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Retrospective Electronic Health Record Review of Preoperative Screening of Candidates for Total Joint Replacement

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Project: Retrospective Electronic Health Record Review for Preoperative Screening of Candidates for Total Joint Replacement

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Abstract

Advanced practice nurses (APNs) play an important role in preoperative screening. The purpose of this project was to determine the effectiveness of pre-operative screening criterion established February 2012 for patients greater than 40 years old who underwent total knee or hip replacement surgery. Of the 1850 electronic health records reviewed, 1065 (57.6%) total knee and total hip replacement surgeries took place before and 785 (42.4%) took place after screening criteria were implemented. Before implementation of screening criteria 53 (4.98%) patients experienced critical changes (code blue or critical assessment team call); after the implementation of screening 30 (3.82%) patients experienced critical changes (code blue or critical assessment team call), a decrease of 1.16% after screening. Critical changes (code blue or critical assessment team call) were higher for patients undergoing total knee replacement (pre 3.47% and post 2.80%) than for patients undergoing total hip replacement (pre 1.50% and post 1.02%) before and after the implementation of screening. Preoperative risk factors that resulted in a critical change (code blue or critical assessment team call) included patients with renal disease 4 (4.8%), cerebral vascular accident/transient ischemic attack 13 (15.7%), cardiac disease 36 (43.4%), hypertension, 2 (2.4%), 2 preoperative risk factors 1 (1.2%), and 3 preoperative risk factors 1 (1.2%). Post-operative complications that caused a critical change (code blue or critical assessment team call) included: pneumonia, 11 (13.3%); surgical site infection, 2 (2.4%); urinary tract infection, 1 (1.2%); anemia, 2 (2.4%); and pulmonary emboli, 10 (12%); and 1 (1.2%) with 2 two post-operative complications. Findings from this project demonstrate that preventive prescreening by

APNs can reduce the incidence of critical changes (code blue or critical assessment team call) and guide care for those patients who do experience a critical change.

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Introduction

Advanced practice nurses (APNs) can play an important role in preoperative screening. This APN role can increase patient safety and decrease health care cost to the patient receiving care and the health care system providing care. Preoperative screening of surgical patients enhances positive postoperative patient outcomes. The introduction of a preoperative screening criteria cultivates critical thinking skills, improves team communication and collaboration (Mulcahy & Pierce, 2011).

Project Purpose

The purpose of this project is to determine the effectiveness of preoperative screening criteria established February 2012 for patients who will undergo total knee and hip replacement surgery by: (a) determining if these screening criteria reduce the number of patients who have a critical change (code blue or critical assessment team call) following surgery, and (b) determining if there are additional preoperative risk factors that may be indicative of the cause of a critical change (code blue or critical assessment team call) in patient status postoperatively?, and (c) identifying what postoperative complications resulted in a critical change (code blue or critical assessment team call)? In order to accomplish this project, a retrospective review of the electronic health records (EHRs) of patients before the implementation of the screening criteria and after the implementation of the new policy was analyzed.

Importance/ Significance of Project

In a two-year period, (May 2010 to April 2012) an orthopedic and rehabilitation hospital in Springfield Missouri serviced 1500 patients. The majority of the patients underwent total hip and knee replacement surgery. Seventy (4.7%) of these patients had

complications intra-operatively or postoperatively. In February 2012, a trend analysis of critical change in postoperative patient status was conducted to determine what postoperative risk factors were associated with a critical change (code blue or critical assessment team call) in older patients receiving a total knee or total hip arthroplasty. Data for the trend analysis was from patients admitted to the orthopedic and rehabilitation hospital for surgery between May 2010 and January 2012. As a result of this analysis, the following screening criteria were put into place to decrease the number of critical assessment team calls and code blue events: (a) personal or family history of malignant hyperthermia, (b) previous difficulty with intubation or anesthesia complication, (c) oxygen dependency, (d) sleep apnea with or without continuous positive air pressure (C-PAP), (e) Body Mass Index (BMI) greater than 40, (f) underlying renal disease (stage IV), (g) recent stroke or transient ischemic attack (TIA) in the last 6 to 12 months; (h) history of heart problems (i.e. coronary artery disease (CAD), congestive heart failure (CHF), atrial fibrillation (A.fib), decreased ejection fraction (EF less than 45%), (i) uncontrolled hypertension, and (j) glycosylated hemoglobin levels (HgA1C) greater than 8.0. Patients with any of these criteria preoperatively no longer have hip or knee replacement at the orthopedic and rehabilitation hospital. These patients will be referred to the main campus of a tertiary health system in Springfield Missouri for their surgery. Important to this investigation is a need to determine: (a) if these screening criteria reduce the number of patients who have a critical change (code blue or critical assessment team call) following surgery and (b) if there are additional preoperative risk factors that may be indicative of the cause of a critical change (code blue or critical assessment team call) in

patient status postoperatively, and (c) what postoperative complications resulted in a critical change (code blue or critical assessment team call)?

Epidemiology

According to the National Center of Health Statistics, 48 million or one in five adults have some type of arthritic pain (Miller, 2008). As our population continues to age, this ratio is likely to increase (Miller, 2008 and McHugh & Luker, 2009). Osteoarthritis of the hip or knee is "one of the major long term health conditions" (McHugh & Luker, 2009 p.1257). McHugh & Luker reported that osteoarthritis is one of the most significant causes of pain and physical disability in adult.

In the end stages of osteoarthritis, according to the World Health Organization (WHO), total joint replacement may be considered to restore function and relieve pain (Miller, 2008). In a nationwide inpatient sample, Miller reported from 2000 to 2006 that 5.8 to 7 per 1000 population had a total knee arthroplasty. Knee replacement cases rose from 264,000 in 1997 to 496,000 in 2006 (63 %) and hip replacement cases rose from 157,000 in 1997 to 228,000 in 2006 (48%) (Miller). First time joint replacement procedures have been increasing equally between males and females, 7.3 males per 1000 and 9.8 females per 1000 (CDC, 2009). The number of procedures has increased for people from the age 45 to 64 years (CDC and Singh, 2011).

If these trends continue, an estimated 600,000 hip replacements and 1.4 million knee replacements will be carried out by 2015 (Miller, 2008). Parker (2011) also predicted 1.5 million total knee arthroplasty by 2015. Singh et al. 2011 noted that total knee and total hip surgeries are each done 750,000 times annually. This supports a projected need for total knee and total hip surgeries to grow from 174 to 263% by 2030.

