The Use of a Pre-Operative Checklist to Decrease Delays and Cancellations in the Cardiac Catheterization Laboratory

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Abstract

Heart disease is the leading cause of death for men, women, and most races and ethnic groups in the United States (US), and costs over 363 billion dollars a year (American Heart Association [AHA], 2021). Every 40 seconds an American will suffer a heart attack, with over one million heart catheterizations performed each year in the US (Virani et al., 2021). Cardiac catheterization is a common procedure used to diagnose and treat those patients suffering a heart attack to identify a blockage(s) that requires either angioplasty with or without stent placement (Virani et al., 2021). With the increase in patient comorbidities coupled with the need for a left heart catheterization (LHC), heart catheterization must be completed as scheduled to prevent the worsening of the patient's condition without unnecessary delays. One way to prevent delays or cancellations of the scheduled heart catheterization is optimizing patients' comorbidities before the heart catheterization to allow the catheterization to proceed as scheduled. Implementation of a pre-operative checklist in the operative setting has been proven to decrease morbidity and mortality when consistently used (Jain et al., 2018). This pilot quality improvement (QI) project investigated the effect a pre-operative cardiovascular catheterization checklist has on delays and cancellations of scheduled heart catheterizations.

The development of the checklist was based on chart reviews of previous patients scheduled to undergo a heart catheterization that was delayed and canceled. The reasons for the delays and cancellations were compiled and were the items used to create the original checklist. The checklist was implemented in an affiliate community hospital. The checklist goals were to prevent delays and cancellations and increase communication between the sending facility and the receiving facility. The pilot QI project lasted five months. Data was collected five months before the initiation of the checklist and five months after the checklist implementation. Forty-

one total patients were involved with the pilot QI project; 24 patients were pre-checklist and 17 patient's post-checklist. The post-checklist group had seven delays/cancellations, and none of those patients underwent a transfer to the receiving facility. Although there were more delays/cancellations after the implementation of the checklist, the checklist identified potential patient issues that needed to be addressed. Those issues identified in the checklist prevented unnecessary transfers which created thousands of dollars in savings.

Introduction

The cardiac catheterization laboratory is a busy, high turnover, stressful department that requires a specialized group of staff. According to Manda & Baradhi (2021) there are over one million heart catheterizations performed each year in the United States and 720,000 Americans will have a new coronary event (defined as first hospitalization for myocardial infarction or coronary heart disease death) according to the National Heart, Lung, and Blood Institute (NHLBI) (Virani et al., 2021). Myocardial infarction (MI) and coronary heart disease (CHD) are 2 of the 10 most expensive conditions treated in the United States and the cost of treating CHD was 103.2 million dollars between 2016-2017 according to the NHLBI. Approximately every 40 seconds an American will suffer a MI (Virani et al., 2021). Based on information tabulated by the NHLBI from 2005-2014 the annual incidence of MI is 605,000 new attacks and 200,00 recurrent attacks and of the 805,000 first and recurrent events, it is estimated that 170,000 are silent (Virani et al., 2021). With the aging population and recent trends towards an increase in stent placement versus open heart surgery the demand for heart catheterizations continue to increase. The overall rates of major complications related to left heart catheterization (LHC) according to American Heart Association (AHA) are extremely rare, most complications arise post procedure including acute kidney injury (AKI), heart failure (HF), pseudoaneurysm and arrhythmias (Pepine et al., 1991). Due to patients having multiple comorbidities, delays and cancellations are occurring more frequently due to those comorbidities not adequately treated prior to the procedure, those include but are not limited to worsening renal function, dye allergy, continuation of blood thinning medications, HF, and infections

Along with optimization of patient's comorbidities prior to scheduled LHC, a thorough history and physical exam is required to identify the suitability of the patient for the LHC. The

focus should be on drug allergies, laboratory values including complete blood count (CBC), complete metabolic panel (CMP), prothrombin time (PT/INR), electrocardiogram (ECG), and chest X-ray (CXR) and ideally should be reviewed a day prior to the LHC according to the American College of Cardiology (ACC) & American Heart Association (AHA) guidelines for heart catheterization (Bangalore et al., 2021). The World Health Organization (WHO) developed a surgical checklist in 2008 that has shown to prevent complications, and decrease morbidity and mortality when consistently used, and the checklist has been applied to other areas of the hospital including interventional radiology, and emergency room (Jain et al., 2018). This pilot quality improvement project will look at implementing a pre-operative cardiac catheterization checklist for patients undergoing a non-emergent LHC and its effect on delays and cancellations by utilizing the interprofessional cardiac team who is crucial in the management of the patient with coronary artery disease (CAD), including those team members who care for the patient prior to the LHC.

Problem Statement

The idea for this pilot QI project was to implement a pre-operative cardiac catheterization checklist in our affiliated hospital in East Liverpool, Ohio (ELCH) that contracts with our organization for cardiac care. The tertiary facility that provides high level cardiac interventions is in Youngstown, Ohio approximately 45 minutes away. Delays and cancellations have become more evident in the last 2-3 years due to the closing of surrounding facilities and the addition of outside facilities using our cardiac catheterization services. The different electronic medical records (EMR) from the outlying facilities and fragmented communication between the sending and receiving facilities contribute to the delays and cancellation. More recently patients have deferred care due to the pandemic and the cardiovascular laboratory is

overwhelmed with LHC's over the last year with delays and cancellations worsening the backlog of cases. Another contributing factor is high complexity patients resulting in an upward trend in intensity of service according to the AHA and the concern is patients that went untreated during the pandemic could re-emerge sicker and costlier in 2021 (Daly, 2020). The current population coming to the CVL has many comorbidities, including but limited to previous cardiac stenting or bypass, peripheral vascular disease (PVD), atrial fibrillation (AF) on oral anticoagulation (OAC), insulin requiring diabetes, chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), obesity, and ongoing tobacco use. Those comorbidities require the provider to address those co-morbidities and identify anything that may need to be treated or optimized prior to the heart catheterization. Currently the cardiac catheterization laboratory (CVL) staff obtain a report that is not standardized from the sending facility. After the patient has left the facility, some information is either missing or not relayed to the CVL staff and when the patient arrives, they are unable to undergo the scheduled LHC for multiple reasons; infection, fever, worsening renal function, blood thinning medications not held, and dye allergies not treated. The idea of a standardized report sheet or checklist has never been developed or trialed in the CVL department. When a patient is unable to undergo the scheduled LHC, it creates a cascade of issues starting with backing up the CVL holding area requiring them to obtain a bed assignment, and new physicians to treat the patient (primary care, and other specialist) which takes time and resources to care for a patient unfamiliar to them. Time is spent obtaining records, and testing at times is unnecessarily repeated, this results in frustration by both the family and patient. The delays and cancellations ultimately put a burden on an already overwhelmed, understaffed facility. By trialing a pre-operative CVL checklist, the goal is an increase in communication

allowing the LHC to be performed at the optimal time determined by the cardiologist without unnecessary delays or cancellations.

