prolonged bedrest, which includes back pain, as well as, urinary discomfort and retention associated with difficulty evacuating the bladder when in recumbent position (Burn, Marshall, & Scrymgeour, 2015).

Problem/Purpose Statement

Although the equipment and access techniques were updated and improved throughout the years, this cardiac catheterization lab never updated its bedrest practice regarding the length of time and head of bed position. This hospital's bedrest practice for diagnostic cardiac catheterization patients with manual sheath removal was remaining on bedrest with the HOB flat longer than recommended by the ACC. Failure to update its bedrest practice resulted in decreased patient satisfaction and ineffective use of hospital resources. Remaining in bed flat for four hours opposed to two hours without position change caused patients to complain of back pain, urinary retention, and inability to eat after diagnostic cardiac catheterizations.

A reduction in length of bedrest was needed to improve throughput this hospital's growing cardiac catheterization population while still maintaining patient safety and excellent quality indicator measurements. A quality improvement practice change was implemented by reducing the total length of bedrest to two hours with increasing the HOB to 60 degrees after one hour. The expected outcome was no greater risk of groin complications involving bleeding, hematomas, pseudoaneurysms, or arteriovenous (A/V) fistulas post procedure.

Clinical Question

Does decreasing the length of bedrest from four hours to two hours and raising the HOB to 60 degrees after one hour for outpatients undergoing transfemoral, diagnostic cardiac catheterizations using 4 to 6-French sheaths and manual sheath removal result in increased groin complications over a three-month period at this large, NYC-based cardiac catheterization lab?

Aims and Objectives

The overall aim of this quality improvement project was to evaluate the effect of reducing the length of bedrest to two-hours and elevating the HOB to 60 degrees after one hour on the

outpatient at this NYC hospital undergoing diagnostic left heart catheterization. The project objectives were to evaluate whether these outpatients had:

- maintained excellent quality indicators for groin complications after decreasing bedrest time to two hours and increasing HOB to 60 degrees at one-hour after diagnostic cardiac catheterization,
- reduced length of stay and discharge times after decreasing bedrest time to two hours and increasing HOB to 60 degrees at one-hour after diagnostic cardiac catheterization,
- increased patient satisfaction after decreasing bedrest time to two hours and increasing HOB to 60 degrees at one-hour after diagnostic cardiac catheterization.

Review of Literature

Dal Molin et al. (2015) performed a non-experimental protocol on how to best perform a systematic review on bedrest practice after cardiac catheterization by detailing databases and search criteria. The authors identified specific search strategies and keywords for each individual database. Then the protocol explained how to best organize each article, so the researchers can identify the implications of bedrest on bleeding and hematoma and patient discomfort. By using this protocol as a foundation, a literature search was performed to obtain current research on bedrest post cardiac catheterization and detailed within a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram (see Appendix A). The databases PubMed and Medline were used to obtain scholarly journal articles. The keywords used during these searches were *bed rest* and *cardiac catheterization.* The search was limited to articles published between 1999 and present. The articles were analyzed for content and limited to those pertaining to bedrest practice for diagnostic cardiac catheterizations only. Any articles using femoral closure devices, radial access, or coronary interventions were removed. The following

articles were used to perform a literature review and detailed within a table of evidence (see Appendix B).

Groin Complications Risk After Early Ambulation Bedrest

Kato et al. (2009) tested the safety and effects of decreasing bedrest time from four to two hours after a transfemoral noncardiac angiography using 4 to 6 French sheaths. Using a randomized control trial, subjects who underwent transfemoral noncardiac angiography from March 2003 to August 2003 were selected. Of the 123 patients during the designated period, 80 elected to enroll into this study. Participants were randomly assigned into two groups: those who had two-hours of bedrest following transfemoral noncardiac angiography and those who had four-hours of bedrest following trans-femoral non-cardiac angiography. The research investigators assessed and analyzed bleeding complications utilizing the Society of Interventional Radiology reporting standards. None of the two-hour bedrest intervention group participants developed minor bleeding, whereas, three of 40 of the four-hour control group participants experienced minor bleeding ($p = .24$). The results found no significant difference between the two-hour and four-hour bedrest groups when analyzing bleeding complications. After this initial randomized control study, a single-armed two-hour bedrest trial was implemented from August 2003 to February 2004. During this trial, researchers documented minor bleeding in one of the 115 (1%) of the total two-hour bedrest participants. Minor bleeding occurred in four of the 195 (2%) total procedures performed. The occurrence of bleeding complications was significantly higher in patients with platelet counts less than 100 ($p = .01$). The study concluded that there was no significant difference between two and four-hour bedrest groups with regarding bleeding complication rate, however platelet count was a significant factor in bleeding complications.

A six-month retrospective and prospective study was performed by Best et al. (2010) to determine the safety of a 90-minute protocol for bedrest post cardiac catheterization. The Alberta Provincial Project for Outcome Assessment in Coronary Artery Disease (APPROACH) database was used to retrospectively obtain control research findings on a four-hour bedrest protocol. In 1995, the prospective portion of this study involved a convenience sampling of patients who met the inclusion criteria at Eastern Health in Alberta Canada. There were 402 participants involved in the control group and 193 participants in the intervention group. This prospective non-concurrent design with a retrospective control used chart reviews to collect demographics, past medical history, and groin complications of the non-randomized control group using a four-hour bedrest protocol. Participants in the experimental group were interviewed to obtain demographics and medical history to identify any confounders; a ruler was used to measure any hematomas; and, access site bleeding was defined as any instance requiring additional manual pressure. The intervention group of participants underwent 90 minutes of bedrest after hemostasis and any groin complications were documented. The research findings found no significant difference of hematoma formation (p = .79) between the control group (3%) and intervention group (3%). In addition, the research results found no significant difference of access site bleeding (p = .48) between control group (0.2%) and the intervention group (0). Neither group had any incidence of vascular complications such as: arteriovenous fistula, pseudo-aneurysm, retroperitoneal bleed, vascular occlusion or vascular dissection.

Gatt, Borg, Agius, and Xuereb (2009) performed a non-experimental quality improvement project for decreasing bedrest after diagnostic cardiac catheterizations using 4-French sheaths. Mater Dei Hospital in the country of Malta monitored 768 participants who underwent a diagnostic cardiac catheterization using a 4-French sheath and ambulated after one

hour of bedrest. The authors reported minimal groin complications after the bedrest practice change, which included 14 (2%) participants with 10 cm in diameter hematomas and 6 (1%) participants with 15 cm in diameter hematomas. In addition, the quality improvement project found that this practice change saved 1,152 hours of recovery time (40% reduction). The earlier discharges from the bedrest practice reduction resulted in cost savings by reducing nurse to patient times. The procedure cost was decreased by diminishing the need for arterial closure devices and prophylactic antibiotics. This quality improvement project concluded that patients may safely ambulate after an hour of bed rest if 4-French sheaths were used.

A systematic review performed by Mohammady et al. (2014) reviewed primary research articles to assess the effects of the duration of bed rest after transfemoral catheterization on the prevention of vascular complications and general discomfort, pain, urinary discomfort and patient satisfaction. This systematic review sampled 20 studies involving a total of 4019 participants with a mean age of 59.5 years. The bedrest time ranged between two to 24 hours. Sheath size varied between 4 to 9 French, although most studies (73%) used 4 to 7 French sheaths. A variety of anticoagulants and anti-platelet drugs were used before and after catheterization, including acetylsalicylic acid, heparin and oral anti-platelet agents in ten studies. All research reviewed found that there was no statistical difference between length of bedrest and groin complications regardless of extraneous variables. There was no statistically significant different between sheath size and groin complications ($p < .05$). The reviewers reported patients had significantly less back pain after two to four hours bedrest compared to six-hours bedrest at two hours (mean difference: -.7, 95% Confidence Interval (CI): -1.07, -.32), four hours (mean difference: -0.6, 95% CI: -.96, -0.24) and six hours of follow-up (mean difference: -3.77, 95% CI: -4.48, -2.92). Reviewers found that the cost of cardiac catheterization procedures was

decreased when length of bedrest was reduced; for example, patients were charged $396 when they underwent six-hour bedrest versus $291 for three-hour bedrest. In addition, transfemoral cardiac catheterization patients can ambulate after two to three-hours bedrest with no effect on the vascular complication risk while simultaneously reducing back pain intensity and urinary discomfort.

Impact of Position Changes During Bedrest Period

Pollard et al. (2003) examined the safety of early sit-up and mobilization after routine cardiac catheterization in contemporary practice by performing a prospective, randomized, open label, and controlled trial. To accomplish this goal, 755 patients scheduled for an elective cardiac catheterization via a 6-French sheath femoral arterial access without involving systemic heparin from 32 United Kingdom hospitals in the year 2000 were randomized into two groups. Because 50 patients withdrew from the study, 362 participated in the control group and 343 in the intervention group. The control group involved 4.5-hours bedrest with increasing HOB to a minimum of 60 degree after four hours. The intervention group involved 2.5-hours bedrest while increasing the HOB at 60 degrees after one hour. Data was recorded through questionnaires provided to the patients at discharge, which were completed and returned immediately. Thirty days post procedure, the patients were contacted by telephone to capture late complications. Bleeding, hematomas and complications were assessed and recorded pre-procedure and then at 30 minutes, two hours post, four hours post and 48 hours post procedure. Pre- and 30 minutes, 2, 4, and 48-hours post-procedure pain were assessed and recorded using the McGill pain questionnaire. Bleeding and hematomas were defined by the need for renewed compression after hemostasis. The results found 34 (9%) hematomas in 4.5-hour bedrest and 44 (13%) hematoma in 2.5-hour bedrest ($p = .15$). Researchers reported 21 (6%) incidences of bleeding in 4.5-hours

bedrest versus 25 (7%) in 2.5-hour bedrest (p = .42). Similarly, the study found no significant difference (p = .539) in incidence of vasovagal during bedrest. Overall the total number of patients with any complications post bedrest was documented as 54 (15%) in the control group and 66 (19%) in intervention group (p = .13). According to these researchers, the intervention group participants reported significantly fewer reports of pain before hospital discharge when compared to the control group; however, specific information or p values were not detailed. The study results concluded that patients undergoing a 6-French procedure had no significant difference in the risk of complications when the HOB was increased 60 degrees at one hour and ambulated at 2.5 hours after hemostasis. These research results also supported that this decreased bedrest protocol improves patient comfort post cardiac catheterization and healthcare economical spending by facilitating earlier discharge.