There are more than "234 million people worldwide" that have an elective surgery each year (Wijeysunder et al. 2010, p. 1365). One in five patients is readmitted within thirty days of having a surgical procedure (Kamel et al. 2011). Preventing readmission saves each institution involved an estimated cost of $26 million dollars annually (Wijeysunder et al.).

Prevention of total joint replacement surgery is a primary consideration. Preventive factors include decreasing obesity and more effectively treating osteoarthritis (Miller, 2008). Eighty percent of aging adults have some physical limitation from osteoarthritis (McHugh & Luker, 2008). Up to one third of total joint surgeries are done on obese patients with a body mass index (BMI) greater than 40 (Amin et al, 2006).

Review of Literature

This section includes a comprehensive review of the literature related to risk factors for complications in older adults following knee and hip replacement. Key words for this literature review include: total joint arthroplasty, clinical pathways, risk factors, and postoperative complications.

Total Joint Arthroplasty

Total joint arthroplasty (also called total joint replacement) is defined as both joint surfaces are replaced with artificial materials, usually metal and high density plastic (Van Herck et al., 2010). Total joint arthroplasty is considered the established gold standard treatment for degenerative end stage disease of the hip and knee (Van Herck et al.).

Clinical Pathways

Clinical pathways (also called care pathways or care plans) are one of the main tools used to manage the quality in healthcare concerning the standardization of care

processes (Kruzik, 2009). Clinical pathways promote organized and efficient patient care based on evidence based practice (Kamal et al. 2011). Using standardized clinical pathways for these orthopedic cases increases the quality and the efficiency of nursing care (Van Herck et al).

The national current practice is a three-day clinical pathway for a total knee replacement and a five day clinical pathway for a non-traumatic total hip replacement (Kruzik, 2009). These pathways are successful because of standardized surgical instruments; less invasive surgical techniques, a team approach to preparing the patient for surgery, recuperation time at home, and decreased health care expense (Kamal et al. 2011). It is thought that clinical pathways can significantly improve the quality of patient care. According to Barbieri et al. (2009), this is true because the clinical pathway gives structure and organization to patient care. These clinical pathways are most effective when combined with thorough preoperative screening (Kamal et al.).

Risk Factors for Patients with Total Joint Arthroplasty

Patients may experience complications following total joint arthroplasty. Risk factors have been identified that may predict the potential for postoperative complications. Advanced practice nurses (APNS) are important for the care of patients undergoing total joint arthroplasty. Identifying patients with preoperative risk factors allows the opportunity for APNS to manage and/or prevent postoperative complications both before and after surgery. Advanced practice nurses can help safeguard patients to have better preoperative medical optimization and stringent postoperative observation and care (Parvizi, 2007).

Preoperative Risk Factors

Preoperative risk factors are defined as the patient's risk from having a surgery and the risk of having surgery with the medical co-morbidities present in their current state of health (Isselbacher et al., 2008). Both a literature review and the orthopedic and rehabilitation hospital's preoperative risk factors for postoperative complications are presented in this section. Preoperative risk factors identified by the orthopedic and rehabilitation hospital in Springfield Missouri for surgery that are indicative of potential for complication in patients undergoing arthroplasty follow.

Personal or family history of malignant hyperthermia. Personal or family history of malignant hyperthermia or hyperpyrexia, an autosomal dominant disease, is characterized by skeletal muscle dysfunction after exposure to some anesthesia or other stressor (Isselbacher et al., 2008). Body temperature may climb to 105 degrees Fahrenheit. This rapid increase in temperature is in response to the inhalation of anesthesia (Isselbacher et al.). This complication may be fatal (Isselbacher et al.2008). This risk factor runs in families, thus it is essential to determine if there is a family history of malignant hyperthermia. Isselbacher et al. noted that fifty percent of malignant hyperthermia patients have no previous anesthesia issues.

Previous difficulty with intubation. Previous difficulty with intubation is a clinical situation where trained anesthesiologists experience difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation, or both (Bjorgul, 2010). The difficult airway is a complex issue with interactions between patient factors, the clinical setting, and the skills of the practitioner and may result in airway trauma, tracheotomy, damaged teeth, cardiac arrest, brain injury, or death (Bjorgul).

American Society of Anesthesiologist score. A medical history may not always predict the presence of a difficult airway. The American Society of Anesthesiologist (ASA) score is a well-established preoperative screening tool for patients because it is designed to assess the patient's physical status of health prior to surgery (Bjorgul, 2010). Scores on the ASA rate the patient on a scale of 1 to 5: ASA 1, normal healthy, ASA 2, mild systemic disease, ASA 3, severe systemic disease with limits of activity but not incapacitated, ASA 4, incapacitating disease that is a constant, and ASA 5, moribund and not expected to survive 24 hours with or without treatment.

Obstructive sleep apnea with or without continuous positive air pressure. Obstructive sleep apnea with or without continuous positive air pressure (C-PAP) is the temporary absence of breathing while sleeping (Isselbacher et al., 2008). Snoring and gasping while sleeping due to obstruction of airway can represent symptoms of obstructive sleep apnea. Further symptoms include sleepiness in the daytime. Patients may fall asleep at traffic lights or at their desk at work. Obstructive sleep apnea can lead to hypertension, myocardial infarction (MI), cerebral vascular accident (CVA), cardiac arrhythmias, and pain control issues and other complications (Isselbacher et al.). Treatment for obstructive sleep apnea includes (a) weight loss, (b) continuous positive air pressure when sleeping (C-PAP), (c) an uvulectomy, or (d) night time oxygen therapy (Isselbacher et al.). With sleep apnea patients that require C-PAP, the risk of undergoing general anesthesia must be weighed against the benefits of the elective joint replacement surgery (Pritchard, 2012).

Body Mass Index (BMI) greater than 40. Measuring body mass index (BMI) is the first step to determine the degree of adiposity. BMI is easy to measure, body weight

in kilograms, divided by height in meters squared (Vasan et al. 2005). Increased BMI greater than 40 is implicated in postoperative medical complications for a patient having a total knee arthroplasty or total hip arthroplasty (Isselbacher et al., 2008). Amen et al. (2006) studied patients with obesity (BMI > 40) versus non-obese (BMI < 30) with medical complications (cardiac, gastrointestinal, and pulmonary) and amazingly reported equal rates for each group (3%), but they found that infection rates increase with higher BMI. Patients with a high BMI, have increased stress around the arthroplasty site and the surrounding bone because of excessive weight (Amen et al.). Patients with a BMI of greater than 35, have a two and one half times greater risk to develop a postoperative infection (Lindsay et al., 2011).