Aim

The aim of this pilot QI project is to decrease delays and cancellations of patients undergoing a non-emergent heart catheterization by 25%. There is no data in relation to average length of time prior to a non-emergent LHC in our facility and there is no national benchmark for the proper timing of non-emergent LHC in the literature. The AHA/ACC states that patients undergoing a diagnostic LHC (one that is not emergent) should be optimized prior to the procedure to prevent or minimize post procedure complications (Virani et al., 2021). Issues that require optimization prior to LHC include decompensated heart failure (HF), acute kidney injury (AKI), the use of OAC's (within 48 hours), recent infection (not treated or cleared by infectious disease), or a dye allergy not treated. The creation of a standardized checklist to prevent delays and cancellations could if implemented properly and consistently be used to address the Triple AIM developed by The Institute for Healthcare Improvement (IHI) improving patient's health by preventing unnecessary complications, decreasing costs incurred with increased length of stay and improving patient satisfaction by completing the test as scheduled (Armstrong & Sables-Baus, 2020). The IHI has drilled down on the business aspect of hospitals identifying the "dark green dollars," the true bottom line not just theoretical cost savings (Martin et al., 2009). The cost can be calculated based on an average time of 45 minutes for a heart catheterization and can translate to a specific dollar amount once the cost has been determined by the facility. Improving population health/outcomes occurs by consistent use of the checklist, therefore decreasing the delays and potentially avoiding any complications that could occur from delaying care, including worsening cardiac function, pneumonia from inactivity, etc. In this complex healthcare arena, the

expectation is for the cardiovascular community to extend this patient centered perspective across the entire cardiovascular spectrum of care.

Background

In 2020 the cardiovascular catheterization laboratory (CVL) in Youngstown, Ohio performed over 1900 cardiac catheterizations labeling it a high-volume center (Jolly et al., 2014). With the closing of a nearby large health system in September of 2018 and the affiliation agreement with a community hospital in East Liverpool, Ohio the numbers have grown steadily over the last several years. With the increase in cardiac catheterization's the need for seamless transfer to and from the CVL is essential to maintaining a schedule and preventing delays and cancellations. The cancellations and delays not only affect the patient, but time therefore money lost to the organization.

System/Organizational Impact

A cross sectional and longitudinal study conducted in the United States reported the mean cost of one minute of OR time is approximately 36-37 US dollars (Childers & Maggard-Gibbons, 2018). The International Federation of Health Plans newest report on cost for common medical services for 2017 report the average price for a LHC requiring an angioplasty (procedure that opens a blocked heart vessel) is 32,200 dollars and with the average time for a LHC being 45 minutes just the procedure alone costs $715.55 a minute (Hargraves & Bloschichak, 2019). The impact of even a delay of a few minutes can add up to millions of dollars over a short period of time.

The ACC/AHA guidelines divided quality of patient care into seven areas. One area discussed is risk stratification defined as making sure the patients are screened and are appropriate for a LHC (Virani et al., 2021). In 2012 the American College of Cardiology, key

specialty and other subspecialty societies developed the Appropriate Use Criteria (AUC) for a LHC (Patel et al., 2012). It was developed to guide a more efficient and equitable allocation of healthcare resources, improve patient care, and health care outcomes in a cost-effective manner (Institute of Medicine, 1999). The CVL has been experiencing a significant number of delays/cancellations over the last year coming from our two sister hospitals and our affiliated hospital. The delays and cancellations create a cascade of events that lead to unnecessary lengthy hospital stays in a facility where the patient must be cared for by a new set of physicians leading to potential medication errors, hospital acquired infections, worsening cardiac function, thereby increasing morbidity and mortality ultimately increasing cost (Marfil-Garza et al., 2018). Powell & Nelson (2008) conclude that medicine has become highly complex and dangerous, and the Agency for Healthcare Research and Quality (AHRQ) has calculated statistics regarding prevalence of hospital adverse events, and a list of the most common procedures requiring hospitalizations. The most current statistics from AHRQ (2015) lists percutaneous transluminal coronary angioplasty (PTCA) as the sixth reason for inpatient stays (Agency for Healthcare Research and Quality [AHRQ], 2019).

The pre-procedure duties of the CVL staff include gathering critical information about the patient that could potentially delay or cancel the LHC. The information includes labs, allergies, vital signs, and recent medications. The registered nurse (RN) in charge must be able to communicate clearly and be knowledgeable enough to collect the critical information and convey any concerns to the interventional cardiologist that may cause a delay or cancellation. With our affiliated hospital not using the same electronic health record (EHR) it has created a break in communication that has led to delays and cancellations in the CVL. The proposed solution is the creation of a pre-operative cardiac catheterization checklist that focuses on standardizing care,

allowing the staff to communicate effectively with the affiliated hospital to avert a delay and or cancellation.

The potential positive impact of a pre-operative cardiovascular checklist that decreases delays and cancellations in the CVL could equate to millions of dollars of savings over several years. The immediate impact would be patients undergoing their planned procedure at the appropriate time ultimately impacting and increasing patient satisfaction, increase in CVL staff and physician satisfaction by decreasing congestion in the holding area of the CVL, and lastly staff being able to care for the patient's efficiently without being caught up in other tasks that could have been dealt with at the sending facility (infection, worsening renal function, dye allergy etc.). The impact of the checklist meets the triple aim of the Institute of Medicine (IOM, 2015).

PICOT Question

Does implementing a pre-operative checklist for inpatient cardiac catheterization patients decrease the cases that are delayed or canceled by 25% compared to those that do not use a checklist over a five-month period?

Literature Synthesis

The review of literature focused on several key words/phrases: safety, communication, handoffs, medical errors, patient safety, safety culture, checklist, cardiac catheterization laboratory (CVL), near misses, information loss, length of stay, procedure delays, and procedure cancellations. Databases utilized included CINAHL, Cochrane library, Pub-Med, and Medline resulting in 115 articles and three books. Forty-nine articles, a current study in the recruitment phase, and three books were perceived to be relevant to the project. Articles included were random control trial's (RCT), quasi-experimental, prospective observational, retrospective cohort

studies, expert consensus, guidelines, quality improvement projects, literature review, reports, and an ethnography study. Studies evaluated originated from both the United States and other countries. The topics this review focused on include safety culture and potential for medical errors, communication, information loss, checklist implementation and patient outcomes. The articles used for this QI project were from 1993-2021. The older article (1993) was included to help explain the framework for this pilot QI project.

The Joint Commission 2022 safety goals include proper patient identification, prevention of infection, improvement in staff communication, identifying patient safety risks and preventing mistakes in surgery (The Joint Commission, 2022). Checklists developed have decreased error when used consistently and properly therefore addressing the National Safety goals set forth by government organizations like Joint Commission and Institute of Medicine (Gordon et, al, 2018; Hawranek et al., 2015; Huded et al., 2018). A specialized checklist is a tool, that when used properly and consistently has embedded safeguards to reduce injury and human error therefore providing consistent, patient centered care (Cahill et al., 2015).

Checklist

The healthcare checklist concept originated from The World Health Organization (WHO) along with the Harvard School of Public Health who developed a nineteen-item tool (checklist) which showed a reduction in morbidity and mortality in the operating room (Jain et al., 2018). The concept of a checklist was applied to other areas of the hospital and has been adopted by a wide range of clinical settings including the operating room, hospital discharges, and information provided during in-patient hospital transfers (AHRQ, 2019). Checklists are a way of standardizing the list of steps to be followed, and the expectation that each step will be followed for every patient, every time. In the consensus statement by the Society for Cardiovascular

Angiography and Interventions, specific standards were identified such as the importance of using a checklist in the operating room as best practice (Naidu et al., 2012). A term coined by Tinsley Anderson et al., (2017) was "checklist fidelity" defined as the purposeful completion of an item on the checklist requiring intra-team communication beyond just simple yes, no answers. It's a meaningful completion of the checklist rather than a simple adherence to the checklist.

Patient outcomes are improved not only by structural interventions, but interventions that promote health by altering the healthcare environment, and interventions that improve the healthcare delivery system including checklists and standardized care pathways (White et al., 2020). Utilizing the checklist increases communication with others in the operating room allowing the focus to be on patient related issues. A checklist in the cardiac catheterization laboratory creates standardized care, improves reliability of the process, and provides an expected standard for the entire team that results in improved patient outcomes and a decrease in errors (White et al., 2020).