A double blind clinical trial was performed by Abdollahi, Mehranfard, Behnampour, and Kordnejad (2015) to assess the effect of changing position and early ambulation on low back pain, urinary retention, bleeding and hematoma after cardiac catheterization. During this study, the severity of bleeding, hematoma, back pain and urinary retention were measured at zero, 1, 2, 4, 6, and 24 hours after angiography over one-year. A convenient sample of 140 patients undergoing elective coronary angiography at Dr. Ganjavian Hospital of Dezful in Iran were obtained and randomly divided into four equal research groups. The control group of participants remained in the supine position for six hours without any movement. The first experimental group involved the HOB increased 15 degrees every hour for the first three hours and then turned onto the right side at fourth hour and left side at fifth hour. The second experimental group involved early ambulation at four hours. The last experimental group involved early ambulation, as well as, position changes as detailed in the first experimental group. The researchers recorded

the study participants' gender, age, BMI, past medical history of diabetes, hypertension status, length of procedure, and time of manual pressure required to achieve hemostasis to identify extraneous variables that may impact study results. The results reported no groin complications for the control and three intervention groups, therefore early ambulation and position changes during bedrest posed no greater risk for hematomas or bleeding. The participants complained of back pain less frequently when allowed to ambulate earlier and change positions. At baseline, there was no significant difference among the four studied groups in the average pain intensity of the participants immediately after entering the ward after angiography. However, there was a significant difference between the mean pain intensity of all the studied groups at the fourth hour (p = .001) especially when comparing the average pain intensity in the control group and the early ambulation and position change group (p = .12). There was a significant difference between the average pain intensity the second group and the third group (p = .015) at the fourth hour. As participants' back pain continued to be recorded, there was a significant difference between the average pain intensity at the sixth hour, as well as, between the control group and the fourth group (p = .04). The most severe back pain was associated with the sixth hour and with the highest pain reported in the control group. The study results supported no significant difference in urinary retention among the four groups.

Impact of Early Ambulation on the Patient Experience

Burn et al. (2015) performed a systematic review to analyze the effects of ambulating earlier after a transfemoral coronary angiogram on back pain. The 18 research articles that met the inclusion criteria contained 4,581 participants, more specifically 2,237 in experimental groups and 2,344 in control groups. These studies were published between 1996 to 2011 and involved participants from United States, Canada, United Kingdom, Hong Kong, Sweden, and

Iran. The results reported that groin complications occurred in 79 participants with 39 in the experimental groups mobilized at or before two-hours and 40 occurring in the control groups mobilized between three and six-hours after procedure. Sheath sizes ranged between 5 to 8 French. There was no statistical difference in groin complications between control and interventional groups ($p = .5$). In addition, six studies involved elevating the HOB to 30 to 60 degrees without any increase in groin complications. All reviewed studies reported less back pain in the early ambulation intervention groups when compared to the controls using three to six hours bedrest and six studies specifically compared two or less hours of bedrest. This systematic review concluded that ambulation after femoral approach coronary angiogram, without deployment of a vascular closure device, may be safe any time after 1.5 hours of bedrest and in doing so reduce patient complaints of back pain related to lying in bed.

Summary of Literature

The previous research articles support reducing the bedrest period for patients after diagnostic cardiac catheterizations using 4 to 6 French sheaths removed using manual pressure (Best et al., 2010; Kato et al., 2009; Mohammady et al., 2014). The bedrest times ranged from 90 minutes to six hours however, no study found a statistically significant difference in groin complications for patients receiving diagnostic cardiac catheterization using 4 to 6-French (Best et al., 2010; Gatt et al., 2009; Kato et al., 2009; Mohammady et al., 2014). Most of these studies used two hours bedrest intervention groups and four hours bedrest as the control. Patients with severe hypertension (systolic blood pressures greater than 180) or receiving oral anticoagulation medications were often excluded from participating in most of these bedrest studies (Best et al., 2010; Pollard et al., 2003). Patients receiving antiplatelet therapy medications did not impact one's risk of groin complications (Burn et al., 2015; Mohammady et al., 2014). Patients with

platelets less than 100 have increased risk of groin complications (Kato et al., 2009). Changing the position of patients' HOB to 60 degrees after one hour of bedrest did not increase one's risk of groin complications and increased patient comfort (Abdollahi et al., 2015; Burn et al., 2015; Pollard et al., 2003).

Patients who were ambulated earlier reported less vasovagal responses, urinary retention, and back pain when compared to patients who had extended bedrest periods (Burn et al., 2015; Pollard et al., 2003). These studies supported that early ambulation after cardiac catheterization to increase patient satisfaction (Burn et al., 2015; Mohammady et al., 2014). Studies repeatedly correlated early ambulation times to earlier discharge times (Burn et al., 2015; Gatt et al., 2009; Mohammady et al., 2014). By decreasing the length of bedrest post cardiac catheterization to reflect evidence-based practice, the cost of this procedure will be reduced thus making it more economical (Gatt et al., 2009; Mohammady et al., 2014). The author believes the lack of current research available on bedrest reduction is related to increase in popularity of the radial approach, availability of closure devices, and the research results repeatedly supporting early ambulation after diagnostic cardiac catheterization.

Theoretical Framework

In order to more effectively implement this quality improvement project, a conceptual framework was needed to organize the action plan. The Iowa Model of Research-Based Practice to Promote Quality Care encompasses the following elements: identify a problem; determine a plan; form a team; gather evidence; critique and synthesize the evidence; determine the validity and appropriateness of the evidence; quality improvement change; determine if the change is appropriate for practice; implement, and disseminate results (Gawliniski & Rutledge, 2008). The Iowa Model best addressed this clinical issue and quality improvement project because it

highlights the importance of considering the healthcare system as an entity and building a team (Gawliniski & Rutledge, 2008). An additional strength of this model is that the trigger to create change can be problem- or knowledge-focused. The length of bedrest was an established problem because it negatively impacted both patients, as well as, optimization of unit resources. Each of the Iowa Model's seven steps have been detailed and applied this specific bedrest quality improvement project. See Appendix C for Seven Steps of Iowa Model for the Bedrest Quality Improvement Project.

This framework places equal importance on each individual team member involved in the implementation; therefore, it was essential to involve the medical providers, nursing staff, patients, and unit infrastructure when using research to guide practice decisions and changes. Updating bedrest practice for patients required the support and involvement of the medical team writing the orders; the nursing staff caring for and monitoring patients post procedure; and, nursing administration monitoring documentation and practice. This formidable team-approach was an essential step to ensuring the success of this evidence-based practice change because it created an opportunity for feedback, buy-in, and investment from all the stakeholders (Doody & Doody, 2011). Nursing administration was transparent regarding all data related to the practice change; however, it was important that this change was generated by the staff directly caring for these patients. To facilitate this staff driven change, Bedrest Super Users were utilized to educate the staff on the practice change and monitor its implementation. These Bedrest Super Users were nurses who expressed interested in assisting in implementing this quality improvement project. The Bedrest Super Users received extensive education and resources to support them in this role. Evidence-based practice changes are more successful when they are frontline practitioner initiated opposed to nursing administration mandated (Doody & Doody, 2011).

The Iowa Model stresses the importance of establishing evidence-based practice prior to implementing practice changes through research (Gawliniski & Rutledge, 2008). By following the Iowa Model, an extensive literature review and appraisal of the evidence must be performed to determine best practices for bedrest after diagnostic cardiac catheterizations. After analyzing the research, a pilot study was developed and implemented to update bedrest practice. As supported by this model, the data collected from the quality improvement project was shared and evaluated weekly by the entire team. If there were any issues or problems noted during the weekly evaluation, the plan was to restart the process for implementing this quality improvement project.

Methodology

A previous year (2017) database was used to retrospectively obtain control findings on the four-hour bedrest protocol with the HOB no greater than 15 degrees. The prospective portion of this quality improvement project used a convenience sample to collect information over a three-month period on the groin complications, discharge times, and patient satisfaction for patients after the two-hour bedrest protocol with the HOB increased to 60 degrees after one hour. To ensure quality, it was important to minimize biases and control data collection errors by recorded and analyzed all patients who met the revised bedrest criteria regardless of ordered bedrest time. The charge nurse documentation was compared with electronic health record (EHR) documentation and orders during chart reviews. Sheath size, gender, significant past medical history, age, and antiplatelet medication was recorded on these patients using a documentation form specifically created for this project (see Appendix D to view tool to record data). Groin complications, length of stay and discharge time, and patient satisfaction were reviewed for the patients undergoing four hours of bedrest in 2017.

Setting

At this NYC-based teaching academic medical center, outpatient cardiac catheterization patients are cared for on two units: Cardiac catheterization lab and post interventional cardiology recovery area. The cardiac catheterization lab involves a six-bay holding area which initiates the recovery of cardiac catheterization patients and possibly discharges if there are no beds available on the recovery area (16 beds). The quality improvement project occurred on both units during Winter 2018.

Project Population

All outpatients scheduled for cardiac catheterizations at this NYC hospital Interventional Cardiology Department scheduled Monday through Friday who meet the inclusion criteria were included in this quality improvement project. Patients, who received a transfemoral, diagnostic cardiac catheterization via a 4, 5, or 6 French sheaths removed without complications using manual compression, were eligible for the two hours bedrest protocol. To be included into this new bedrest protocol, patients must have had the following characteristics: receive no more than 500 units IA heparin; systolic blood pressure less than 180 mm Hg; diastolic blood pressure less than 100 mm Hg; platelet count greater than 100; and, did not receive oral anticoagulation medications like rivaroxaban or warfarin. Patients may have received anti-platelet medications prior to procedure, however they could not have received intravenous (IV) heparin or bivalirudin drips.

Patients who are older than 85 years old were excluded from participating in the decreased bedrest protocol. This age group was considered a high-risk population due to a significantly increased rate of multiple comorbidities (Merschen, Khormi, Jada, Kobakhidze, & Robinson, 2014). The quality improvement project recorded outcomes on these patients for a

twelve-week period. This project required a minimum sample size of 120 patients who underwent the new bedrest protocol, which was based upon the average monthly diagnostic procedure volume with consideration of physician preferences for different access site approaches and closure methods for this hospital.

Subject Recruitment

Since this was an evidence-based practice change, every patient was assessed to determine if appropriate for the new two-hour bedrest protocol. Any patients who were outpatients, meaning not admitted to an inpatient setting or transferred from the emergency department, were considered for this quality improvement project. The inclusion and exclusion criteria were utilized when deciding if the patient should be ordered for the decreased bedrest order set. An algorithm explaining the bedrest inclusion and exclusion criteria was posted throughout both units as a reference to LIPs (licensed independent practitioner) and nursing staff (See Appendix E for bedrest algorithm). It was ultimately to the discretion of the attending physician whether the patient is appropriate for the decreased bedrest protocol.

Consent Procedure

A waiver of consent was obtained from Rutgers's University Electronic Institutional Review Board (eIRB). Patients were not individually consented for the two-hour bedrest protocol because the current hospital policy states that patients will undergo bedrest for the length of time specified by physician's orders. Instead, all patients were consented for their cardiac catheterization procedure, during which the LIP discussed risks and benefits of the procedure. One of those risks detailed included hematoma and groin complications which is the normal practice when obtaining informed consent for these procedures. The informed consenting process involved describing the bedrest process and various lengths. LIPs explained that the

length of bedrest will be determined by access site, sheath removal, and procedure outcome. If the patient had a diagnostic procedure, patients were informed that bedrest will be between two to four hours.