Underlying renal disease (stage IV). According to Harrison's Principles of Internal Medicine (2008), underlying renal disease (stage IV) represents patients whose kidneys can no longer function adequately. These patients will already have elevated blood urea nitrogen (BUN) and creatinine. Surgical procedures without appropriate preoperative and postoperative renal plan of care can make renal function worse (Isselbacher et al., 2008).

Recent stroke or transient ischemic attack. A recent stroke or transient ischemic attack (TIA) in the last 6 to 12 months places the patient in a fragile neurologic state (Easton et al 2009). A TIA is a neurologic deficit having a reversible vascular cause (Isselbacher et al. 2008). A TIA produces stroke-like symptoms that resolve within twenty four hours (Easton et al.). A stroke is a sudden loss of neurologic function and sometimes these losses are permanent (Isselbacher et al.). The National Stroke Association (2006) adopted the ABCD2 score as a simple prognostic assessment tool

with moderate predictive accuracy of TIA occurrence. The ABCD2 score developed by Easton et al. equals age, blood pressure, clinical features, duration of symptoms, and diabetes control. This assessment tool is used for predicting a patient's stroke risk after a TIA (Isselbacher et al.).

History of heart problems. A history of heart problems (i.e. coronary artery disease (CAD), congestive heart failure (CHF), atrial fibrillation (A.fib), decreased ejection fraction (EF) less than 45% places the orthopedic surgical patient at preoperative and postoperative risk (Pritchard , 2012). Congestive heart failure is the inability of the heart to circulate enough blood effectively through the heart to meet the body's metabolic needs (Isselbacher, et al., 2008). Prognosis of CHF depends on the ejection fraction rate. Ejection Fraction is the percentage of blood emptied from the ventricle during systole. A left ventricle EF is fifty-five to seventy percent in a healthy heart. The EF can be markedly decreased if part of the heart muscle dies as in a heart attack. Cardiac evaluation preoperatively and a postoperative plan of care would ideally be in place for these orthopedic patients with any cardiac medical history (Isselbacher et al.).

Uncontrolled hypertension. In uncontrolled hypertension the patients' blood pressure is 140 mm/Hg or higher systolic or 90 mm/Hg or higher diastolic when found three separate blood pressure readings taken several weeks apart (Isselbacher et al., 2008). Uncontrolled hypertension is a risk factor for CAD, CHF, CVA and renal disease (Easton et al., 2009). Hypertension can be silent and asymptomatic until a medical crisis arises (Easton et al.). Uncontrolled hypertension preoperatively or hypertensive crisis postoperatively after a total joint surgery puts the patient at risk for a CVA (Easton et al.).

Preoperative control of a patient's blood pressure has been documented to decrease postoperative complications (Isselbacher et al.).

Glycosylated hemoglobin levels greater than 8.0. Diabetes is a chronic metabolic disorder marked by hyperglycemia or elevated blood sugars (Isselbacher et al., 2008). The laboratory test to diagnose poorly controlled diabetes is called glycosylated hemoglobin levels (HgA1C). An HgA1C greater than 8.0 suggests poor long-term (ninety day) glucose control (Isselbacher et al.). Diabetes decreases collagen synthesis and can impact wound healing therefore increasing the risk of postoperative prosthetic failure (Moon et al. 2008). Moon et al. (2008) studied 222 total knee arthroplasty patients and reported that postoperative complications are twice as likely for a diabetic (17.6%) versus nondiabetic (8.1%) patients if blood sugars are not controlled. Tight diabetic blood sugar control can decrease the risk of postoperative infection (Lindsay et al., 2011).

History of smoking. Smoking is also a preoperative risk factor. Singh et al. (2011) reported that smoking up to the time of surgery can increase the risk of pneumonia, surgical site infections and is associated with higher risk of one-year mortality in patients undergoing elective total joint replacement surgery. Preoperative smoking cessation plans should be in place for patients considering elective joint replacement surgery (Lindsay et al., 2011). Smoking cessation can decrease the risk of infection (Lindsay et al., 2011). Smoking is an important public health problem. Singh et al. notes that twenty-three percent of the general United States adult population still smoke in spite of the known health risks.

Postoperative Complications

Important to this project is screening preoperatively to help reduce postoperative complications. For this project postoperative complications include: (a) fever, (b) anemia, (c) pneumonia, (d) surgical site or wound infection, (e) deep vein thrombosis (DVT) with and without pulmonary embolus, and (f) urinary tract infection (UTI).

Fever. Fever is a body temperature above 38 degrees C (100.4 degrees F), according to Harrison's Principles of Internal Medicine, (2008). Most early postoperative fever is caused by the inflammatory response of surgery and resolves spontaneously (Ghosh et al., 2006). Each incidence of fever should be investigated for the source (Isselbacher et al., 2008). Fever can be caused by any of the above postoperative complications. The potential causes for immediate fever during the operative and postoperative period are mainly limited to exposure to medications, blood products, trauma of surgery, and the rare malignant hyperthermia (Ghosh et al.). A study by Ghosh et al. (2006) reported fevers resulting from the trauma and stress of surgery will resolve within two to three days. There are many causes for fever within the first week of surgery (Isselbacher et al., 2008). Nosocomial infections (pneumonia, surgical site, urinary tract,) are common during this early postoperative period (Ghosh et al.).

Pneumonia. Postoperative pneumonia tends to occur within five postoperative days (61%) (Montravera et al., 2002). Postoperative pneumonia should be suspected if patient has clinical signs of infection that include: fever, purulent sputum, leukocytosis, worsening oxygenation, and a new radiographic infiltrate (Isselbacher et al. 2008 and American Thoracic Society, 2005). Singh et al. (2011) report that smoking up to the time

of surgery; can increase the risk of pneumonia. Postoperative pneumonia can delay patient recovery from total joint surgery by loss of physical therapy days due to this preventable medical illness (Singh et al.).

Surgical Site infection (SSI). A study Pravizi (2007), reported surgical site drainage present more than forty eight hours is concerning. Postoperative wound redness two centimeters beyond margins of wound should be addressed (Pravizi). Preoperative skin cleansing of surgical site with an antiseptic solution and preoperative prophylactic antibiotics has been shown to decrease surgical site infection (SSI) (Lindsay et al., 2011). The National Institute of Health and Clinical Excellence (NICE) 2008 give published guidelines on the measures to prevent and treat surgical site infections (Lindsay et al). These guidelines according to Lindsay et al. provide best practice for preventing SSI by stressing the importance of good hand washing techniques and postoperative wound care. Lindsay et al. note that infection of a total joint is a very significant adverse event; it affects the patient, the medical team and consumes hospital resources.