Unfortunately, the problem with checklists is their inconsistent use in areas outside the operating room. Best practices for improving patient safety can be developed around establishing a culture of safety, implementing safety processes, and creating a systems-based approach to patient safety (Cahill et al., 2015). Throughout the review, reasons for not consistently following the checklist came from senior staff resistance, time constraints, and lack of education in understanding the importance of said checklist. The biggest benefit of a checklist is when the team believes it has a practical value and has potential to improve patient outcomes (Cahill et al., 2015). The concept of a checklist is not specific to the operating room but should be used in any surgical procedure. The checklist should have customized content and the team should be educated on its use. The successful performance of a checklist requires acceptance and adherence

to the checklist by creating a checklist that is customized to the specific procedure and providing appropriate training on the use of the checklist (Verwey & Gopalan, 2018).

Checklists that were developed for inpatient areas to prevent venous thromboembolism (VTE) and other medical errors/oversights found that checklists are only successful if the staff are educated on their use and policies are put into place that require their use, proving that checklists could be successful both in the OR and on the floors of the hospital (White et al., 2020; Beeler et al., 2014). Time constraints, not all team members being present to complete the checklist can lead to incomplete or no checklist at all. Without the proper members of the healthcare team present to complete the checklist the value of safety and the safety mechanisms put in place by the checklist to prevent errors are minimized (Beeler et al., 2012; Braham et al., 2014; Regueiro et al., 2012; White et al. 2020). Some studies did show a decrease in adverse events like a checklist developed for neuro-interventions, but the numbers did not prove statistical significance (Fargen et al., 2012). The concept of a checklist requires that those involved in caring for the patient are given the time and encouragement to accurately complete the checklist without any push back from fellow workers or providers.

Plan-Do-Study-Act over several cycles can help with the development of checklist by utilizing staff and provider feedback. The idea of employee buy-in and ownership helps increase the use of the checklist and Plan-Do-Study cycles are a tool to increase participation (Gordon et al., 2014 & Lindsay et al., 2018). Both of those studies focused on cardiac procedures although the results were not statically significant errors, patient incidents did decrease opening the door for further investigation into checklists dealing with patients undergoing cardiac procedures. Currently there is a study found on ClinicalTrials.gov in the recruiting phase in Barcelona, Spain (National Institute of Health [NIH], 2019). This study is looking at the development and

evaluation of the impact of a safety checklist adapted to interventional cardiology. This is the first clinical trial that identifies a checklist specifically designed for use in an interventional cardiac catheterization lab. The outcome of this study will potentially influence health care organizations in their own implementation of such a checklist. Small studies like the one in Australia with 35 patients used a checklist for patients undergoing a LHC showing an improvement in the transfer of patient information but did not address delays or cancellations related to use of a checklist (Nicholson et al., 2021). Appendix A contains the checklist developed by Nicholson et al., (2021) for patients undergoing a cardiac catheterization that was used as a stepping off point when developing the layout of the checklist used in this project.

Safety Culture and Potential for Medical Errors

Safety culture can be defined as the way safety is perceived and valued in a healthcare facility. The Institute of Medicine (IOM) has stressed the importance of promoting a culture of safety to prevent error and increase patient safety ultimately improving patient and staff satisfaction (Institute of Medicine, 1999). A prospective observational study by White et al. (2020) described a multifaceted implementation strategy for successful use of a checklist that includes education, acceptability, and behavior changes. Rossiter et al., (2020 and Ziman et al., (2018) concluded that a checklist creates a culture of safety, addressing the staff's fear of punitive action when reporting near misses or errors. The checklist allows staff to speak up regarding patient safety in a non-threatening environment without the fear of retaliation.

Healthcare leadership must vacate the culture that demeans, and disrespects staff that voice concerns regarding safety and quality and shift toward a culture of safety. The Joint Commission laid out groundwork to improve the culture of safety by instituting programs that hold all healthcare providers, regardless of seniority or profession, accountable to protocols and

safety measures that result in a culture of safety therefore minimizing the organizations vulnerability to multiple risks and increasing patient safety (Liang et al., 2019). Protocols like those instituted in an emergency department (ED) to care for STEMI patients streamlined care resulting in decrease in door to balloon time thereby decreasing thirty-day mortality (Huded et al., 2018). The protocol provided patients with the guideline driven treatment (GDMT) regardless of physician's thoughts or preconceived ideas therefore decreasing the potential for error (patient not receiving ASA, or other antiplatelet medication), or the CVL not being called out (miscommunication) resulting in less hospital events.

Communication and Information Loss

The "time-out "concept was developed and mandated for any procedure by Joint Commission to prevent wrong patient, wrong procedure/surgery by increasing meaningful communication. Joint Commission defines a "time out" as an immediate pause by the entire team to confirm the correct patient, procedure, and site. Building on the time-out concept is the development of checklists to increase communication and decrease information loss. Checklists have been used by pediatric cardiologists in the perioperative setting that address both the time portion but also address things like allergies, recent vital signs that require the staff to be actively involved creating a team atmosphere. Studies like that of Gordon et al., (2014) found that the staff felt communication and morale improved with the usage of a checklist. When communication is part of the checklist it creates a sense of participation and investment with the staff involved, this in turn increases performance (Gawande, 2010). Information loss happens at every level in a healthcare organization and the failure to remedy that loss can ultimately result in patient harm. Handoffs, such as the SBAR (Situation, Background, Assessment, and Recommendation), along with checklists have been developed to improve communication and

decrease information loss, thereby decreasing errors and improving patient safety. Information loss can occur with patient transfers from one department to another, pertinent information that was not communicated with the accepting department that could lead to delays in treatment or adverse patient events (Cahill et al., 2015).

A randomized control trial (RCT) by Downey et al., (2013) found that by implementing a formal bedside handoff process between emergency room physicians, it provided an additional opportunity to exchange information, clarify test results, and review plans of care therefore decreasing potential for errors and increasing patient satisfaction due to their direct involvement and understanding of their care. Best practice guidelines developed by Im & Aaronson (2020) proposed a conceptual framework that describes three major domains for improving safety in the ED. The three domains are: cultivating a safety culture, implementing processes to improve patient safety, and creating a systems-based approach. Cultivating a safety culture relies on leadership support, staff buy in, education, training in teamwork, and communication techniques. Standardizing the handoff format increased communication and decreased errors again showing increase in staff and patient satisfaction (Im & Aaronson, 2020). Educating the staff on the use and purpose of the checklist results in increased use therefore leading to increased communication, organization, clinical judgment and decrease in information loss (Reyes et al., 2016). Although patient outcomes were not evaluated in the studies, it can be implied that patient outcomes improved based on prior studies and recommendations from the IOM and Joint Commission (Robins & Dai, 2015).