Risks/Harms

There were some potential risks or harm that could have affected subjects because of quality improvement project interventions. The potential physical risks of this project could have included groin complications (such as: hematomas, bleeding, pseudoaneurysms and A/V fistulas) for the patients participating in the two-hour groin bedrest protocol. This risk was minimized by having the nurses check the site for complications every 15 minutes and after position changes. The increased chart reviews and audits required to obtain data on discharge and bedrest times potentially could have impacted the participant's privacy and confidentiality. This risk was minimized by maintaining the confidentiality standards used when performing any of the departmental required audits while using only aggregate data.

Subject Costs and Compensation

There was no additional subject costs and compensation for this quality improvement project.

Project Interventions

Any outpatients who have a diagnostic left heart cardiac catheterization using transfemoral approach 4 to 6-French sheath with manual sheath removal were recorded by the principal investigator or Bedrest Super User using an arbitrary numeric identifier. The patient's age, gender, sheath size, hemostasis time, bedrest length of time physician order, anti-platelet therapy pre-procedure, aortic stenosis, and any groin complications was recorded on these

outpatients. Outpatients who were ordered for two-hour protocol were remained in a supine position with the head of bed flat for 60 minutes post hemostasis.

Patients received vital signs, groin site assessments, and neurovascular assessments every 15 minutes for one hour. If no bleeding or hematoma was noted after 60 minutes, the nurse increased the head of the bed to 60 degrees. The nurse immediately checked the groin site after the position change. If at any point during two-hour bedrest bleeding or hematoma was noted, then the patient remained on bedrest for a total of four hours with HOB no greater than 15 degrees. Bleeding was defined as blood loss requiring dressing saturation and needing immediate compression at the arterial puncture site (Mohammady et al., 2014). Any noted hematomas were measured for the quality indicator measurement reports. For the purpose of reporting, small hematomas were defined as less than 5 cm, whereas large hematomas were defined as greater than 5 cm (Boztosun et al., 2007). If no complications were noted, patient remained at 60 degrees for an hour for a total of two hours of bedrest. Patients received vital signs, groin site assessments, and neurovascular assessments every 15 minutes the additional one hour. At the two-hour mark, nurse performed orthostatic blood pressures. After determining patient was not experiencing orthostatic hypotension, then the patient ambulated while being accompanied by a nurse. If the patient developed a groin complication during ambulation, then he or she was returned to bed and remained on bedrest for an additional two hours. If no groin complications, the patient was discharged as per LIP order.

Outcomes Measured

Groin complications. Prior to this quality improvement project, this hospital required any hematomas or access site bleeds to be documented using the Patient Safety Incidence (PSI) reporting system. Groin access site complications were monitored on the PSI reporting system by

nurse manager and recorded. Incidence of groin complications including pseudo-aneurysms, hematomas, and access site bleeds were included in the weekly quality improvement and quality indicator reports. If groin complications were identified via PSI, then additional chart reviews were performed to determine any factors that could have impacted groin complications. These PSI and chart reviews were analyzed in an open forum to objectively collect data.

Length of stay and discharge times. Each patients' post-procedure plan of care was recorded by the charge nurse. Patients sheath removal, bedrest order time, and discharge plan were recorded by the charge nurse. Any patient who was unable to complete the reduced bedrest was recorded for analysis. In addition, nursing leadership, Bedrest Super Users, and the principal investigator performed chart reviews on patients to determine if decreased bedrest orders were followed. The length of stay was defined as discharge time minus groin hemostasis time and recorded in minutes.

Patient satisfaction. Press Ganey® survey results were used to determine patient satisfaction for patients discharged from the recovery unit. The team planned to pay extra attention to any questions related to pain and delays in care. March 2018 to June 2018 scores related to patient-nurse interactions, pain management, procedure delays, overall hospital rating, and whether they would recommend the hospital to friends and family were analyzed.

Project Timeline

This quality improvement project was performed over a two-year period involving the following steps:

- May 1, 2017 to November 15, 2017:

  -Project development with stakeholders

  -Complete writing project proposal

-Present project to Chief Nursing Officer to receive site approval letter (See Appendix F for letter of approval from Chief Nursing Officer)

- November 28, 2017

  -Present project to team for approval

- December 2017 to January 1, 2018

  -Submit project to Rutgers University eIRB for approval (See Appendix G for letter of approval from Rutgers University eIRB)

- January 1, 2018 to February 1, 2018:

  -Cath lab nurse manager, clinical resource nurse, and bedrest super users will educate nursing staff on new bedrest practice. The benefits and evidence-based practice were shared with the staff

  -The medical director of interventional cardiology will educate the LIPs and fellow physicians about the practice change regarding bedrest

  -The nurse manager was contact the information technology (IT) department about developing new order sets to include new bedrest protocol

- February 1, 2018 to April 30, 2018

  -New bedrest practice was implemented for patients who meet the criteria

  -Medical director, Cath lab nurse manager, Interventional Recovery unit nurse manager, clinical resource nurse, and bedrest super users met weekly to review patient charts, QI and PSI reports to determine practice implementation barriers and implications

- May 1, 2018 to June 1, 2018:

-Cath lab nurse manager, clinical resource nurse, and bedrest super users reviewed and analyzed data to determine to new bedrest protocol was effective

- June 1, 2018 to September 1, 2018:

  -Evaluation of data and writing final project

- November 2018:

  -Presentation of finalized project

- December 20, 2018:

  -Graduation from Rutgers Doctor of Nursing Practice Program

Resources Needed

There were some resources required to implement this practice change, which were detailed in a budgetary break down (see Appendix H for budget for bedrest quality improvement project). It was important to change the EHR order set to include the two-hour bedrest protocol, so the LIPs could more easily order it. Because this hospital already owned the EHR and has employees available to make such changes, the economic cost considerations were negligible. The principal investigator was responsible for the cost of printing and laminating educational resources for the units, including the algorithm and documentation reminders. Double sided tape was bought and used to hang these laminated resources throughout the department. The principal investigator absorbed the cost of printing the power point presentation slides and educational resources for each Bedrest Super User. In addition, the principal investigator provided candy at each education session for the Bedrest Super Users. The printing and binding of the final project proposal was the responsibility of the principal investigator.

Evaluation

There were several people involved in the evaluation of this quality improvement project; including: nursing leadership, medical director of the cardiac catheterization lab, Bedrest Super Users, principal investigator, and Doctor of Nursing Practice project team. The overall goal of this project was to determine the safety and efficacy of changing the bedrest practice. Statistical Package for the Social Sciences (SPSS) version 23 was used to record and analyze all data collected during this quality improvement project. Descriptive statistics were collected and analyzed, including mean, median, and frequency table. Preliminary data was reviewed weekly with all the stakeholders to identify any unanticipated barriers or problems related to this quality improvement project. A *t*-test or chi-square test was used to determine any difference between the control and intervention groups. A p value ($< .05$) was used to determine statistical significance.

Data Analysis, Maintenance & Security

Data Analysis

A frequency table with descriptive statistics was created to analyze the demographic data of the population involved in the 2018 reduced bedrest quality improvement project compared with the 2017 control population demographics; including the patient age, gender, sheath size, aortic stenosis, and pre-procedure anti-platelet medications. The mean age of the intervention and control groups were compared using a *t*-test to determine whether there was a statistically significant difference between the two groups. The other categorical data were compared using a chi-square test to determine whether there was a statistically significant difference between the intervention and control groups. In addition, Kruskal-Wallis test was used to compare the differences within the group. Data pertaining to each objective were analyzed individually.

Groin complications. The groin complication rates from February 1, 2017 to April 30, 2017 and February 1, 2018 to April 30, 2018 were analyzed and compared to determine if patients had any change in complication rates. The number of groin complications for patients who participated in the new bedrest protocol during this three-month period were compared with the number of groin complications for diagnostic cardiac catheterization patients who had a manual sheath removal during the previous year. A chi square test was performed to determine statistical significance.

Length of stay and discharge times. To reduce the influence of outliers related to patients unable to ambulate early due to clinical issues, the median length of stay and discharge times were analyzed for all outpatients and compared to the median length of stay and discharge times from previous year. An independent *t*-test was performed to determine statistical significance.

Patient satisfaction. The mean patient satisfaction 2018 Press Ganey® scores for the specified questions was compared to the mean 2017 Press Ganey® scores to analyze the impact of new bedrest protocol. Since these surveys are filled out anonymously, it was impossible to correlate results to specific patients following the new protocol versus the four-hour bedrest. Therefore, all March 2018 to June 2018 patient satisfaction results were included in the intervention analysis and all received March 2017 to June 2017 patient satisfaction results were included in the control analysis. An independent *t*-test was performed to determine statistical significance.

Data Maintenance and Security

All data was kept confidential and collected in the aggregate with no personal identifiers, meaning at no time birthdays or complete names were documented. The charge nurse recorded

the first three letters of the patients last name and the first initial when recording the patients involved in the quality improvement project and their outcomes. When collecting information into the statistical software, the identity of the patients received an arbitrary identification number. The documentation was collected by the project director and nurse manager each day and kept in a secure location. Then the data was transcribed onto an encrypted file. After data analysis and publication of results, the master copy of this collected data will be destroyed using the hospital designated patient information shredder within one year of completing the study. In accordance to Rutgers University Office of Information Technology requirements, a copy of the collected data and encrypted file will be stored in the project chair's office for one year after graduation. The university copy of these data will be destroyed by the project chair using Rutgers Office of Research Regulatory Affairs current recommendations for data and file destruction.

Results

During this 12-week quality improvement project pilot period from February to April 2018, a total of 244 patients were recruited. There were 214 patients (male, n = 105; female, n = 109) who participated in the two-hour bedrest protocol. There were 30 patients (male, n = 20; female, n = 10) who underwent diagnostic transfemoral cardiac catheterization procedures with manual sheath removal but were not ordered the two-hour bedrest protocol due to physician preference. The two-hour bedrest intervention group had a mean age of 62.3 (SD = 11.1, range 33-86). One hundred eighty-seven (87%) participants received aspirin prior to their procedure, more specifically 115 (54%) participants received 81 milligram (mg) aspirin and 72 (34%) participants received 325 mg aspirin prior to the procedure. Forty-nine (23%) participants received some form of antiplatelet medication (75 mg clopidogrel, n = 28; 300 mg clopidogrel, n = 3; 600 mg clopidogrel, n = 28; 90 mg ticagrelor, n = 9; 10 mg prasugrel, n = 1) prior to their

procedure. Only four (2%) participants had a diagnosis of aortic stenosis prior to their procedure. All these diagnostic procedures were performed using 4 to 6 French sized sheaths, which included 146 (68%) 4-French sheaths, 58 (27%) 5-French sheaths, and 10 (5%) 6-French sheaths.