Urinary tract infections. The occurrence of urinary tract infection (UTI) postoperatively is linked to length of stay, presence of urinary catheter, and hygiene care (Isselbacher et al. 2008). Lindsay et al. (2011) as a result of a study, found no clear evidence that a perioperative UTI can increase the risk of a prosthetic joint infection. However, presumed risk favors treatment of UTI before elective joint replacement surgery is done (Lindsay). Within large study of 2621 patients having elective joint replacement surgery done by Lindsay et al. (2011) only 23 patients (or 0.9%) developed a UTI after postoperative urinary catheterization.

Anemia. Anemia due to blood loss varies considerably in clinical presentation depending on site, severity, and situation (Isselbacher et al., 2008). Postoperative anemia can affect total joint arthroplasty recovery. When a patient feels weak, tired, or dizzy because their hemoglobin is 8.0 or lower after surgery, it may be difficult for the patient to complete postoperative physical therapy requirements (Isselbacher). Additionally, underlying heart disease can become problematic and symptomatic with the presence of postoperative anemia after a total joint surgery (Poulin-Tabor et al. 2008 and Parker, 2011). Blood transfusion is the treatment of choice for anemia (Isselbacher et al.). Major orthopedic cases (total hip replacement, total knee replacement, and hip fractures) consume eight percent of all transfused units and are the leading cause of blood transfusions in surgical patients (Spahn, 2010).

Deep vein thrombosis with pulmonary embolus. For patients undergoing orthopedic surgery, deep vein thrombosis (DVT) with pulmonary embolus (PE) is the most life-threatening complication (Parker, 2011). Papakostidis et al. 2011 reports 0.2%-5% of all patients who develop pulmonary embolus dies. Without prophylaxis, 40 to 80% of orthopedic surgical patients develop one or both (DVT or PE) within 7-14 days after surgery (Parker, 2011 and Papakostidis et al., 2011). These postoperative complications are prevented with ambulation and anticoagulation therapy (Isselbacher et al., 2008). According to Warwick (2010), anticoagulation prophylaxis decreases the rate of postoperative DVT by 60 to 70 percent.

Final Evidence of Project Completion

Implementation of the project was completed at the end of December 2012. The following section presents the project design and the results of the project

Methodology

This retrospective EHR review was designed to determine if: (a) preoperative screening criteria established February 2012 for patients who undergo total knee and hip change(code blue or critical assessment team call) following surgery, (b) there are additional preoperative risk factors that may predict a critical change (code blue or critical assessment team call) following surgery and (c) there are postoperative complications that resulted in a critical change (code blue or critical assessment team call)?

Setting and Sample

The setting for this study was an orthopedic and rehabilitation hospital that is part of a tertiary health care system in Springfield Missouri. Subjects were adult patients (greater than age 40) who had undergone a total knee or hip replacement surgery at the orthopedic center. These subjects were obtained from the electronic health record (EHR).

Protection of Human Subjects

Permission to initiate the project was obtained from the orthopedic and rehabilitation hospital Institutional Review Board (IRB) see appendix A. Permission was also obtained from the University of Missouri-St. Louis IRB. After IRB approval was received, data collection began.

Procedure for Data Collection

Data was collected using a retrospective review of electronic health records (EHRs) of patients at the orthopedic and rehabilitation hospital. This study involved the use of existing data from adult patient's electronic health records (EHRs) that had undergone total knee or hip replacement surgery, thus no informed consent was needed.

The investigator contacted the Health Information Management to determine the best method to store the data until identifiers can be removed. Patient's names were only used to retrieve the electronic health record (EHR). Patients were completely anonymous. A code number was assigned to each electronic health record (EHR) reviewed and no information retrieved was linked back to the patient record. No personal and medical information was directly linked with a patient name.

The nursing staff at the orthopedic and rehabilitation hospital provided the names of patients that meet the criteria for the study. Electronic health records (EHRs) were reviewed for the needed information. Data collected was entered into an Excel spread sheet. Demographic data that were collected from the patient's electronic health records (EHR) included age, sex, type of surgery (hip or knee), and medical diagnoses.

Preoperative risk factors that were collected from the EHR include : (a) personal or family history of malignant hyperthermia, (b) previous difficulty with intubation or anesthesia complication, (c) oxygen dependency, (d) sleep apnea with or without continuous positive air pressure, (e) Body Mass Index greater than 40, (f) underlying renal disease (stage IV), (g) recent stroke or transient ischemic attack in the last 6 to 12 months, (h) history of heart problems i.e. coronary artery disease, congestive heart failure, atrial fibrillation, decreased ejection fraction less than 45%, (i) uncontrolled hypertension, (j) glycosylated hemoglobin levels greater than 8.0.

Postoperative complications that were collected from the EHRs include: (a) fever, (b) anemia, (c) pneumonia, (d) surgical site or wound infection, (e) deep vein thrombosis with and without pulmonary embolus, and (f) urinary tract infection, and (g) if the subject had a critical change (code blue or critical assessment team call).

Data Analysis

Descriptive statistics were used to characterize the sample. A retrospective review of the EHRs of patients before the implementation of the screening criteria and after the implementation of the new policy was analyzed. An EXCEL data collection tool was designed.

Research Questions and Discussion of Results

In this retrospective designed study, a total of 1850 EHRs were reviewed from May 2010 to December 2012 to determine the total number of patients who underwent total knee and total hip replacement surgery. Of the 1850 EHRs that were reviewed, 1065 (57.6%) total knee and total hip replacement surgeries took place before screening criteria were implemented and 785 (42.4%) total knee and total hip replacement surgeries took place after screening criteria were implemented in February 2012.

The EHR review found that 83 (4.49%) of the1850 patients, greater than age 40 who underwent total knee and total hip replacement, experienced a critical change resulting in a code blue or critical assessment team call. These 83 EHRs were de-identified and no patient names were used. The age of patients ranged from 42 to 94, 34 (41%) were male and 49 (59%) were female; 59 (71.1%) underwent total knee replacement and 24 (28.9%) total hip replacement surgery. Of those who met the criteria for inclusion in the study, 53 (63.9%) had surgery prior to the new screening criteria and 30 (36.1%) had surgery after the new screening criteria had been implemented.

Research Question 1. Will there be a difference in the number of older adult patients (greater than age 40) with total knee or hip replacement surgery postoperatively

who have a critical change (code blue or critical assessment team call) before the implementation of screening criteria or after the implementation of the screening criteria?

There were 1065 total hip and knee surgeries before the implementation of screening criteria resulting in 53 (4.98%) patients who experienced critical changes (code blue or critical assessment team call). There were 785 total hip and knee surgeries after the implementation of screening criteria resulting in 30 (3.82%) patients who experienced critical changes (code blue or critical assessment team call). There was a 1.16% drop in total hip and knee replacement patients who experienced critical changes (code blue or critical assessment team call).