Checklist Implementation and Patient Outcomes

Checklists have been proven to decrease errors and improve patient outcomes. This information comes primarily from studies done in the operating room, but many researchers have

applied the checklist principal to other areas of the hospital to include ED, CVL, floor transfers, and bedside reporting (Nan et al., 2017). Even with evidence that checklists save lives, other areas of the hospital are slow to implement checklists. Some reasons include staff perceptions that it increases their workload, no buy-in from management, and no education in proper use and benefits of a checklist. Nan et al., (2017), in his meta model, coined the term "dynamic checklist" one that is not static (same for every patient), it is electronic and is described as a smart checklist, identifying individual characteristics or potential needs of a patient, and flagging them to enhance patient care and improve patient outcomes, all while decreasing errors. A dynamic checklist developed for a cardiac catheterization lab in China looked at the checklist items and flagged abnormalities of patients in red increasing communication between caregivers increasing quality and decreasing errors. Dynamic checklists have the function of managing health care processes by individualizing checklist items and extracting pertinent data from the electronic health record. Creating a dynamic checklist creates ease of integration into the workflow and will be viewed as a useful tool to enhance communication, not merely another task to be completed (Nan et al., 2017). A comprehensive ST elevation myocardial infarction protocol (CSP) developed by Kumar et al., (2020) specifically for patients experiencing a ST elevation myocardial infarction (STEMI) lead to the development of a protocol for outlying facilities to treat STEMI patients with guideline drive medical therapy in a timely fashion. The protocol led to decrease in door to balloon time therefore decreasing infarct size, incidences of cardiogenic shock (CS) and patient mortality (Huded et al., 2018) The focus was on improving STEMI care at the initial facility instead of focusing on diverting patient to tertiary care facility and not providing patients with timely treatment. Checklists can provide the healthcare team with a comprehensive, unbiased, guideline driven treatment plan that could be applied in many different

facilities for many different diagnoses. With improved outcomes, healthcare providers will see the worth in the checklist and this belief will increase adherence to using the checklist (Nicholson et al., 2021).

Best Practice

Clinical Expert Consensus statement on best practice in the CVL provided recommendations for information to include in the checklist and updated guidelines on treatment modalities for dye allergy and renal function (Naidu et al., 2012). These guidelines can be used to develop a checklist that standardizes the care for the patient, increases communication between the nurse and the physician potentially decreasing the delays, cancellations and therefore providing best outcomes.

A quality improvement project by Patel et al., (2015) utilized the format Plan-Do-Study-Act (PDSA). This project reinforced the need to educate staff to increase checklist compliance therefore increasing communication, decreasing errors, and improving patient outcomes. Using PDSA, the "plan" was establishing a checklist, the "do", to identify deficiencies and make changes, the "study" reviewing and modifying the checklist, and finally, the "act", to finalize and implement the modified checklist. Using checklists as a cognitive forcing strategy, an approach of debiasing providers to prevent diagnostic errors and streamline care (Regueiro et al., 2013). Given the high propensity of potential errors in the cardiac catheterization due to the nature of the procedure, a checklist should be a standard in all CVL's. Checklists ensure that processes are carried out as designed by standardizing care based on best practice to provide best outcomes. Utilizing a pre-procedural checklist in other areas of the hospital has shown to be statistically significant in decreasing adverse events (Hawranek et al., 2015).

Limitations in the Literature

The literature clearly supports the development and implementation of a checklist to improve outcomes and decrease errors. The literature reviewed dealt more with checklists that focused on the peri-operative/intra-operative period not the pre-operative period in the CVL. This limitation in the literature is the driving force behind this project, looking at a checklist used prior to patients entering the catheterization lab to prevent any delays or cancellations. Many of the studies lacked diversity: sex, ethnicity along with types of hospitals: rural versus urban. Another factor that needs to be considered when educating the staff on use of a checklist, is their experience as a nurse which was not discussed in any of the retrieved articles but could play a major role in understanding the importance of checklists in preventing errors, or omissions that result in delays and or cancellation in the CVL. Novice nurses especially from the sending facility with limited experience with patients undergoing LHC and limited understanding of the procedure could require extra education about the LHC procedure, risks, and potential complications.

Cost is important to consider when developing a project. Liang et al., (2019) tracked federal funding for patient safety research from 1995-2014 finding there has been a steady increase in patient safety research since the release of To Err is Human in 1999. Focus has narrowed from general assessment of preventable medical errors to specific conditions. With an increase in EMR's and the development of additional federal agencies the goal for patient safety is to reduce preventable deaths while being fiscally responsible (Liang et al., 2019). A cross sectional and longitudinal analysis by Childers and Maggard-Gibbons (2018) looked specifically at cost per minute in operating rooms in California calculating that 1 minute of OR time equaled $36-37.00 reiterating the need to keep scheduled procedures on track limiting delays and

cancellations not only for better patient outcomes but for fiscal responsibility. Ultimately, lack of communication and human mistakes result in medical errors and increase mortality, thereby increasing cost. Through developing a department specific checklist, educating the staff, and increasing staff by in, the consistent use of a pre-operative checklist should, in turn, decrease medical errors, increase positive patient outcomes, ensure fiscal responsibility, and decrease cases being delayed or canceled.

Concepts

The principal concepts in this QI pilot include safety, effectiveness, efficiency, quality, communication, and adult education. Nurses are positioned to improve the quality of healthcare through evidenced based patient interventions/strategies that increase patient safety, decrease errors and are fiscally responsible. AHRQ defines safety as the absence of harm, by creating a culture of safety and a system of delivery that includes nurses, patients, and organizations (AHRQ, 2019). The IOM has defined quality in healthcare in terms of standards, unfortunately quality indicators continue to focus on the 5D's (death, disease, disability, discomfort, and dissatisfaction) instead of focusing on positive elements of quality including achievement of self-care, health related quality of life, health promoting behaviors (IOM, 2015). Safety is the foundation upon which all aspects of quality care are formed. Adult learners want to see the effort they are putting forth producing new knowledge and contributing positively to their work environment. Adult learners want tasks that apply to the job at hand and learn things that assist them to excel at their job

Effectiveness can be applied to external validity; the ability of an intervention to have a meaningful effect on the patient's condition while efficiency focuses on interventions producing an intended result and done in an economic way (Palmer & Torgerson, 1999). Nursing being an

active participant in the change and seeing the positive results will result in checklist compliance. Effectiveness is doing the right things (interventions) to achieve the goal (effect). Efficiency and effectiveness when applied to the healthcare arena are used synonymously and have similar criteria. To have effective communication the message being conveyed must be clear and well defined and if not can lead to misinterpretation. Effective communication leads to clear understanding of the goals set forth in the QI pilot. Timeliness is the time between information obtained and the appropriate application of that information at the appropriate time. By delivering information in a timely manner, applying that information in a timely manner at the appropriate time to decrease complications/errors (Office of Disease Prevention and Health Promotion, 2020).

Framework

Knowles et al., (2012) coined the theory Andragogy-Adult Learning Theory, which is used synonymously with the term adult learning (Appendix A). The concepts of this theory along with the information processing theory (cognitivism) work collaboratively and apply to the QI project. The focus of this project is to decrease delays and cancellations. To accomplish that goal the staff at the sending facility must understand the causes of the delays/cancellations and how to execute the checklist to prevent them from happening. Understanding how to approach and teach the adult learner will assist me in focusing on how best to implement this checklist. Adult learning theories require that the content needs to be relevant and useful, it should connect to experience, and that the adult learner actively participates in learning (Knowles et al., 2012). Learning occurs through the internal processing of information, and teaching should be focused on implementing strategies that increase a person's learning (Ertmer & Newby, 1993). The checklist can be a tool that provides

high quality, efficient, seamless, safe care that aligns with the goals of the Institute of Medicine (IOM) (Institute of Medicine, 1999).