Patients who underwent a diagnostic procedure involving a manual sheath removal in February to April 2017 was collected as the control group using retrospective chart reviews. A total of 170 patients (male, $n = 92$; female, $n = 78$) were ordered to have the standard bedrest of 4 hours with the HOB no greater than 15 degrees after a transfemoral diagnostic cardiac catheterization. There was not a statistically significant difference when comparing the gender of the control and intervention groups; $X^2(1) = .97$, $p = .33$. The control group had a mean age of 63.7 ($SD = 10.5$, range 37-89). There is not a statistically significant difference when comparing the age of the control and intervention groups; $t(371) = 1.32$, $p = .19$.

One hundred-fifteen (68%) participants received aspirin, which included 102 (60%) participants who received 81 mg aspirin and 13 (8%) participants who received 325 mg aspirin prior to their procedure. Fifty (29%) participants received an antiplatelet medication (75 mg clopidogrel, $n = 39$; 600 mg clopidogrel, $n = 4$; 90 mg ticagrelor, $n = 2$; 10 mg prasugrel, $n = 5$) prior to their procedure. Five (3%) participants had a diagnosis of aortic stenosis.

All these diagnostic procedures were performed using 4 to 6 French sized sheaths, which involved 136 (80%) 4-French sheaths, 11 (6%) 5-French sheaths, and 23 (13%) 6-French sheaths. It is suspected that the addition of a new physician who used primarily 5-French sheaths with manual sheath removal after the 2017 control period created this significant difference in 5-French sheaths. Table 1 displays that the 2018 two-hour bedrest intervention group and 2017 control groups were not significantly different in gender, age, clopidogrel dose, ticagrelor dose or

diagnosis of aortic stenosis. Aspirin dose and clopidogrel dose was significantly different between the control and intervention groups.

Table 1.
Demographics between groups post transfemoral cardiac catherization

	2017 Control (n=170)	**2018 Intervention (n=214)**	**Statistics**	***P*-value**
Age [years: mean (*SD*)]	63.7 (+/-10.5)	62.2 (+/-11.1)	$t(371) = 1.32$	.19
Gender, *n* (%)				
Male	92 (46)	105 (49)	$X^2(1) = .97$	.33
Female	78 (54)	109 (51)		
Aspirin dosing *n* (%)				
None	55 (32)	27 (13)	$\chi^2(2) = 46.7$	< .01**
81 mg	102 (60)	115 (54)		
325 mg	13 (8)	72 (34)		
Clopidogrel dosing *n* (%)				
None	127 (75)	178 (83)	$\chi^2(3) = 8.49$	.04*
75mg	39 (23)	28 (13)		
300mg	0 (0)	3 (1)		
600mg	4 (2)	5 (2)		
Ticagrelor dosing *n* (%)				
None	168 (99)	205 (96)	$\chi^2(1) = 3.12$	.08
90mg	2 (1)	9 (4)		
Prasugrel dosing *n* (%)				
None	165 (97)	210 (98)	$\chi^2(1) = 3.77$	.05
10 mg	5 (3)	4 (2)		
Aortic stenosis *n* (%)				
No	165 (97)	210 (98)	$\chi^2(1) = 0.48$	0.49
Yes	5 (3)	4 (2)		
Sheath size *n* (%)				
4 French	136 (80)	146 (68)	$\chi^2(2) = 32.8$	< .01**
5 French	11 (6)	58 (27)		
6 French	23 (13)	10 (5)		

Note. **p* < .05, ***p* < .01

Length of Bedrest

The intervention group had a mean length of bedrest of 134 minutes (*SD* = 28.7, range 81-338) and median length of 127 minutes. Of the patients ordered for the two-hour bedrest period, the median length of bedrest was 127 minutes for 4-French sheaths; 125 minutes for 5-French sheaths; and 139 minutes for 6-French sheaths. This two-hour bedrest intervention group had a total of 188 (88%) participants who had their HOB raised to 60 degrees at one hour. The other participants did not have any documentation regarding their HOB position; therefore, it

was assumed that the HOB remained flat. The documented reasons for patients remaining in bed longer than their ordered bedrest included: low blood pressure; leg numbness secondary to nerve blocks from lidocaine administration during the procedure; and, lethargy secondary to sedation received. Two patients, who were ordered reduced length of bedrest patients, had to remain in bed for four-hours as a result of vasovagal responses post procedure. Both patients had this adverse reaction while the HOB was still flat; therefore, it could not be correlated directly to the new bedrest practice change. Two (< 1%) patients who ambulated early experienced falls because the patients had nerve blocks from the lidocaine administered during the procedure. An immediate action plan was incorporated that educated nursing on the importance of assessing patient's sensation in both thighs prior to ambulation.

2018 Control group: Transfemoral diagnostic procedures with manual sheath removal patients who were ordered the standard protocol of 4 hours bedrest and HOB no great than 15 degrees had the following median length of bedrest: 231 minutes for 4-French sheaths (107-minute bedrest reduction); 256 minutes for 5-French sheath (131-minute bedrest reduction); 249 minutes for 6-French sheaths (109.5-minute reduction); and 247 minutes all sheaths (120-minute reduction). Table 2 supports that there was a statistically significant difference between the patients ordered two-hours bedrest and those who were not ordered the new bedrest protocol.

Table 2.
2018 Patients: Comparisons between groups of 2-hours bedrest ordered compared to those ordered 4 hours bedrest post transfemoral cardiac catherization

	2-hr Bedrest Order (*n* = 214) Intervention	**4-hr Bedrest (*n* = 30) Control**	***t*(*df*)**	***P*-value**
Length of bedrest *n*, [minutes: mean (*SD*), median]	214 134 (+/-28.7), 127	30 246 (+/-45.2), 247	*t*(242) = -18.33	< .01*
Length of stay post *n*, procedure [minutes: mean (*SD*), median]	178 184 (+/-57), 174	25 300 (+/-54.7), 311	*t*(31.8) = 9.82	< .01*

Note. **p* < .01

Groin Complications

From February to April 2017, two diagnostic transfemoral cardiac catheterization patients experienced hematomas; more specifically, one was identified after ambulation and one in the bedrest period. During the February to April 2018 bedrest pilot project, none of the patients who ambulated early experienced a groin complication or bleeding at any time during the recovery period. A chi-square test was performed and found no statistically significant difference between the control and intervention group's rate of groin complications, $X^2(1) = 2.53$, $p = .11$ (Table 3).

Table 3.
Groin complication comparison between groups post transfemoral cardiac catheterization

	2017 Control (*n* = 170)	**2018 Intervention (*n* = 214)**	***t*(*df*)**	***P*-value**
Hematoma	2	0	$X^2(1) = 2.53$	.11
Bleeding	0	0	n/a	n/a
A/V fistula	0	0	n/a	n/a

Length of Stay and Discharge Times

There were 131 control group patients and 178 intervention group patients who were discharged the same day. The mean length of stay for these patients was 283 minutes (*SD* = 55.3, range 162-498) and median was 277 minutes. In the intervention group, the mean length of stay for these patients was 184 minutes (*SD* = 57, range 85-515) and median of 174 minutes. An

independent-samples *t*-test was conducted to compare the length of stay for patients in the control and intervention groups. The length of stay in minutes was significantly different for the control group ($M = 283$, $SD = 55.3$) and intervention group ($M = 184$, $SD = 57$); $t(285) = 15.3$, $p < .01$. Table 4 shows additional results and suggests that there was a statistically significant difference between the control and intervention group's length of stay.

Table 4.
Length of stay comparison between groups post-transfemoral cardiac catheterization

	2017 Control (*n* = 131)	**2018 Intervention (*n* = 178)**	***t*(*df*)**	***P*-value**
4-French Sheath *n*, [minutes: mean (*SD*), median]	109 281 (+/-57.1), 277	125 1823 (+/-55.4), 171	*t*(232) = 13.3	< .01*
5-French Sheath *n*, [minutes: mean (*SD*), median]	8 299.63 (+/-54.1). 297	48 187.40 (+/-63.62), 174	*t*(10.52) = 5.29	< .01*
6-French Sheath *n*, [minutes: mean (*SD*), median]	14, 290 (+/-41), 287	5, 192, (+/-29.1), 194	*t*(17) = 4.9	< .01*
Total	131, 283 (+/-55.3), 277	178 184 (+/-57), 174	*t*(285) = 15.3	< .01*

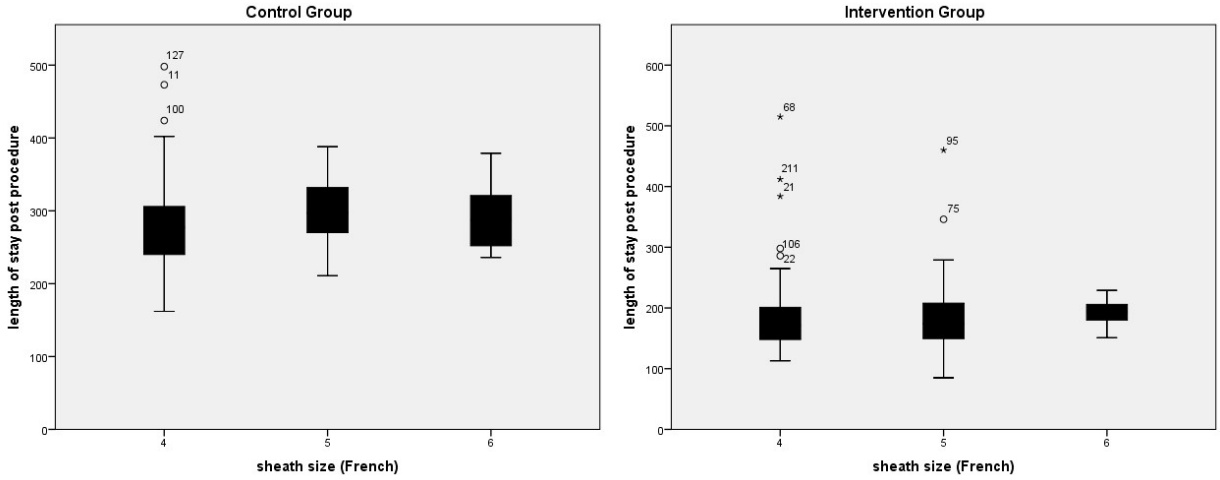
Note. **p* < .001

Since the aspirin dose, clopidogrel dose, and sheath size were significantly different between the control and intervention groups, the length of stay was compared using these variables. A Kruskal-Wallis test showed that there was not a significant difference of length of stay between aspirin dose in the control group, $\chi^2(2) = 0.59$, $p = .74$. Similarly, a Kruskal-Wallis test showed that there was not a significant difference of length of stay between aspirin dose in the intervention group, $\chi^2(2) = 1.58$, $p = .45$. When comparing the clopidogrel dose in the control group, a Kruskal-Wallis test showed that there was not a significant difference between dosages, $\chi^2(2) = 1.28$, $p = .53$. However, a Kruskal-Wallis test showed that there was a significant difference of length of stay between clopidogrel dosages in the intervention group, $\chi^2(3) = 9.22$,

p = .03. Specifically, the mean rank of clopidogrel dosing on length of stay in the intervention group is 600 mg > 75 mg > none > 300 mg clopidogrel dosing.