There were 59 patients (3.19%) who underwent total knee replacement surgery. Of these 59 patients, 37 (3.47%) had a critical change (code blue or critical assessment team call) prior to implementation of screening criteria and 22 (2.80%) had a critical change (code blue or critical assessment team call) post implementation of screening criteria. There were 24 (1.30%) patients who underwent total hip replacement surgery. Of these 24 patients, 16 (1.50%) had a critical change (code blue or critical assessment team call) prior to implementation of screening criteria and 8 (1.02%) had a critical change (code blue or critical assessment team call) post implementation of screening criteria. There was only a 0.67% drop in total knee replacement patients who experienced a critical change (code blue or critical assessment team call) and a 0.48% drop in total hip replacement patients who experienced a critical change (code blue or critical assessment team call). Descriptive statistics suggest the risk for critical change (code blue or critical assessment team call) in this project sample of patients is higher for patients undergoing total knee replacement (pre 3.47% and post 2.80%) than for patients undergoing total hip

replacement (pre 1.50% and post 1.02%) both before and after the implementation of screening.

The results of this project support the continued use of screening criteria for patients who will have total knee and total hip replacement surgery. The first trend analysis done at the orthopedic and rehabilitation hospital (before February 2012 screening criteria implemented) found that 1500 patients had surgery. Of these 1500 patients, seventy (incidence 4.7%) of them had a critical change (code blue or critical assessment team call) event. This project (after February 2012 screening criteria implemented) found the incidence of critical change (code blue or critical assessment team call) events decreased 1.16%.

This is consistent with other investigators who reported that preoperative screening of surgical patients enhances positive postoperative patient outcomes. The introduction of a preoperative screening criteria cultivates critical thinking skills, improves team communication and collaboration (Mulcahy & Pierce, 2011).

Results of this project demonstrated a decrease in the incidence of a patient experiencing a critical change (code blue or critical assessment team call) following total knee and hip replacement surgery. Therefore, it is important for advanced practice nurses in an orthopedic setting to establish a protocol for an annual evaluation and a continuous quality improvement system measuring the incidence of patients experiencing critical change (code blue or critical assessment team call). Noted earlier, descriptive statistics suggest the risk for critical change (code blue or critical assessment team call) is higher for patients undergoing total knee replacement (pre 3.47% and post 2.80%) than for

patients undergoing total hip replacement (pre 1.50% and post 1.02%) both before and after screening.

A review of operating room records provided by the orthopedic and rehabilitation hospital, found both total knee and hip replacement surgeries take 90 to 120 minutes to complete. This surgery time was also reported by Kruzik, 2009 and Kamal et al., 2011. There is no data to support that increased anesthesia and surgery time may have impacted these results. There was also no data found at the project location or in a literature review and search to support that total knee replacement surgery patients are at greater risk than total hip replacement surgery patients for a critical change (code blue or critical assessment team call). Isselbacher et al. (2008) does support the fact that replacing a total knee can be more complicated than replacing a total hip. Although this finding from this project may have been incidental, further monitoring of the incidence of critical change (code blue or critical assessment team call) for patients undergoing total knee replacement surgery is an important recommendation of this project.

Research Questions 2. What preoperative risk factors are indicative of the cause of a critical change (code blue or critical assessment team call) in patient status postoperatively?

Of the 83 patients who had total knee and hip replacement surgery before and after screening criteria, 56 (67.4%) patients had the following preoperative risk factors that resulted in a critical change (code blue or critical assessment team call): renal disease 4 (4.8%); cerebral vascular accident/transient ischemic attack 13 (15.7%); cardiac disease, 36 (43.4%); and hypertension, 2 (2.4%). One (1.2%) patient had two preoperative risk factors-cerebral vascular accident/transient ischemic attacks and

cardiac; and one (1.2%) patient had three preoperative risk factors-cerebral vascular accident/transient ischemic attacks, cardiac, and renal.

Findings from this project are consistent with Easton et al. (2009) who reported that uncontrolled hypertension preoperatively or hypertensive crisis postoperatively after a total joint surgery puts the patient at risk for a critical change (code blue or critical assessment team call). Preoperatively, of these 56 patients, 13 (15.7%) had a cerebral vascular accident/transient ischemic attack, 2 (2.4%) had a hypertensive event, and 2 (2.4%) patients with multiple risk factors had a cerebral vascular accident/transient ischemic attack as one of the risk factors.

Preoperative control of a patient's blood pressure has been documented to decrease postoperative complications (Isselbacher et al., 2008). This is also consistent with the Pritchard (2012) study that reported having a history of heart problems (i.e. coronary artery disease (CAD), congestive heart failure (CHF), atrial fibrillation (A.fib), decreased ejection fraction (EF) less than 45% places the orthopedic surgical patient at preoperative and postoperative risk. This is also supported by Isselbacher et al. (2008), who recommended a cardiac evaluation preoperatively and ideally, a postoperative plan of care be in place for orthopedic patients with any cardiac medical history.

Findings from this project were supported by Isselbacher et al., (2008) who noted surgical procedures without an appropriate preoperative and postoperative renal plan of care could make renal function worse. Four (4.8%) patients in this project, who had renal disease preoperatively, had a critical change (code blue or critical assessment team call).

Of the 83 patients that had a critical change (code blue or critical assessment team call) event, 15 (18%) of them had a recorded BMI greater than 40 [12 (14.4%) before the

screening criteria; 3 (3.6%) post screening]. Preoperative screening for BMI greater than 40 resulted in a 10.8% drop in patients who had a critical change (code blue or critical assessment team call) at the orthopedic and rehabilitation hospital. Patients with a BMI of greater than 40 are referred to the main hospital campus of the health system for their surgery.

This project supports the need to monitor a patient's BMI preoperatively to decrease the number of critical change (code blue or critical assessment team call) events. This is also supported by other investigators who found that an increased BMI greater than 40 is implicated in postoperative medical complications for a patient having a total knee arthroplasty or total hip arthroplasty (Isselbacher et al., 2008 and Amen et al. 2006). Patients with a BMI of greater than 35 have a two and one half times greater risk to develop a postoperative infection (Lindsay et al., 2011).

At the orthopedic and rehabilitation hospital patients found to have a preoperative risk factor on the screening criteria must have medical clearance before their surgery can take place. Before the implementation of the screening criteria in February 2012, the medical clearance was not being consistently done. Ideally, this clearance would come from the patient's primary care physician. The other option for this clearance available since the new screening criteria, February 2013, is the face-to-face screener by collaborating physician through the orthopedic and rehabilitation hospital optimization clinic. Those patients who fail medical clearance are directed to appropriate follow up medical care.