Information must transfer to the nurse in the most effective and efficient manner. The concepts from the adult learning theory provide a framework to accomplish those goals of this QI project as the checklist success depends on the registered nurses utilizing the checklist (Klug Redman, 2007). From the adult learning theory emerged five characteristics/assumptions of the adult learners: self-concept, adult learner experience, readiness to learn, orientation to learning and motivation to learn (Knowles et al., 2012). As a person matures, they transform from a dependent personality to a self-directed individual as defined by self-concept. The adult learning experience refers to the wealth of experiences that becomes a valuable tool in learning. Readiness to learn increases as the person age as they are seeking new knowledge about their role in society in this case their job. Adults focus on learning changes from procrastination to immediate application and from a certain subject of interest to problem solving as explained by orientation to learning(Van der Walt, 2019). As people age and mature, the motivation to learn changes from extrinsic to intrinsic; learning those things that assist them to excel at their job or improve their life (Van der Walt, 2019). Providing the staff with literature supporting the implementation of a checklist to increase communication, patient safety and overall staff satisfaction, and including them in the role out of the checklist will, according to the framework, help provide a smooth implementation.

The pilot QI project looks at a checklist that when properly utilized will decrease delays and cancellations of LHC's. My population is RN's which are adult learners that are of differing ages and experiences. Adult learners need to know that what they are asked to do is not just increasing their workload with another piece of paper but will have a positive impact on patient

care. The motivation comes from the perception that this learning (checklist) will be useful and assist them in performing a task or solving a problem with their patient, making the care more seamless and less chaotic. Orientation to learning according to Knowles is focused on immediate application of knowledge to solve a problem which aligns with the literature that adults are interested in learning subjects that have immediate relevance and impact to their job (Braham et al., 2014).

Aims and Objectives

One of the aims of this pilot QI project was to identify the reasons the LHC cases are being delayed or canceled including but not limited to, worsening renal function, untreated dye allergy or an inadequately treated infection to the staff's attention (Appendix B). Those previously listed reasons can be resolved by the application of a checklist and an increase in communication. Communication is fractured between the bedside nurses, the physicians, and with the receiving CVL staff. By acknowledging that the bedside nursing staff are the gatekeepers and have the information to create a smooth transition from the bedside to the catheterization laboratory, the checklist bridged the information gap from bedside to the CVL. Unfortunately, the community hospital sending the patients for a LHC does not use the same electronic medical record (EMR) that the receiving hospital utilizes, which created significant problems as the nurse in CVL cannot just look up lab work and recent events during the patient's hospitalization. Utilizing the checklist helped the CVL identify abnormal lab work, treatment, or lack of treatment for active infections, and abnormal labs or vital signs that could delay or cancel a patient's upcoming heart catheterization. Another issue is that the sending facility staff assume that the cardiologist has addressed all the issues prior to the patient leaving for the LHC. For example, the patient is put on the schedule on Friday for a LHC and may not have been seen on

Sunday by a cardiologist or the patient leaves early on Monday prior to being seen by cardiology. The pre-operative cardiac catheterization checklist is a tool that provides a road map for the nurses to follow and create a conversation with the receiving facility CVL staff that eliminates assumptions and deals strictly with facts.

Another aim is empowering the bedside nursing staff to have those important conversations with the cardiologists regarding changes in their patient that may prohibit the scheduled LHC, hopefully reinforcing the relevance of the checklist as a communication tool. For example, a patient with a dye allergy and there were no orders written to pre-medicate, or the need to hold oral anticoagulation (OAC). As the checklist becomes a part of the transfer process the staff will become more familiar with the issues causing delays and be more proactive with solutions. The nursing staff at the sending facility can't fix a problem they don't know exists, using the checklist educates them on what information is needed to create a seamless transfer to the receiving facility. The studies/QI projects in the literature did have some commonalities when dealing with checklists; there was an increase in staff satisfaction regarding safety and increased communication, allowing the staff to have important conversations with the cardiologist (Braham et al., 2014; Downey et al., 2013; Fargen et al., 2012).

Another gap occurs in the timing of the checklist. Many studies and QI projects in the CVL and other surgical areas focus on the actual procedure (intra-operative), this checklist focuses on pre-operative issues that could delay or cancel the procedure (Braham et al., 2014; Fargen et al., 2012; Gordon et al., 2014). The checklist was presented with information that may be new to the novice nurse and a refresher for the expert nurse that may have previously worked at a facility that did LHC's. With the initial introduction I obtained information regarding the staff's background from the managers of the four floors (ICU, ED, and telemetry). By

implementing the cardiac catheterization checklist, I provided information to the nursing staff that they find relevant, assist in problem solving and ultimately improve patient care. Meeting the aims of identifying reasons for delays and cancellations by utilizing the checklist to increase communication the objective of this Pilot QI project of decreasing delays and cancellations in the CVL by 25% which was not met.

Study Setting

The setting for this project was a 152-bed community hospital in Northeastern Ohio that is affiliated with a 550-bed tertiary care facility that provides cardiac care including cardiac catheterizations. The tertiary facility did over 1900 heart catheterizations in 2019. This community hospital is in an urban setting with a population of over 10,000 with a median income of $32,119 with 27.9% living in poverty, and 8.9% of those under 65 years old are uninsured (United States Census Bureau, 2020).

Sample

A convenience sample of registered nurses (RN) on four floors of the community hospital including intensive care (ICU), emergency department (ED), and the two telemetry floors that are sending patients for a scheduled LHC were subjects for this QI project. The nurses who participated are those RN's sending a patient for a heart catheterization to Youngstown, Ohio. The sample is random and given the time of the transfer, the RN's utilizing the checklist will be from the daylight shift.

Methods

According to Winters et al., (2009) there are four different types of checklists, and this checklist falls under a static parallel checklist which is defined as a checklist that is completed by one operator (the staff RN at the sending hospital) and executed as a series of read and do tasks.

For successful implementation of the checklist, acceptance and compliance are crucial (Thomassen et al., 2011). The development of the pre-operative cardiac catheterization checklist started after an email was sent by the manager of the CVL to the cardiologist's and APRNs in cardiology regarding the increase in preventable delays and cancellations of heart catheterizations that were increasing the already overburdened, understaffed CVL. After identifying the problem, the key stakeholders identified included the CVL manager, CVL charge RN's, managers of the floors at ELCH sending patients to CVL, CNO at ELCH, five interventional cardiologists and the six general cardiologists who provide cardiology services to ELCH and are the one's sending the patients for a heart catheterization. A preliminary needs assessment was completed by reviewing 12 months of transfers from ELCH in 2020 working with the manager of CVL identifying the causes of the delays and cancellations. The chart review was done by hand taking over 100 hours to complete, requiring review of paper CVL schedules, and reviewing the EPIC chart to identify the reason for the delay or cancellation. Some of the reasons included untreated dye allergy, kidney function worsening, infection, respiratory failure, Hgb <8.0, and pregnancy test not done. The information obtained from the chart review provided the rationale for the items that would be included in the checklist development.