The sheath sizes also were significantly different in the control and intervention groups. A Kruskal-Wallis test showed that there was not a significant difference between groups for sheath size and control length of stay, $\chi^2(2) = 1.71$, $p = .43$. Similarly, a Kruskal-Wallis test showed that there was not a significant difference between groups for sheath size and intervention length of stay, $\chi^2(2) = 1.28$, $p = .53$. Table 5 are two box-plot charts that display the control and intervention groups length of stay for each sheath size.

Table 5.
Length of stay comparison between sheath size for control and intervention groups



There were several factors that contributed to some patients having a prolonged length of stay, including: nursing delays, availability of escorts home, patient sedation recovery, low blood pressure, and food tray deliveries. The Bedrest Super Users addressed and improved any non-clinical issues during their weekly meetings. Nursing administration contacted the food service supervisor to ensure sandwiches would be delivered earlier to facilitate discharge times. During the pre-procedure phone calls, patients were educated about the potential to be discharged early and the need for an escort home. Despite these barriers, there was a 103-minute reduction in

overall length of stay when comparing the two groups using the median, which reduces the influence of outliers.

Patient Satisfaction

Press Ganey® responses from March 2017 to June 2017 (control) and March 2018 to June 2018 (intervention) were analyzed to determine this project's impact on patient satisfaction. The principal investigator focused on The Press Ganey® questions related to patient-nurse interactions, pain management, procedural delays and whether they would recommend the hospital to friends and family. The Press Ganey® mean scores for *overall rating of the hospital*, *rating compared to other hospitals*, *overall nursing care*, *pain management*, and *wait times for procedure* increased after this bedrest practice change was implemented. The 2018 mean score for *likelihood to recommend hospital to others* decreased when compared to the mean results of from 2017. A *t*-test was performed and there was a relationship between bedrest length and patient experience related to pain, $t(27) = -2.45$, $p = 0.02$. In addition, a *t*-test was performed to find that there was a statistically significant difference between the length of bedrest and patient perception of procedural wait times, $t(27) = -2.73$, $p = 0.01$. Table 5 provides details regarding mean, *SD*, and *p* values for the control and intervention patients satisfaction results.

Table 6.
Patient Satisfaction Results comparison between groups

	Control (*n* = 17)	**Intervention (*n* = 12)**	***t*(*df*)**	***P*-value**
Overall rating of hospital [score: mean (*SD*)]	89.9 (+/-3.92)	91.4 (+/- 3.65)	*t*(27) = -1.03	.31
Rating compared to other hospitals [score: mean (*SD*)]	88.6 (+/-9.75)	91.7 (+/-5.52)	*t*(27) = -.98	.34
Overall care of nursing [score: mean (*SD*)]	93.8 (+/-6.16)	95.9 (+/-3.07)	*t*(27) = -1.07	.29
How well was your pain controlled [score: mean (*SD*)]	89.1 (+/-7.05)	95.8 (+/-7.55)	*t*(27) = -2.45	.02*
Wait times for procedure [score: mean (*SD*)]	85.9 (+/-2.85)	90.1 (+/-5.44)	*t*(27) = -2.73	.01**
Likelihood to recommend hospital to others [score: mean (*SD*)]	94.1 (+/-4.52)	91.6 (6.75)	*t*(27) = 1.18	.25

Note. **p* < .05, ***p* < .01

Discussion

Based upon its results, this project successfully achieved its aims and objectives. The length of stay for transfemoral diagnostic cardiac catheterization patients with manual sheath removal was decreased by over 100-minutes while maintaining safe patient outcomes and improving patient satisfaction. Since this project was considered successful, the bedrest practice change should be expanded to inpatients and emergency department patients throughout this hospital. Despite its success, this quality improvement project had some limitations. One weakness involved this project's design because it used only one hospital setting. This project population limited one's ability to achieve generalizability to other hospitals or settings. Future projects using different hospital settings are needed before one can generalize its results. This project design also had a potential risk for selection bias because it relied on the attending

physicians to order the shortened bedrest for any patients who met the criteria. There were 30 patients who met the reduced bedrest criteria out of 244 (12%) and were not ordered the new bedrest protocol because of physician preference. Continued monitoring of patient outcomes and educating of all attending physicians is required when maintaining this bedrest practice change.

The Iowa Model was important to implementing this quality improvement project because it helped to minimize its limitations. By building a strong, multidisciplinary implementation team prior to the start of this project, departmental buy-in was established. The medical director, principal investigator, and Bedrest Super Users provided additional education and support to any attending physician who was not ordering the reduced bedrest protocol. By sharing the preliminary results of this project weekly to the entire department, it reduced the attending physicians' fears and apprehensions related to participating in the reduced bedrest practice. In addition, the Iowa model was useful in organizing this quality improvement project's implementation process. By first establishing bedrest evidence-based practice through a comprehensive literature review, this project was built on a strong foundation. Sharing these research articles with the entire department further supported the safety and positive impact on patient care expected by this quality improvement project. This increased eagerness of the attending physicians to order the reduced bedrest and the nurses to follow the new protocol correctly.

Implications for Clinical Practice

There are several implications for clinical practice that resulted from this quality improvement project. The outcomes from this project support that elevating the HOB to 60 degrees after one-hour of bedrest and ambulating after two-hours of total bedrest for transfemoral diagnostic cardiac catheterizations via 4 to 6 French sheaths with manual removal is

safe and does not increase one's risk of groin complications. These results were consistent with previous studies (Best et al., 2010; Kato et al., 2009; Mohammady et al., 2014). An improvement in patient satisfaction scores for pain management implies that patients' perception of pain was improved by this practice change. This is consistent with previous studies which supported that bedrest reduction reduced patient pain (Burn et al., 2015; Pollard et al., 2003). Patients also rated the wait times better after the new bedrest pilot; thus, suggesting that there were fewer procedural delays as a result of this practice change. Length of stay was decreased by over 100 minutes, which lead to a cost reduction and more effective utilization of recovery space.

Implications for Quality/Safety

Based upon the results of this quality improvement project, the new bedrest practice should be expanded to include inpatients and emergency department patients. To maintain quality and safety standards, the departments who regularly receive these patients post-procedure will receive extensive education. Bedrest Super Users will perform weekly chart audits to ensure that this new bedrest protocol change becomes part of this department's practice. Any issues with the reduced bedrest will be addressed by the Bedrest Super Users through education and in-services. Groin complications will continue to be monitored weekly. Any increase in this quality indicator measurement will be analyzed to determine if the inclusion of inpatients impacts this outcome negatively. The entire Bedrest Team will monitor and adjust the inclusion and exclusion criteria as needed.

Implications for Healthcare Policy

The impact of this project on health policy is related to the optimization of recover space and decrease procedure cost. This quality improvement project allowed for optimization of patient throughput and post-procedure beds, which will ultimately reduce procedural costs and

provide an opportunity to increase volume. With increased recovery space, more patients can potentially be diagnosed with heart disease and receive treatment at this hospital. By running this department more efficiently, this department will increase its revenue. In addition, Medicare and Medicaid's reimbursement rates are impacted by patient satisfaction survey results. The results of this quality improvement project were consistent with supportive literature that reported reduced bedrest improves overall patient satisfaction, which could increase hospital revenue (Burn et al., 2015; Mohammady et al., 2014). As experienced by this author, it is essential that cardiac catheterization departments optimize its profits so that the hospital can use its income to maintain other important community-based departments that usually operate at a loss, like emergency departments.

Implications for Education

Education is an important tool to disseminate the results of this quality improvement project on the local and national levels. The data will be shared with the entire cardiac catheterization department staff; including: Attending physicians, LIPs, and nurses. Since this three-month pilot project found no statistically significant risk of groin complications, this bedrest practice change will be rolled out to the entire diagnostic catheterization population at this hospital. To accomplish this goal, the entire hospital will be educated about the practice change. Poster presentations will be submitted to this hospital's Nurse's Week Celebration in May and the Quality and Safety Week in June, where the entire hospital can see this quality improvement project's results. Journal club presentations will be performed throughout the hospital to educate all units about the new bedrest practice. It is especially important to educate departments that use similar access techniques, like interventional radiology and

electrophysiology. By doing so, it will help to generate interest in implementing new pilot projects that will potentially reduce bedrest in other departments.

On the collegiate level, this project will be shared with Rutgers University School of Nursing during a final presentation prior to graduation. Since this project is applicable to other hospital settings, it is essential to share it on the national and global level. This bedrest quality improvement project will be submitted for scholarly publication to the Journal of Cardiovascular Nursing. These findings also will be used to develop an opinion-based editorial for Cath Lab Digest. In addition, a poster will be submitted to National Teaching Institute and Critical Care Exposition in 2019. This is the annual education and networking conference by the American Association of Critical Care Nurses and would allow knowledge obtained from this project to be spread on a national and global level.

Plans for Future Scholarship

Now that the bedrest practice for diagnostic transfemoral cardiac catheterizations with manual sheath removal is updated, future projects should address bedrest for closure devices and interventions to ensure best practices are implemented. A literature review is needed to determine the evidence-based practice for all procedures and techniques used in this department. Then another three-month pilot should be implemented for any changes to determine its impact on groin complications, length of stay, and patient satisfaction.

Since this quality improvement project may be applicable to other departments that use similar access techniques, the principal investigator will share the results of this quality improvement project with the nurse managers and clinical resource nurses. The principal investigator will work with any departments that express an interest in implementing a bedrest

practice change by performing a comprehensive literature review for their specific population and updating their bedrest protocol to reflect evidence-based practice.

Summary

Updating the bedrest practice for outpatients after a diagnostic cardiac catheterization was needed at this hospital. The old bedrest practice of ordering four hours bedrest with the HOB no greater than 15 degrees was never updated to reflect ACC and AHA recommendations (Bashore et al., 2012). The literature review supported that patients could safely have their HOB elevated to 60 degrees after one hour and ambulate after two hours of bedrest without an increased risk of groin complications. The extended bedrest period increased patient complaints of pain, which negatively impacted patient satisfaction results. When patients ambulate sooner, they can eat and void more easily, which improves patient satisfaction. Early ambulation results in better utilization of nursing and hospital resources by decreasing length of stay after diagnostic procedures. By discharging patients more quickly, valuable holding area space is freed for prepping and recovering additional patients which decreases procedural delays. Continued education of the stakeholders is required to ensure this quality improvement change continues to be part of this department's bedrest practice. The results of this quality improvement project will be shared throughout the hospital, as well as, on the national level so this bedrest practice change can be expanded to other departments.

References

Abdollahi, A. A., Mehranfard, S., Behnampour, N., & Kordnejad, A. M. (2015). Effect of positioning and early ambulation on coronary angiography complications: A randomized clinical trial. *Journal of Caring Sciences, 4*(2), 125-134.