Research Question 3: What postoperative complications resulted in a critical change (code blue or critical assessment team call)?

There were 27 (32.5%) of the 83 patients with postoperative complications. These postoperative complications include: pneumonia, 11 (13.3%); surgical site infection, 2 (2.4%); urinary tract infection, 1 (1.2%); anemia (that caused critical change event), 2 (2.4%); and pulmonary emboli, 10 (12%). One (1.2%) patient had two post-operative complications, anemia and urinary tract infection.

Eleven (13.3%) patients experienced pneumonia. These findings are consistent with other investigators who reported that postoperative pneumonia can delay patient recovery from total joint surgery because the patient is unable to have physical therapy days due to this preventable medical illness (Singh et al., 2011). It is interesting to note in this project, only two of the eleven postoperative pneumonia cases were smokers. Singh et al. and Lindsay et al. (2011) reported that smoking up to the time of surgery can increase the risk of pneumonia, surgical site infections and is associated with higher risk of one-year mortality in patients undergoing elective total joint replacement surgery. It is important to have preoperative smoking cessation plans in place for patients considering elective joint replacement surgery because smoking cessation may decrease the risk of infection postoperative pneumonia.

Two patients (2.4%) experienced surgical site infection (SSI). A study Pravizi (2007), reported surgical site drainage present more than forty eight hours is concerning. Postoperative wound redness two centimeters beyond margins of wound should be addressed (Pravizi). Preoperative skin cleansing of surgical site with an antiseptic solution and preoperative prophylactic antibiotics has been shown to decrease surgical site infection (SSI) (Lindsay et al., 2011). Lindsay et al. support that infection of a total joint is a very significant adverse event; it affects the patient, the medical team and

consumes hospital resources. The two patients who had a SSI also had a BMI greater than 40. This finding is supported by Lindsay et al., 2011 who report that patients with a BMI of greater than 35 have a two and one half times greater risk to develop a postoperative infection.

Only one patient (1.2%) experienced a urinary tract infection (UTI). Isselbacher et al. 2008 is consistent with this finding that the occurrence of an UTI postoperatively is linked to length of stay, presence of urinary catheter, and hygiene care. Lindsay et al. (2011) reported that a UTI could increase the risk of prosthetic joint infection. The one patient in this project who experienced an UTI did not experience a prosthetic joint infection. Treatment of UTI, a presumed risk factor, may have prevented a prosthetic joint infection.

Postoperative anemia was experienced by two patients (2.4%) that caused a critical change and can affect total joint arthroplasty recovery. Because anemia (hemoglobin 8.0 or lower) after surgery may cause patients to feel weak, tired, or dizzy, it may be difficult for patients to complete postoperative physical therapy requirements (Isselbacher). Additionally, Poulin-Tabor et al. (2008) and Parker (2011) reported that underlying heart disease could become problematic and symptomatic with the presence of postoperative anemia after a total joint surgery. The two patients with anemia received blood transfusions. Blood transfusion is the treatment of choice for anemia (Isselbacher et al.). Major orthopedic cases (total hip replacement, total knee replacement, and hip fractures) consume eight percent of all transfused units and are the leading cause of blood transfusions in surgical patients (Spahn, 2010).

Of the 83 patients in this project sample 10 (12%) had a DVT with pulmonary emboli even though they had prophylactic anticoagulation therapy and were ambulated. These project findings are consistent with authors who report postoperative complications are prevented with ambulation and anticoagulation therapy (Isselbacher et al., 2008) but anticoagulation prophylaxis can only decrease the rate of postoperative DVT by 60 to 70 percent (Warwick, 2010). For patients undergoing orthopedic surgery, deep vein thrombosis (DVT) with pulmonary embolus (PE) is the most life-threatening complication (Parker, 2011). Papakostidis et al. (2011) report 0.2% to 5% of all patients who develop pulmonary embolus die. Without prophylaxis, 40 to 80% of orthopedic surgical patients develop one or both (DVT or PE) within 7 to 14 days after surgery (Parker, 2011 and Papakostidis et al., 2011). Because of the coordinated care by APNs and the medical team at the orthopedic and rehabilitation hospital, these 10 patients with DVT with pulmonary emboli were successfully treated and discharged.

Future Considerations for Screening

Because of the extensive review of the literature, two additional risk factors were discovered. These two factors are a psychiatric history, and fat emboli.

Patients who have a psychiatric history were not addressed as a preoperative risk factor group. Isselbacher et al. (2008) report that patients who take psychiatric medications specifically mood stabilizers can have anesthesia issues, complications and/or interactions. According to Nauert, 2012, the presence of mood disorders preoperatively can result in the reporting of higher postoperative pain levels. Higher postoperative pain levels can result in longer hospital stays.

Patients who have a fat emboli complication were not addressed as a postoperative risk factor in this project. According to Galway and Gugliotti (2012), the risk of fat emboli postoperatively is a greater concern for the patients who have bilateral total knee arthroplasties done. These patients have larger fatty embolic load present than the unilateral total knee arthroplasty patient does. The symptom for this complication is sudden hypoxia during surgery. Galway and Gugliotti (2012) report, that this complication occurs 0.1% to 12% of the time.

This DNP project was designed to increase patient safety and identify patients at risk. Because the APN and medical team at the orthopedic and rehabilitation hospital are committed to screening for patients at risk for a critical change (code blue or critical assessment team call), plans are in place to add these two patient groups to the screening criteria for future tracking. Advanced practice nurses play an important role as clinical experts in bringing evidenced based practice to patient care. This DNP project is an example of why alerting the orthopedic and rehabilitation hospital team that there is a potential for a critical change (code blue or critical assessment team call) event using evidence based findings that can impact patient care in the orthopedic setting. Advanced practice nurses have an important to role to be leaders who can impact, change, and improve everyday patient care based on evidence. This DNP project was successful in supporting the role of APNs as a leader and a voice in today's healthcare.

Outcomes

The short-term outcome for this project was to improve postoperative patient outcomes (code blue or critical assessment team call). Has the screening criteria decreased these patient events? Measurement of this outcome was completed by

comparing the patients that had code blue or critical assessment team call before the February 2012 criteria and after the February 2012 criteria were implemented. The outcome results showed fewer complications with better screening. According to Kellogg 2004, the outcome (a reduction in complications) should be attained within one to three years.