After compiling the reasons for the twenty-five (27.78%) delayed or cancelled cardiac catheterizations out of ninety (Appendix B), the information was emailed to the CVL manager, the five interventionalists, and the six general cardiologists for review. The follow-up to the email included individual discussions with each of the five interventional cardiologists, six general cardiologists, and the CVL manager regarding the idea for a pre-operative cardiac catheterization checklist, and the concept of a pre-operative cardiac catheterization checklist was

accepted with no hesitation. The next step was talking with the CVL charge staff about the barriers/concerns they experience when receiving patients from ELCH, and those barriers/concerns voiced by the RN's mimicked many of the issues found during the chart review. The CVL charge staff felt that the communication was fragmented between the sending and receiving hospitals leading to patients being sent with little or no report, and difficulty obtaining the necessary patient information required to identify issues that may delay or cancel the heart catheterization until after the patient arrived. Although the CVL charge staff was receptive to the idea they did voice concerns about how much more work this would add to their daily responsibilities. A discussion with the cardiologists, CVL manager and CVL charge staff that the use of a checklist could standardize the process and ensure all elements are addressed therefore decreasing variability and improving performance (Winters et al., 2009). The initial literature review provided many articles regarding checklist use in operating rooms and during handoffs to floors, but very little literature regarding a pre-operative checklist specific to a cardiac catheterization procedure. A pre-operative cardiac catheterization checklist at a nearby facility was obtained and that checklist was used as a jumping off point along with the information obtained from the chart review, the interventional cardiologists, and the CVL staff. I contacted multiple healthcare facilities in a 100-mile radius only one was using a pre-operative cardiac catheterization checklist, mentioned above. An updated literature search in 2021 revealed a pre-operative cardiac checklist (Appendix C) by Nicholson et al., (2021), that was used to help further develop the first draft of the checklist. After putting together, the first draft of the checklist it was sent to the cardiologists via email for review with the instructions to respond with any concerns or ideas to improve the checklist within a one-month time frame. A reminder email was sent two weeks after the first email due to a lack of responses from the

cardiologists. After week three of no responses, meetings were scheduled with each one of them over the next two months addressing any concerns regarding the content of the checklist. After a total of three months the checklist (Appendix D) was approved by the cardiologist's, the CVL charge staff and the CVL manager. A copy of the checklist was provided to the CNO and managers at ELCH via email and followed up with a phone call one week later to address any concerns they may have with the checklist. No concerns regarding the checklist were verbalized but they did want to talk about the process/logistics once the checklist was completed by their staff. A meeting was scheduled with the CVL manager, the CVL charge RN's, the lead interventional cardiologist, the lead cardiologist at ELCH, the CNO at ELCH, and the mangers at ELCH that focused on a step by step guide on the timing of the checklist, how it will be sent, who is in charge of reviewing the checklist once it arrives in CVL, and if there are any identified concerns that could lead to a delay or cancellation the process the CVL charge RN's will follow.

After compiling all the input from the above stakeholder's, an email was sent to the CNO and managers at ELCH laying out the steps of how the CVL staff wanted the information relayed and the timeline to relay the information. It was decided that to make sure the CVL staff had ample time to review the checklist the patient's being sent from ELCH would not be scheduled before 1000, allowing time for the RN to complete the checklist and send it one hour prior to the patient being picked up. The rationale for this time was the CVL staff arrive at 0630, and the patient arrives in CVL two hours before the scheduled heart catheterization, and the transportation time to the receiving hospital is around 45 minutes. Any patient scheduled earlier, the CVL staff would not have time to review the checklist to identify any concerns with the interventionalist prior to the patient being enroute to CVL. The ELCH RN's have access to a fax machine and faxed the checklist using a cover page to identify the sending RN's name and

contact number. Once the fax is sent, the sending RN followed-up with a phone call to CVL to make sure the checklist has arrived. Once the checklist has arrived, the charge RN reviewed it, and if any concerns were identified they were brought to the interventionalist assigned to that patient. If the heart catheterization needs to be delayed/cancelled the CVL charge RN cancelled or adjusted the transport time with the ambulance company and notified the sending cardiologist, why the catheterization is being delayed/cancelled and those issue(s) were addressed to allow for the LHC to happen later that day or be rescheduled. If the LHC could be scheduled for later that day the sending cardiologist notified the CVL charge RN of what adjustments/treatments were done. The CVL charge RN notified the sending RN about the adjustment in scheduling, transportation or need to cancel the procedure. It was the responsibility of the sending RN to notify the patient, and any family members about the delay or cancellation.

The plan was to review the checklist along with the process outlined above with the RN's at ELCH at their monthly staff meeting, but administration preferred to roll out the process without my input to the staff. The issues identified during the initial chart review was reviewed with the CNO, floor managers, the lead cardiologist, and the medical director at the sending hospital. At ELCH administration's request I was unable to share those findings with the staff at the sending facility, and the rationale for why these issues lead to delays and cancellations. The leadership at ELCH decided the mangers at ELCH were solely responsible for introducing the checklist to their RN's. A tip sheet that included contact information for the CVL staff was provided to the staff, managers, and CNO at ELCH, and was posted at the nurse's station to help reinforce the process. Each floor at ELCH was given 15 copies of the checklist that was placed in a purple-colored folder on each floor in a designated spot to be determined by the manager.

Once the checklist was reviewed by the CVL charge RN and is no longer needed it was collected and stored in CVL holding area and was reviewed weekly for the five-month duration of this pilot QI project. Reviewing the checklists in the folder weekly allowed for issues regarding completeness of the form, to be addressed in a timely manner. Any issues with the completeness of the checklist from the sending facility were addressed with the CNO at ELCH via email. Monthly emails were sent to the CNO at ELCH to check in and address any concerns or issues they experienced with the checklist or the process. Unfortunately, no responses were obtained from the email's sent to the CNO. The CVL manager, CVL charge RNs, and the CNO at ELCH were provided my contact information including email and phone number if any concerns arise.

The checklists were placed into a database (Appendix E) that included, sex, age, date, if they were admitted after the procedure or discharged, the sending floor, and the reason any patient even after the checklist was completed, was delayed, or cancelled after arriving at the receiving facility.

Design

The PICOT question looked at testing the effect of an intervention (the checklist) on a patient's outcome (delays/cancellations in the CVL). The QI project looked at compliance rates with the checklist. Comparison of pre-checklist and post-checklist percentages of the delays and cancellations of patients sent for a scheduled LHC. It was anticipated there would be a 25% decrease in delays and cancellations of patients being sent from the community hospital for non-emergent LHC's. A pilot QI project, utilizing a checklist which is known to have a positive impact on health outcomes including reducing complications, mortality, and patient injuries (Winters et al., 2009). The challenge was to rapidly understand which new ideas work, under

what circumstances and then use that information to disseminate the successful approach to the complex ever changing healthcare arena (Hussey et al., 2013). To determine if the checklist captures the items that could delay or cancel a heart catheterization the Plan-Do-Study-Act (PDSA) cycle was utilized. The PDSA is an effective tool to test and learn about changes on a small scale (Melnyk & Fineout-Overholt, 2019). The PDSA cycle is a trial learning strategy in which solutions for improvement are made and repeatedly tested (Armstrong & Sables-Baus, 2020).

Data Collection Tools/Analysis

The pre and post checklist cancellations and delays are described as percentages on a chart (Appendix F). Reporting of the descriptive/demographics are reported as numbers/percentages for categorical variables, and continuous variables reported as a mean. Descriptive/demographics were obtained from the checklist. Comparison of telemetry nurses, ED, and ICU nurses' compliance with the checklist presented in percentages.

Data Analysis/Results

The mean age was 62 for the pre-checklist group and 64 for the post checklist group. There were 58.82% female in pre-checklist group and only 37.50% in post-checklist group.

Figure 1 shows the location of the patient's undergoing a LHC (pre and post checklist), most of the patients came from the 5th floor 50% and 52.94% respectively.