Bashore, T. M., Balter, S., Barac, A., Byrne, J. G., Jeffrey J. Cavendish, Chambers, C. E., . . . Tommaso, C. L. (2012). 2012 American College of Cardiology Foundation/Society for Cardiovascular Angiography and Interventions expert consensus document on cardiac catheterization laboratory standards update. *American College of Cardiology Foundation and the American Heart Association, Inc.* doi:10.1002/ccd.24466

Best, D. G., Pike, R., Grainger, P., Eastwood, C. A., & Carroll, K. (2010). A prospective study of early ambulation 90 minutes post-left heart catheterization using a retrospective comparison group. *Canadian Journal of Cardiovascular Nursing, 20*(4), 15-20.

Bianchi, R., D'Acierno, L., Crisci, M., Tartaglione, D., Cappelli Bigazzi, M., Canonico, M., . . . Calabrò, P. (2017). From femoral to radial approach in coronary intervention. *Angiology, 68*(4), 281-287. doi:10.1177/0003319716656714

Boztosun, B., Güneş, Y., Yildiz, A., Bulut, M., Saglam, M., Kargin, R., & Kirma, C. (2007). Early ambulation after diagnostic heart catheterization. *Angiology, 58*(6), 743-746. doi:10.1177/0003319707308890

Burn, K. L., Marshall, B., & Scrymgeour, G. (2015). Early mobilization after femoral approach diagnostic coronary angiography to reduce back pain. *Journal of Radiology Nursing, 34*(3), 162-169. doi:https://doi.org/10.1016/j.jradnu.2015.04.008

Dal Molin, A., Faggiano, F., Bertoncini, F., Buratti, G., Busca, E., Casarotto, R., . . . Allara, E. (2015). Bed rest for preventing complications after transfemoral cardiac catheterisation: A protocol of systematic review and network meta-analysis. *Systematic Reviews, 4*, 47.

Dang, D., & Dearholt, S. L. (2017). *Johns Hopkins nursing evidence-based practice: Model and guidelines* (3rd ed ed.). Indianapolis, IN: Sigma Theta Tau International.

Doody, C. M., & Doody, O. (2011). Introducing evidence into nursing practice: Using the IOWA model. *British Journal of Nursing, 20*(11), 661-664. doi:10.12968/bjon.2011.20.11.661

Gatt, V., Borg, M., Agius, J., & Xuereb, R. G. (2009). Nurse management with 1-hour ambulation post 4-French cardiac catheterization is safe and cost effective. *Cath Lab Digest, 17*(7).

Gawliniski, A., & Rutledge, D. (2008). Selecting a module for evidence-based practice change: A practical approach. *AACN Advanced Critical Care, 19*(3), 291-300. doi:10.1097/01.AACN.0000330380.41766.63

Kato, F., Sato, Y., Yuasa, N., Abo, D., Sakuhara, Y., Oyama, N., . . . Terae, S. (2009). Reduction of bed rest time after transfemoral noncardiac angiography from 4 hours to 2 hours: A randomized trial and a one-arm study. *Journal of Vascular and Interventional Radiology, 20*(5), 587-592.

Merschen, R. J., Khormi, I., Jada, L., Kobakhidze, T., & Robinson, J. (2014). Octogenarians and issues in cath lab care. *Cath Lab Digest, 22*(9).

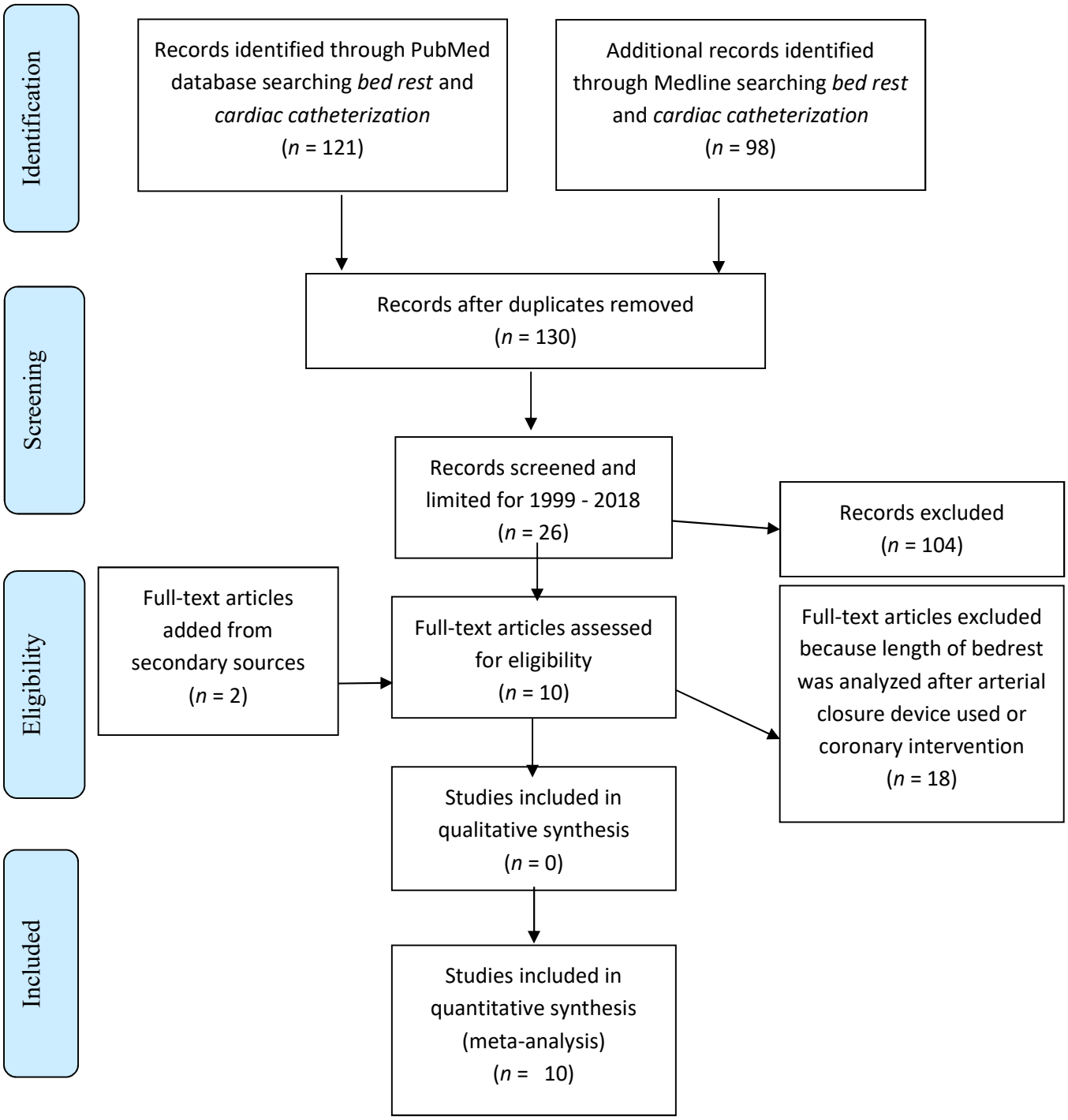
Mohammady, M., Heidari, K., Akbari Sari, A., Zolfaghari, M., & Janani, L. (2014). Review: Early ambulation after diagnostic transfemoral catheterisation: A systematic review and meta-analysis. *International Journal of Nursing Studies, 51*, 39-50. doi:10.1016/j.ijnurstu.2012.12.018

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The, P. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLOS Medicine, 6*(7), e1000097. doi:10.1371/journal.pmed.1000097

Pollard, S. D., Munks, K., Wales, C., Crossman, D. C., Cumberland, D. C., Oakley, G. D., & Gunn, J. (2003). Position and Mobilisation Post-Angiography Study (PAMPAS): a comparison of 4.5 hours and 2.5 hours bed rest. *Heart, 89*(4), 447-448.

Appendix A

Prisma Diagram of Literature search criteria for bedrest practice. Adapted from *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement*, by Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G., 2009, *Public Library of Science Medicine*. 6(7).



Appendix B

Table of Evidence with appraisal of evidence level and quality. Adapted from *Johns Hopkins nursing evidence-based practice: Model and guidelines* (3rd ed.), by Dang, D., & Dearholt, S. L., 2017, Indianapolis, IN: Sigma Theta Tau International.

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
1	Abdollahi, A. A., Mehranfard, S., Behnampour, N., & Kordnejad, A. M (2015)	Research study (Double blind randomized control trial)	Patients having elective coronary angiography using 6-French femoral artery sheaths from Dr. Ganjavian Hospital of Dezful in Iran during 2011 to 2012 -140 patients randomly divided into four groups with 35 members in each group: 1) control group remained in the supine position for 6 hours without a	***Back pain** -Average pain intensity recorded having patients use numeric (0-10) pain scale to rate pain at 1 hr, 2 hr, 4 h, 6hr and 24 hr post procedure for each group -0 means no pain and 10 means severe pain / No significant difference among the four studied groups in the average pain intensity of the subjects immediately after entering the ward after angiography and 24 hours after the angiography / Significant difference between the studied groups when the mean of pain intensity at the fourth hour ($p = .001$) / Significant difference between the average pain intensity in the control group and the fourth group at the fourth hour after angiography ($p = .01$) / Significant difference between the average pain intensity the second group and the third group at the	*Only one author has a background specific to cardiology or radiology. One author has a background in nurse midwifery * Pain is measured using subjective data only. Would have been good to involve vital signs to incorporate objective findings *Urinary retention is measured using subjective data only. Would	Level I/ Good quality

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			movement 2)first experimental group patients head of bed (HOB) increased 15 degrees every hour for first 3 hours. Then patient turned onto right side at 4th hour and left side at 5th hour 3) Second experimental group involved early ambulation at 4 hours 4) Third experimental group involved early ambulation and change position as per above described	fourth hour after angiography (p = .02) / Significant difference between the average pain intensity the third group and the fourth group at the fourth hour (p = .001) / Significant difference between the average pain intensity between the control group and the fourth group at the sixth hour (p = .04) /Most severe back pain is associated with the sixth hour and the highest pain score was reported in the control group ***Hematoma/Bleeding complications** -Ruler was used to determine the diameter of hematoma -Blood gases drawn to determine bleeding amount 1)An increase in gas weight in per gram equals 1 ml of bleeding -Hematoma larger than 5 cm as a significant 2)Hematoma and bleeding more than 100 ml as a significant bleeding have defined /-No bleeding and hematoma in any of the subjects in four groups	have been good to incorporate a bladder scanning into the study for objective findings. *Study only included participants from hospitals located in Iran. Undetermined if equipment or techniques are same as United States for cardiac catheterization	

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			protocol	***Urinary retention** -Ask patient if they felt they needed to urinate /6 people (15%) in the control group -2 people (6%) in change position group at the second hour /1 person (3%) in early ambulation group in the fourth hour /1 person (3%) in the group with both change position and early ambulation at the first hour /No significant difference among the groups per authors using chi-square statistical test. No p value detailed		
2	Best, D. G., Pike, R., Grainger, P., Eastwood, C. A., & Carroll, K. (2010)	Quantitative Research study (quasi-experimental design)	Control group: -402 participants in the non-randomized control group who received the three- to four-hour ambulation protocol -Retrospective data collected through chart reviews from	**Hematoma** -hematoma was measured and categorized as <5 cm, 5–10 cm or > 10 cm /Control group had 11 out of 402 (3%) - Intervention group had 6 out of 193 (3%) /No significant difference between hematoma formation (p = .79) **Access site bleeding** -Bleeding was defined as access site bleed requiring additional manual pressure to be applied	*Intervention group comprised of convenience sample *Only studied patients who had cardiac catheterizations from Alberta Canada. Undetermined if equipment or techniques are same as the	Level II/ Good quality