The first trend analysis done at orthopedic and rehabilitation hospital (before February 2012 screening criteria implemented) found that 1500 patients had surgery. Of these 1500 patients, seventy (incidence 4.7%) of them had a critical change (code blue or critical assessment team call) event. This project (after February 2012 screening criteria implemented) found the incidence of critical change (code blue or critical assessment team call) events decreased 1.16%. This short-term outcome was met.

An intermediate outcome was to implement an annual trend analysis of patient events to monitor the effect of preoperative screening. This trend analysis will be designed and recommended to the orthopedic and rehabilitation hospital team for future use.

Another intermediate outcome was to monitor if a change in preoperative screening policy is needed. For example, are there any screening criteria that need to be added or removed as a result of continued monitoring? Because of the extensive review of the literature, two additional risk factors were discovered. These two factors are a psychiatric history, and fat emboli. They will be added to the screening criteria. A preoperative screening tool and an actual face-to-face preoperative screening trial are currently being utilized.

A long-term outcome would be to develop a continuous quality improvement system around critical incidence, code blue or critical assessment team calls. Long term outcomes (a reduction in complications) should be attainable within four to six years, according to Kellogg (2004). The long-term outcome can be monitored comparing the first trend analysis with patient information gathered since February 2012 followed by the implementation of an annual trend analysis. (Appendix B and C). The exact outcome of this goal will be further explored in the future.

Stakeholders

The stakeholders are: (a) hospital administration, (b) physicians (orthopedic surgeons, anesthesia, and internal medicine physicians), (c) nursing staff, (d) patients, (e) insurance/payer source, (f) information technology (IT), (g) educational services, and (h) nurse practitioner staff.

The stakeholders listed above have all collectively worked together to complete this project. The intended impact of this project was to develop consistent screening procedures that lead to successful outcomes, advocate practice changes, engage stakeholder involvement and improve more cost efficient patient care.

Barriers

The barriers included: (a) the literature review to date is of split opinion about the value and benefit of preoperative screening, (b) getting stakeholders to listen and agree on what should be done, (c) lack of physician education about the limitations for this unit, (d) no critical care unit or critical care nursing staff, (e) lack of resources- no stat lab or x-ray service available on 24/7 basis, (f) the human tendency to believe that all surgical cases will have the desired outcome with no plan for poor results, (g) cost of having the

unit open over the weekend for census of 2-3 patients, (h) lack of standardization of patient care, (i) not consistently following policies and procedures. (j) inexperienced nursing staff.

Evaluation Plan

This program is an observational design. It is a retrospective cohort study. Cohort studies measure changes in outcomes based on exposure (Gordis, 2009). In this case, the exposure is the implementation of the screening criteria. It will use the historical data of an EHR review. Observational studies are common in most fields that study the effects of various treatments of patients including medicine, economics, epidemiology, education. psychology, and sociology (Rosenbuam, 2010). According to Gordis (2009), two of the largest and most informative observational studies done were the Framingham Study and the Nurses' Health Study. Observational design assumes a casual order of A precedes B, therefore A caused B (Rosenbuam, 2010). The data is usually presented descriptively providing information about the who and the what (Gordis, 2009). Gordis (2009) supports that observational evaluation design studies can provide: (a) information on real world use and practice, (b) detect benefits and risk in practice, (c) help formulate hypothesis and research questions, (d) provide community-level data for clinical trials, (e) inform clinical practice. For these reasons, observational evaluation design fits well for this project.

Utilization of nurse practitioners for this DNP project will improve the quality of patient health care. Addressing the research questions within this DNP project will increase patient safety and save health care dollars.

Project Limitations

The first limitation is sample size. The final sample size that met study criteria was eighty-three. This sample size is small. Initially, the sample size was expected to be larger.

The second limitation is that the time period before the screening criteria implementation (20 months) and the time period after the screening criteria implementation (11 months) was not equal.

Third, after presenting this project and reviewing the data collected and the findings, future consideration would be to add to the project patients with preoperative mood disorders. Patients on psychiatric medications specifically mood stabilizers can have anesthesia issues, complications and/or interactions. This project did not address that preoperative risk factor.

Fourth, another consideration for the future would be to add fat embolus to the postoperative risk factor list. That complication was not addressed in this project.

Fifth, this project only looked at preoperative co-morbidities and post-operative data of patients that had a critical change (code blue or critical assessment team call) event and not the preoperative co-morbidities and post-operative data of the whole total (1850) hip and knee replacement population.

Applications to Practice

This project was a beginning to impact patient care and safe outcomes for this orthopedic and rehabilitation hospital population. It has the potential to be expanded in the future. This project is ongoing and moving forward more than initially anticipated. A patient care safety issue prompted the development of this doctorate of nursing practice

(DNP) project. From this project have come the developments of screening criteria, a preoperative screening tool, and an actual face-to-face preoperative screening trial, all currently being utilized at an orthopedic and rehabilitation hospital in Springfield Missouri, that is part of a tertiary health care system.

There is the potential for a full time provider position to develop if the face-to-face preoperative screening trial proves successful. To date, this project has cost the health system no money and potentially saved thousands of health care dollars and resources in averted complications and settlement costs. There has been no increased health care cost passed on to this served patient population.

The orthopedic and rehabilitation hospital is currently supporting the continuation of the screening criteria and face-to-face preoperative screening of this patient population. It is believed that to date, these screening components have been more effective than the statistics of this project represent.

Looking forward, this doctorate of nursing practice (DNP) project is about several things. First, it is about solving a patient safety issue. Second, it is developing into useable tools that impact patient care, safety, and positive outcomes. There is great potential for this project to continue into the future, the final outcome and screening statistics to date are still ongoing. The potential savings of today's health care dollar in this patient service line is huge, impactful and important all from the development of this doctorate of nursing practice (DNP) project.

Accomplishment of DNP Essentials

The Doctor of Nursing Practice (DNP) education allows nurses to develop into

clinical experts and leaders in nursing practice. The DNP essentials are defined by the American Association of Colleges of Nursing (AACN, 2006). The eight DNP essentials were met through the course study of science, organizational systems, informatics, health care policy, interdisciplinary collaboration to improve patient safety and outcomes, and health prevention and wellness (AACN, 2006). It addresses the APN role in preoperative screening. Research findings such as 1) preoperative and postoperative risk factors for total knee and hip replacement surgeries 2) current trends, epidemiology and evidence-based literature review 3) project outcomes also support the accomplishment of the eight DNP essentials. This project fulfills these essentials with evidence-based advanced nursing practice and clinical scholarship to develop, design and implement this project.