Figure 1

Patient Location

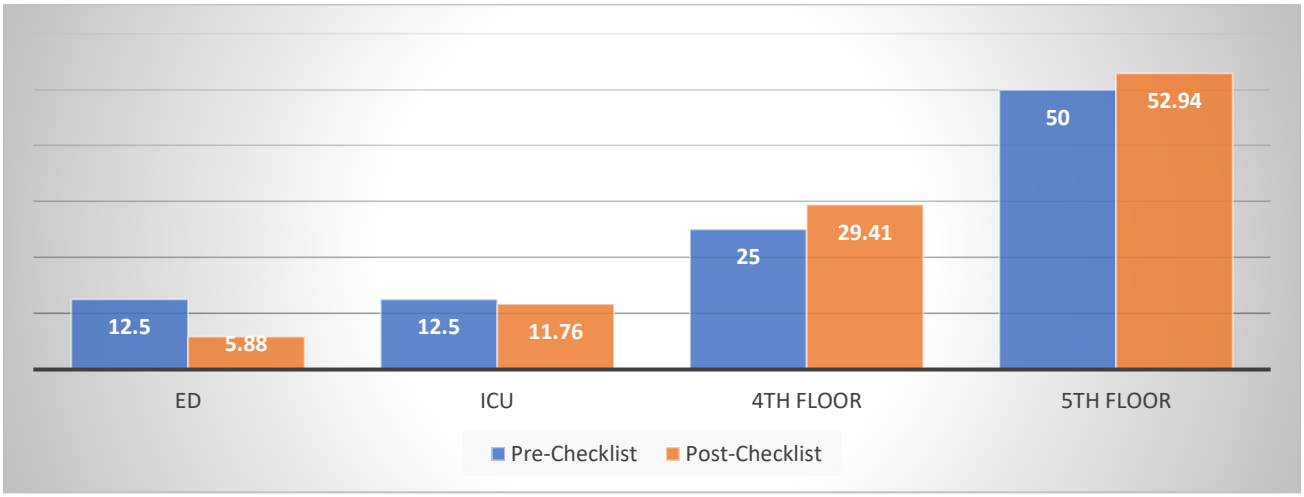


Figure 2 compares admissions in pre, and post checklist groups 79.17% compared with 58.82%. Discharges pre, and post checklist groups 20.83% compared with 41.17%.

Figure 2

Admissions and Discharges

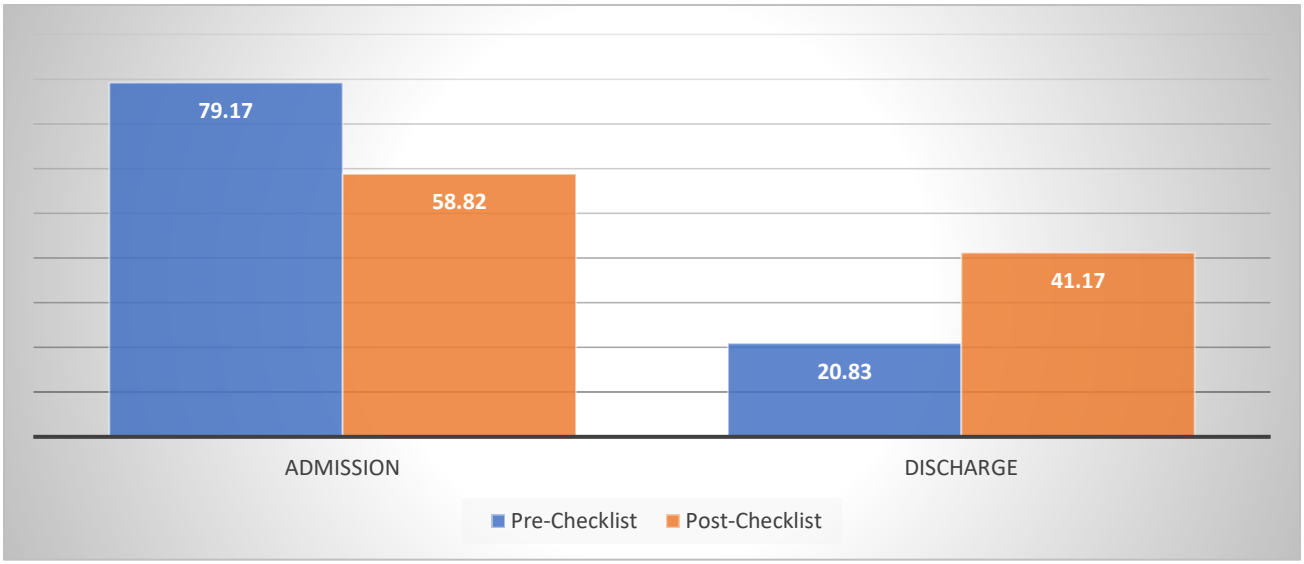
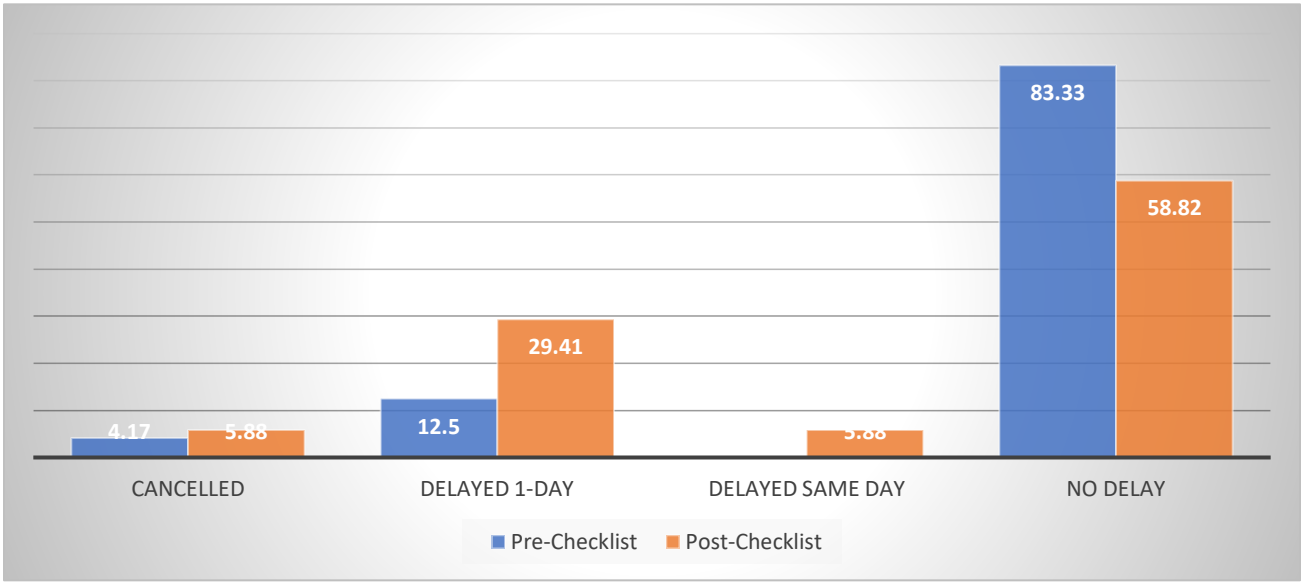


Figure 3 illustrates in the five months pre-checklist there were 24 patients transported to SEHC for scheduled LHC's of those 12.5% were delayed, 4.17% were cancelled, but all were transported to the receiving facility requiring additional care, admission, and treatment prior to re-scheduling the LHC.

Figure 3

Delays and Cancellations



The average cost on a one-day admission ($3226.00) along with the transportation costs ($1277.00) on average costs the facility $4503.00 for just a one-day delay. The total cost to the facility was over $18,012.00, since one patient stayed more than one day extra after transport due to his complex medical problems. Three of those delays were scheduled next day and all underwent stent placement and were discharged one day post procedure. The fourth patient was cancelled due to acute kidney injury (AKI), they remained in the hospital for several days and then was re-scheduled as an outpatient for a LHC. The cancelled LHC required not only several days of hospitalization at the receiving facility but required specialties like nephrology to

manage the patients AKI. That $18,012.00 does not include the cost of the time spent to re-adjust the schedule, also the need to consider the non-productive time of the staff and providers that could be used to care for another patient. Of the 24 patient's pre-checklist that underwent a LHC 16.67% or 4 patients were delayed or cancelled.