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			The Alberta Provincial Project for Outcome Assessment in Coronary Artery Disease (APPROACH) database for six months Intervention group: -193 participants ambulated after 90 minutes bedrest from Hospitals in Alberta, Canada -Prospective data gathered for six months	/Control group had 1 out of 402 (< 1%) - Intervention group had zero - No significant difference between access site bleed rate (p = .48) **Vascular Complications** - No occurrence of AV fistula, pseudoaneurysm, retroperitoneal bleed, vascular occlusion, or vascular dissection **Access site** -No significant difference in whether the right or left femoral access site was used for the procedure (p = .82) **Comorbidities** No significant differences in risk factors and comorbidities between two groups **Medications** -No significant difference was found in the use of aspirin pre-procedure (p = .7) -Control group reported significantly higher use of clopidogrel than the intervention group (p < .001)	United States *Bleeding definition was subjective. It would have been beneficial to incorporate objective findings like hemoglobin changes or length of time manual pressure required to be reapplied	

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
				-Intervention group reported significantly more patients using warfarin pre-procedure than in the control group ($p < .001$)		
3	Burn, K. L., Marshall, B., & Scrymgeour, G. (2015)	Systematic review and Meta-analysis	-4581 participants post-diagnostic cardiac catheterization from facilities located in various countries (7 United States, 3 Canada, 2 United Kingdom, 1 Hong Kong, 1 Sweden, and 1 Iran) -Research studies length varied from between 3 and 24 months and published between 1996 to 2011 -Control	**Post Procedure Vascular Complications** Less than or equal to 2 hours bedrest interventions compared to 3-6 hours bedrest (6 studies) -Total participants in 831 Control group and 699 in Intervention group -Control: 40 vascular complications -Intervention: 39 vascular complications -No significant difference ($p = .5$) Less than or equal to 3 hours bedrest interventions compared to 4-6 hours bedrest (10 studies) -Total participants in 2017 Control group and 1910 in Intervention group -Control: 238 vascular complications -Intervention: 190 vascular complications -No significant difference ($p = .06$) Less than or equal to 4 hours bedrest interventions compared to 6 hours or greater bedrest (15 studies) -Total participants in 2344 Control group and 2237 in Intervention	*only 4 of the 15 studies reviewed were 10 years or less old. *4 studies were non-randomized control trials---which may have had selection biased *5 studies had small sample sizes with limited information with less than 150 participants in the control and intervention groups	Level II/ Good quality

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			group: 2,344 patients (ranging from 3-24 hours) -Intervention group: 2,237 patients (ranging from 1.5-4 hours)	group -Control: 288 vascular complications -Intervention: 239 vascular complications -No significant difference (p = .09) **Back pains** -14 out of 15 studies reported less back pain and stiffness with early ambulation after cardiac catheterization -Patients ambulated after 1.5 hours experienced significantly less back pain at the end of bedrest compared with their control group who ambulated after 5 hours bedrest (p < .001) -Studies that measured back pain at 4 hours, 8 hours, and the next morning showed the intervention groups had less pain at all three-time frames (p < .001) -Pts who ambulated at 2 hour completed patient satisfaction questionnaires and reported less back pain and higher levels of satisfaction than the control group		
4	Dal Molin, A., Faggiano, F., Bertoncini, F.,	Non-experimental	n/a	**Protocol for performing a systematic review on the effects of post-catheterization length of bed**	*no details on number of	Level IV/Good quality

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
	Buratti, G., Busca, E., Casarotto, R., . . . Allara, E. (2015)	(protocol/expert opinion)		**rest on bleeding and hematoma, other vascular complications, patient symptoms and patient discomfort, among patients who underwent transfemoral cardiac catheterization** **Databases recommended** -Medline -EMBASE -Cochrane -CINAHL -SCOPUS -SciELO **Specific search strategies and keywords used for each database detailed within article** **How to best organize of articles on bedrest** 1- Article: * Title * Author * Year of publication * Journal 2- Study characteristics: * Setting and location of the study * Number of patients * Mean patient age	articles expected to be identified *stakeholders that should be involved in systematic review not detailed	

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
				* Duration of bed rest * Purposes of procedure: diagnostic or therapeutic intervention * Setting: elective or emergency * Size of catheter (potential effect modifier) * Presence of procedures to promote hemostasis (potential effect modifier) * Study design (randomized or quasi-randomized) 3- Results (divided by duration of bed rest): * Number of patients per study group * Number of patients presenting active bleeding, including oozing and hemorrhage * Number of patients presenting hematomas or ecchymosis * Number of patients presenting late vascular complications such as pseudoaneurysms and arteriovenous fistulae * Mean and standard deviation of patient discomfort scales * Mean and standard deviation of urinary discomfort scales * Mean and standard deviation of back pain scales		

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
5	Gatt, V., Borg, M., Agius, J., & Xuereb, R. G	Non-experimental (quality improvement project)	768 participants after transfemoral diagnostic cardiac catheterization using 4-French sheaths, who ambulated one hour after a mean manual compression time of 9 minutes from Mater Dei Hospital, Malta	**Bedrest/Discharge times** -Mean bedrest time 59 minutes (2 to 120 minutes) -453 (59%) discharged within 2 hours from the vascular sheath removal time -Prior bedrest mean 2 hours and 30 minutes **Vascular Complications** -14 (2%) participants had 10 cm in diameter hematomas -6 (< 1%) participants had 15 cm in diameter hematomas **Cost savings** -This practice change saved 1,152 hours of recovery time (40% reduction). -Early discharges resulted in cost reduction of unspecified amount by reducing nurse to patient times -Reduced need for arterial closure devices which decreases cost of procedure	*No control group to compare intervention group complication rates with *No specified cost savings in dollars	Level V/Good quality
6	Kato, F., Sato, Y., Yuasa, N., Abo, D., Sakuhara, Y.,	Quantitative Research study (randomized	-All participants had 4 or 5-French	**Age** -Control group: Mean age 66 years old (minimum age 39 and maximum age 81 years old)	*Safety of 2-hour bed rest for patients older than 79 years	Level I/ Good quality

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
	Oyama, N., . . . Terae, S. (2009)	control trial and clinical trial)	transfemoral single or dual puncture arterial sheaths for noncardiac angiography with manual removal at Obihiro Kosei Hospital in Obihiro, Japan **Randomized Control Trial** -80 participants were randomized into two groups between March to August 2003 -Control group four hours bedrest -Intervention group two hours bedrest **Clinical Trial**	-Intervention Group: Mean age 66 years old (minimum age 48 and maximum age 83 years old) -No significant difference (p = .94) **Gender** -Control group: 27 (68%) participants were male -Intervention group: 24 (60%) participants were male -No significant difference (p = .64) **Post Procedure Vascular Complications** Randomized Control Trial -Control group: 3 of 40 patients in four-hour group had bleeding after ambulation -Intervention group: None of the 40 patients in the two-hour group developed minor bleeding within two hours after manual compression -No significant difference (p = .24). Single-arm two-hour bed rest trial -1 of the 115 procedures minor bleeding (< 1%) -No major bleeding complications developed	remains unknown because only two participants were older than 79 years in the randomized control trial and then excluded from singled arm trial *Although, access and sheath size same as cardiac angiogram, this study only included participants undergoing non-cardiac angiograms. *Only studied participants from hospital located in Japan. Undetermined if equipment or	

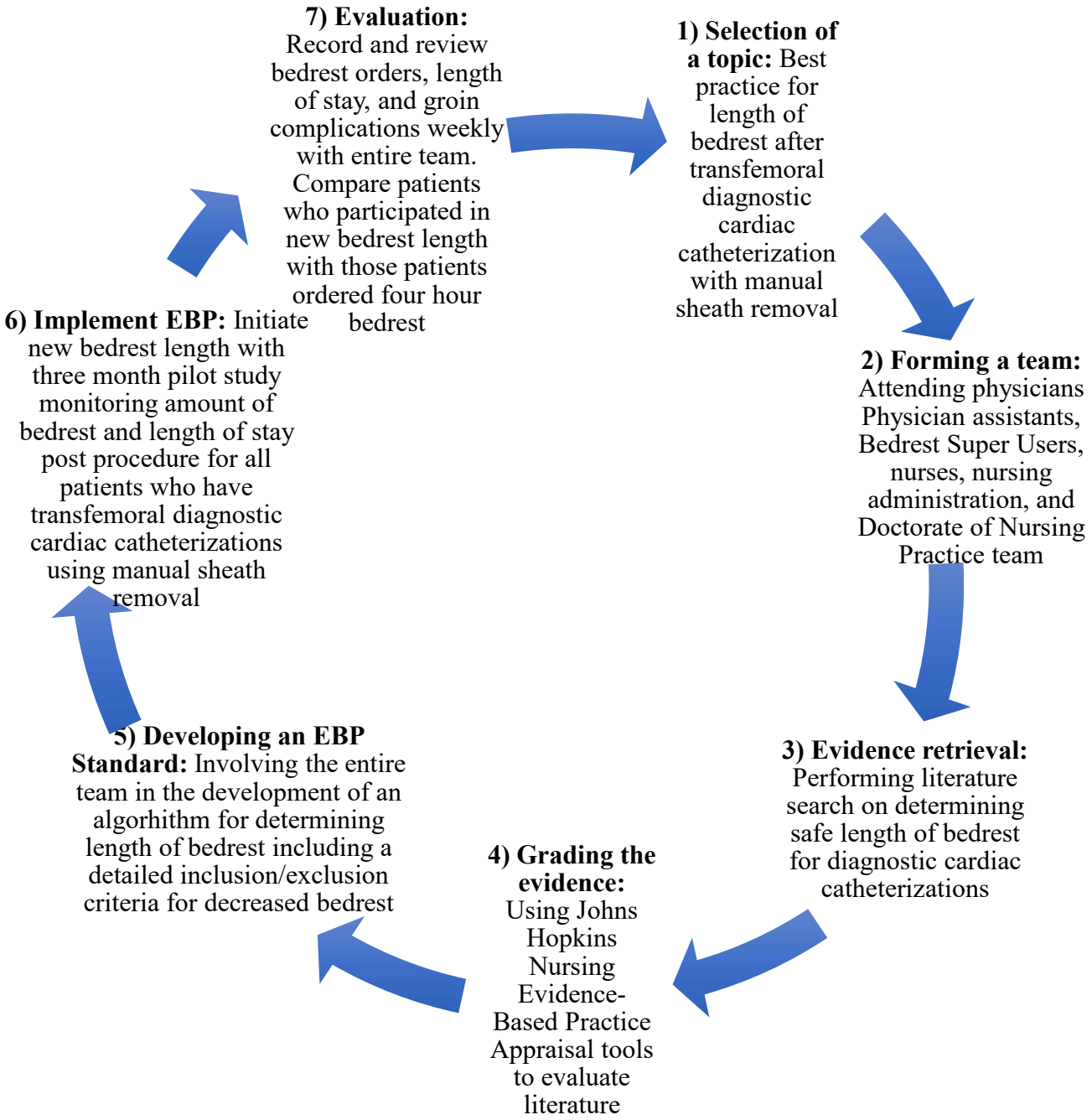
Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			-Single-armed two-hour bedrest trial between August 2003 to February 2004 -115 participants	Factor Contributing to Groin Complications Among all Participants -67 of 195 participants had platelet count less than 100 per microliter of blood -4 participants with low platelet count reported groin complications -Significant difference (p = .01)	techniques are the same as the United States	
7	Mohammady, M., Heidari, K., Akbari Sari, A., Zolfaghari, M., & Janani, L. (2014).	Systematic review and Meta-analysis	-4019 total participants with transfemoral diagnostic cardiac catheterization with manual compression or mechanical sheath removal using 4 to 9-French sheaths and catheters (73% used 5 to 7 French sheaths) from 20 randomized control trials -Control	**Bedrest length** -The time in bed after catheterization ranged from two to 24 hours **Vascular Complications** Four studies compared two-hour bedrest (n = 413) and four-hour bedrest (n = 388) hematoma incidence -Control group: 18 hematoma groin complications -Intervention group: 13 hematoma groin complications -No significant difference (p = .11) Three studies compared two-hour bedrest (n = 311) and four-hour bedrest (n = 265) incidence of bleeding at groin site -Control group: 10 participants had bleeding at groin site after	*14 studies were older than 10 years at the time the systematic review was performed. *11 studies involved a small sample size of less than 150 total participants. *Reviewers cited some studies were unclear about the risk of bias	Level I/ high quality