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Appendix A

CoxHealth

NOTICE OF EXEMPTION FROM IRB REVIEW

To: Jill Rude, FNP
1000 E. Walnut Lawn, Ste 207
CoxHealth Walnut Lawn
Springfield, MO 65807

From: Karen Gambon, IRB co-Chair

Date: September 20, 2012

This letter is to advise you that the project you are requesting to conduct to "determine the effectiveness of pre-operative screening criteria established February 2012 for patients who will undergo total knee and hip replacement surgery" is exempt from Institutional Review Board (IRB) oversight. This project is exempt under the Department of Health & Human Services regulation 45 CFR 46.101 (ii), Exemption (4): "*Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.*"

It is my understanding that you will be analyzing and comparing charts of patients having surgery before to patients having surgery after the implementation of the screening criteria. The development of a process to then continuously analyze how this screening criteria effects CAT calls and code blue events leans towards Quality Improvement.

Please notify the IRB office of any changes made in the conducting of this project, intentions of use of findings, or any other pertinent information. Changes made may result in a non-exempt status of your project making you noncompliant with government regulations. Because you will be obtaining patient identifiable information to look at patient charts, you must contact the Health Information Management Department to determine the best method to store that data until identifiers may be removed. They will also assist you in completing an Accounting of Disclosures log as well.

We wish you success in your project and look forward to working with you on future projects. Please contact Cortney Freeman if you need further assistance or there is anything else the IRB may help you with. She may be contacted at (417) 269-7669 or via email at Cortney.Freeman@CoxHealth.com.

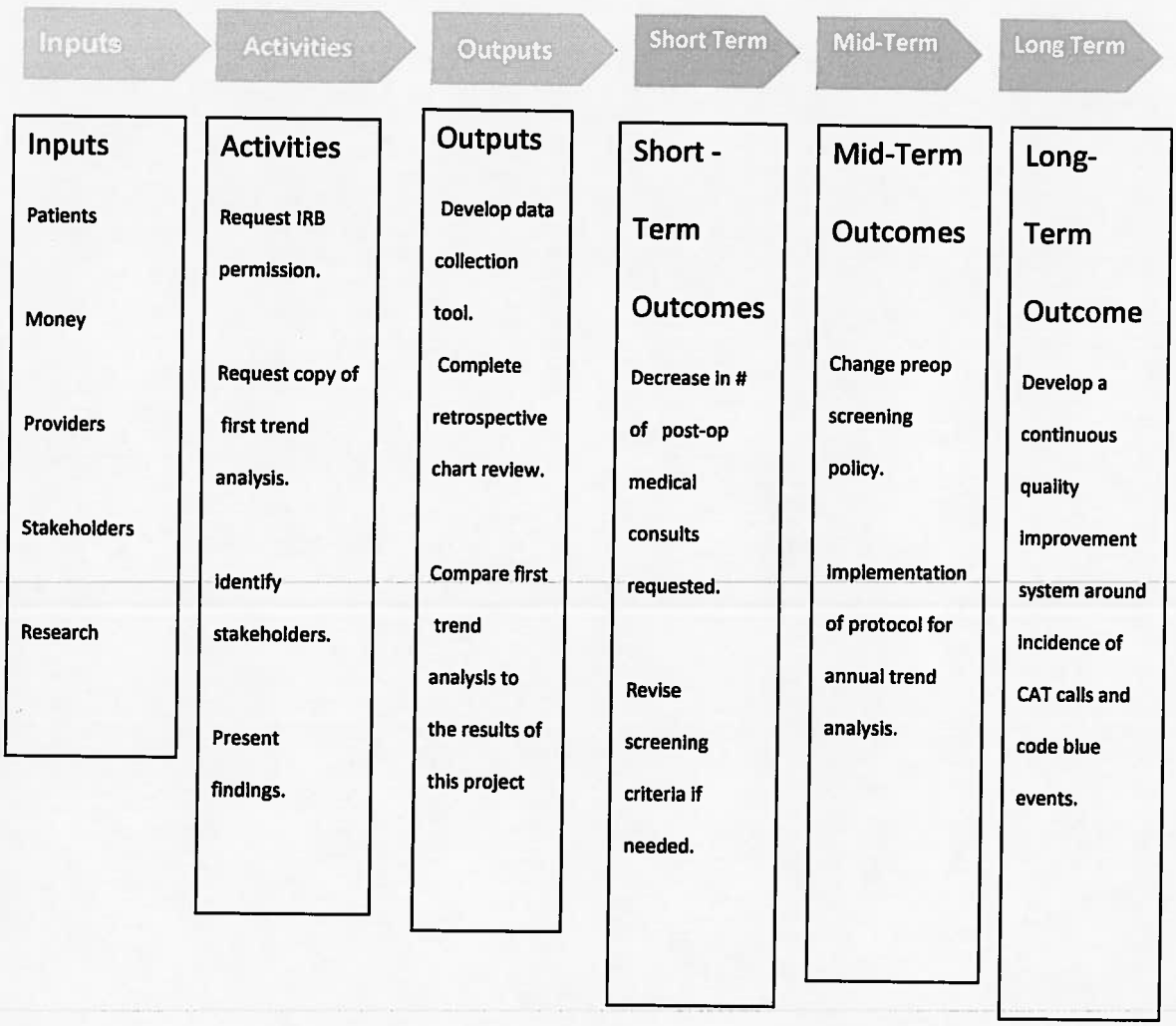
KG/cf

Appendix B

Logic Model

Logic Model Components Evaluation Focus	Indicator(s) or Evaluation Questions	Data Method(s)/Source(s)
Decrease number of postoperative medical consults requested. (short-term outcome) Request copy of first trend analysis.	Did screening criteria implementation of 2/12 help lower medical consult requests?	Retrospective EHR review. Patient consult list. Copy of first trend analysis (before 2/12).
Revise screening Criteria if needed. (short-term outcome)	Does screening criteria meet all patient/provider needs?	Retrospective EHR review. Stakeholder input from quarterly meetings.

Appendix C


Inputs
Activities
Outputs
Short Term
Mid-Term
Long Term
Inputs
Patients
Money
Providers
Stakeholders
Research
Activities
Request IRB permission.
Request copy of first trend analysis.
identify stakeholders.
Present findings.
Outputs
Develop data collection tool.
Complete retrospective chart review.
Compare first trend analysis to the results of this project
Short - Term Outcomes
Decrease in # of post-op medical consults requested.
Revise screening criteria if needed.
Mid-Term Outcomes
Change preop screening policy.
implementation of protocol for annual trend analysis.
Long-Term Outcome
Develop a continuous quality improvement system around incidence of CAT calls and code blue events.