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
			group: 2,344 participants (ranging from 3-24 hours) -Intervention group: 2,237 participants (ranging from 1.5-4 hours)	ambulation -Intervention group: 7 participants had bleeding at groin site after ambulation -No significant difference (p = .77) **Medications** -Variety of anticoagulants and anti-platelet drugs were used before and after catheterization, (ie acetylsalicylic acid, heparin and oral anti-platelet agents in ten trials) in 10 trials -Six trials did not include participants who received anticoagulants or anti-platelet drugs **Back Pain** Comparing 2 to 4 hour bedrest versus 6 hours bedrest -Pain was significantly lower in the intervention group at two-hour follow up (p < .001) -Pain was significantly lower in the intervention group at four-hour follow up (p = .001) **Cost of Procedures** -Cost of procedures was less when bedrest was reduced	*Reviewers specified that some articles had methodological flaws but did not specify what these involved	

Article #	Author & Date	Evidence Type	Sample, Sample Size & Setting	Study findings that help answer the EBP question	Limitations	Evidence Level & Quality
				-Patients were charged $396 for six-hours of bedrest and $291 for three-hours of bedrest		
8	Pollard, S. D., Munks, K., Wales, C., Crossman, D. C., Cumberland, D. C., Oakley, G. D., & Gunn, J. (2003)	Quantitative Research study (randomized control trial)	-755 participants who had an elective diagnostic cardiac catheterization using a 6-French sheath with manual removal from 32 United Kingdom hospitals in the year 2000 -50 participants withdrew from the study, leaving 362 in group A and 343 in group B Group A (control) -4.5 hours of total bedrest	**Hematoma** -Control group: 34 (9%) -Intervention group: 44 (13%) -No significant different (p = .15) **Bleeding** Defined as need for immediate recompression of groin site -Control group: 21 (6%) -Intervention group: 25 (7%) -No significant difference (p = .42) **Vasovagal** -Control group: 7 (2%) -Intervention group: 9 (3%) -No significant difference (p = .54) **False aneurysm** -Control group: 1 (< 1%) -Intervention group: 1 (< 1%) -No significant difference (p = 0.97) **Total number of patients with complications** -Control group: 54 (15%) -Intervention group: 66 (19%) -No significant difference (p = .13)	*Study older than 10 years however repeatedly referenced in all current research when referring safety of position changes during bedrest *Pain is measured using subjective data only. Would have been beneficial to incorporate vital signs for objective findings *Study only included participants from hospitals located in United	Level I/ Good quality

Appendix C

Seven Steps of Iowa Model for the Bedrest Quality Improvement Project. Adapted from *Introducing evidence into nursing practice: Using the IOWA model*, by C.M. Doody and O. Doody, 2011, *British Journal of Nursing,* 20, 11, p. 661-664



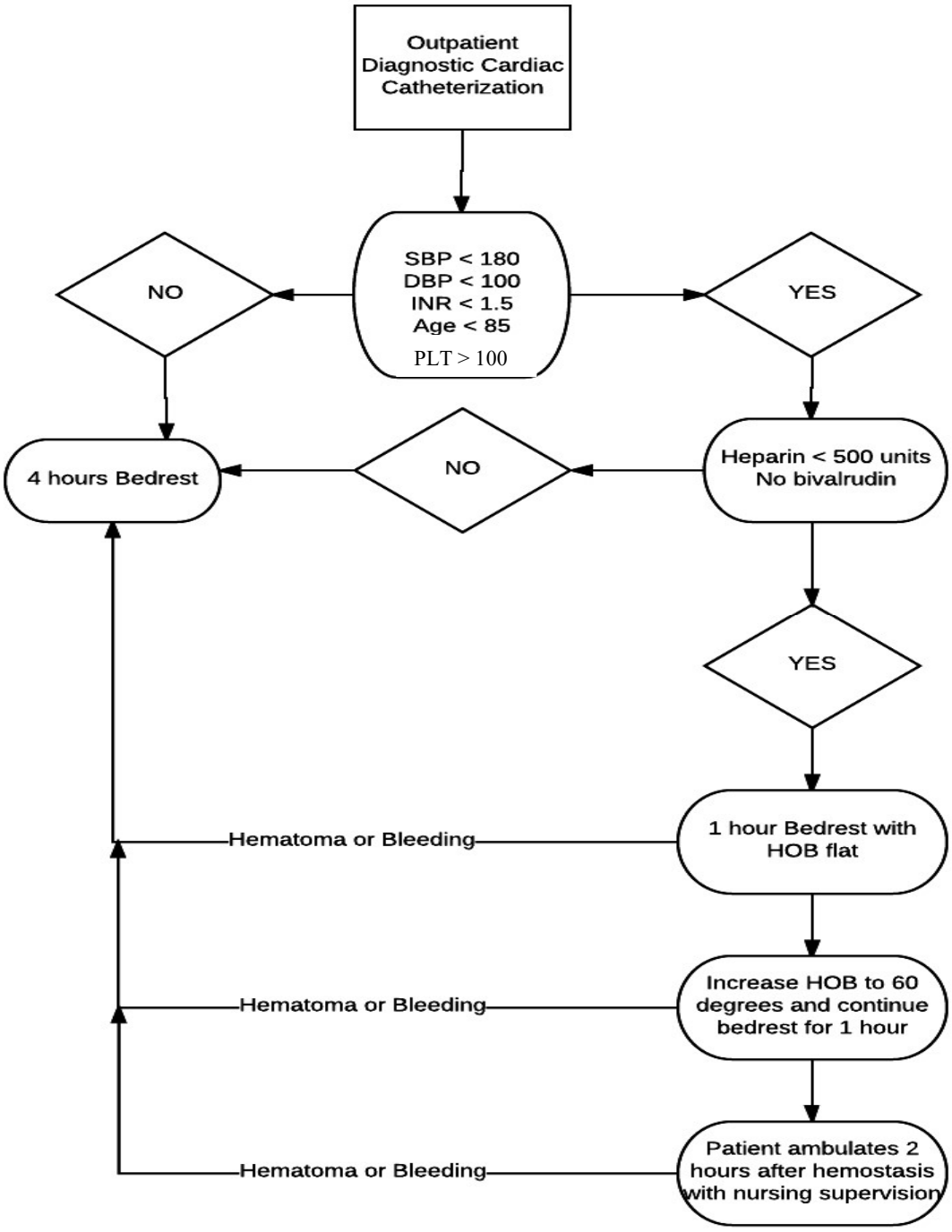
Appendix D

Document to Record Bed Rest Protocol Participants

Date	Patient (First 3 letters last name and first name initial	Sheath Size Gender (M/F) Age	2 hours bedrest ordered (check if applicable)	Hemostasis time	Aspirin (check if applicable) AND Dose	Clopidogrel (C)/ Ticagrelor (T)/ Prasugrel (P) AND Dose	Aortic Stenosis (check if applicable)	Discharge Time/Complications if applicable Hematoma (H) Bleed (B) Vasovagal (V)

Appendix E

Bedrest Algorithm



Appendix F

Letter of Approval from Chief Nursing Officer

[redacted]

September 20, 2017

Ms. Kristen Tuozzo, MSN, RN-BC

We have reviewed your project, System Modification for Quality Improvement Following Diagnostic Cardiac Catheterization Using Manual Pressure, and it does not meet the federal requirements for research requiring human subject's protection, and does not require IRB review.

Findings from projects that are not deemed research involving human subjects *may be published*. Should a journal request information on IRB status, the following statement may be included: **Based on Federal Regulations 45 CFR 46.102, which provides the statutory definitions that guide human subjects research, this project is not considered research involving human subjects and hence does not require IRB review.**

You are approved to conduct your quality project at [redacted] under your faculty mentor supervision.

Sincerely,

[redacted]

[redacted]

Appendix G

Letter of Approval from Rutgers eIRB

eIRB Notice of IRB Determination

STUDY PROFILE

Study ID: [redacted]

Title: Quality Improvement for Bedrest Protocol Following Outpatient Diagnostic Cardiac Catheterization Using Manual Pressure Sheath Removal

Principal Investigator:	Kristin Tuozzo	**Study Coordinator:**	Kristin Tuozzo
Co-Investigator(s):	Ying-Yu Chao Ronald Keller Ann Marie Mauro		
Review Type:	Non-Human Determination		

CURRENT SUBMISSION STATUS

Submission Type:	Request for Determination of Non-Human Subject Research (including Quality Assurance/Quality	**Submission Status:**	Approved

Appendix H

Budgetary Cost of Bedrest Quality Improvement Project

Resource	Number Needed	Cost	Total Cost
Information technology (IT) to update HER	1 hour	$100	100
Box of laminating sleeves	1	$10	10
Double sided tape	2	$2.50	5
Unit-based laminated resources	20	$0.05	1
Bedrest Super User education packets	15 packets	$1.25	18.75
Candy for Bedrest Super User information sessions	5 bags	$3	15
Binding final project	5	$50	250
Total cost of project			$399.75