Looking at the data from five months post-checklist there were seventeen patients that underwent a scheduled LHC, 41.17% or 7 patients were delayed or cancelled post checklist implementation, resulting in a 24.50% increase in delays and cancellations. One patient was cancelled due to AKI, and an elevated INR and was re-scheduled as an outpatient. One patient was delayed but done same day requiring dye allergy prophylaxis and underwent stenting and was discharged next day. Another dye allergy was delayed one day, underwent LHC the next day and did not require any intervention and was discharged the same day to home. Four of the patients were delayed by one day due to staffing issues due to an increase in emergent unscheduled LHC those days. If you remove the 4 patients that were delayed due to staffing the percentage drops to 17.66% still above the pre-checklist numbers. Of the six delays only two did not have the checklist faxed to CVL, but the staff had called the floor to get a report that allowed them to cancel the transport, have the patient treated and re-scheduled. The cost savings to the facility for those six patients not being transported and bedded for an additional one day equates to $27,018. If you add the possibility that the cancelled LHC that had AKI, and elevated INR could have required a multiple day stay at the receiving facility that dollar amount could easily exceed $40,000.

Figure 4 looks at checklist non-compliance in relation to floors sending 52.94% (nine patients) came from the 5th floor.

Figure 4

Checklist Non-Compliance

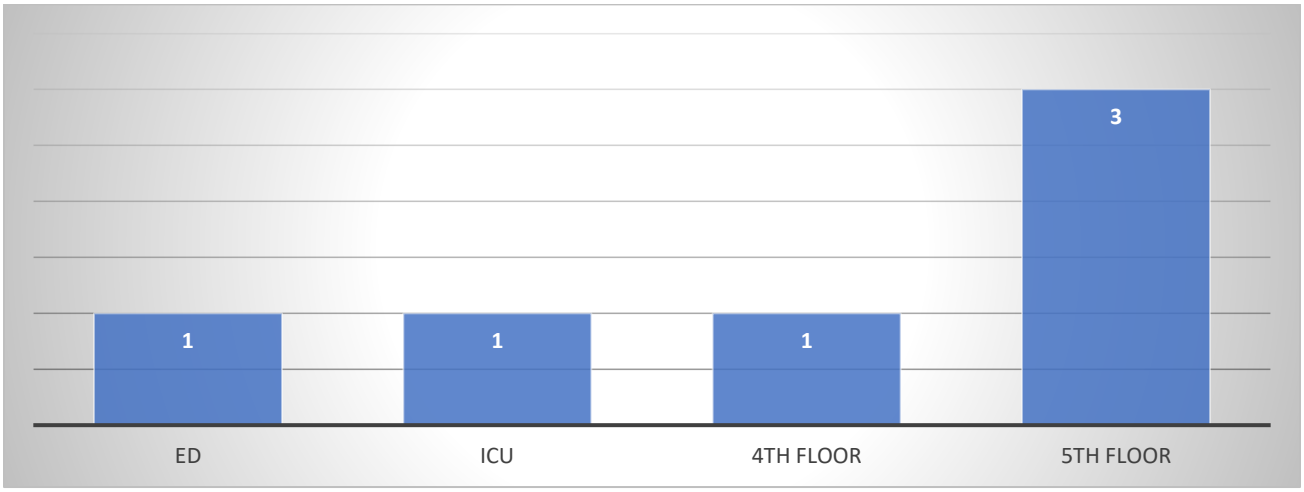


Figure 5 focuses on checklist completion, of the six patients two did not have a checklist faxed to CVL, one patient required no intervention and was sent home same day, the other was a dye allergy that was treated same day, and the patient underwent stenting and was discharged the next day.

Figure 5

Checklist Compliance

Cost/Benefit Analysis

Looking at the data after checklist implementation none of the 7 patients that were delayed or cancelled were transported to the receiving facility thereby allowing the patient to continue to be treated at the facility that knows the patient. Although the cost of the transport is absorbed by the receiving facility and not passed on to the patient, sending a patient that may be cancelled and rescheduled as an outpatient creates a cost to the receiving facility. The average cost of an ACLS ground transport is $1277.00 (Henderson, 2022). If a patient is admitted due to a delay the average cost per inpatient day is $3226.00 (Kaiser Family Foundation [KFF], 2022). The checklist prevented the unnecessary cost of transportation, bedding the patient, and increase workload of CVL staff carrying for a patient in the holding area until a bed was found at the receiving facility. The average total cost for a one-day delay including the transportation is $4503.00. The cost benefit analysis clearly shows the cost savings this checklist could potentially have over the next five years based on the five-month QI project could save tens of thousands of dollars.

The time spent developing and rolling out the QI project did not require any additional formal meetings but did require regular communication with the head general cardiologist at ELCH and to the interventional cardiologists when a concern or question arose during the implementation phase. The issues that arose during the implementation were due to the timing of the checklist being faxed and the cardiologists needing to make sure they are encouraging the staff to fill out the checklist and communicate any concerns to them, so the LHC is not delayed or cancelled. Those questions or concerns were addressed by a simple text or phone call to the concerned party/parties. An email was sent monthly to the CNO at ELCH to keep her informed of how the project was going and if there were any issues. Unfortunately, I received no responses

to the email communication that was sent. Issues regarding not sending the checklist were addressed by the CVL charge RN with the staff at the sending facility. The only issue that the CVL charge RN's verbalized was the timing of when the checklist was sent. Some of those issues included it not being faxed instead it was sent with the patient. When the checklist was not sent prior to transport the charge CVL RN made sure they spoke with the sending RN asking the questions on the checklist to make sure the patient could be done on the scheduled day, preventing an unnecessary transport and admission to the receiving facility. No time was provided by administration at the sending facility to re-educate or discuss the barriers to completing the checklist with the staff.

Ethics

An email was sent to the IRB regarding the QI project. A letter was received 1/9/2022 stating this pilot QI project is exempt from IRB oversight (Appendix G). The Kent State IRB exception form was completed prior to the initiation of the pilot QI project.

Budget Justification/Resources Needed

Materials and supplies including paper, ink, computers, and printing was provided at the tertiary facility where I am employed. There were approximately 100 hours spent reviewing CVL records from the previous twelve months (100 x 55.00 = $5500). The manager at the receiving hospital will allow time for me to discuss the project with the CVL staff at their scheduled staff meetings allocating 2 hours/$110.00. Approximately 4 hours was spent speaking with CVL charge RNs about checklist and any concerns or adjustments regarding checklist equaling $220.00. Approximately 10 hours/$550.00 was spent communicating with cardiologists regarding checklist development and how the plan to initiate the checklist at community hospital. With only the CNO/managers speaking with the sending RN staff $660.00 budgeted for the staff

meetings and remedial meetings was not needed. Approximately 20 hours/$1100.00 was spent gathering the data post checklist, meeting with statistician, analyzing the results to be presented in this paper.

Figure 6

Cost Benefit Analysis

Cost Benefit Analysis							
PRE- OPERATIVE CHECKLIST							
	Initial Costs	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*TOTAL*
CHART REVIEW - 100 hours @ $55/hr.	$ 5,500						
CARDIOLOGIST MEETINGS - 10 hours @ $55/hr.	$ 550						
CVL STAFF MEETINGS - 2 hours @ $55/hr.	$ 110						
CVL CHARGE MEETINGS - 4 hours @ $55/hr.	$ 220						
MEETNGS WITH OTHER STAKEHOLDERS 8 hours @ $55/hr.	$ 440						
REVIEW POST CHECKLIST DATA & MEETING WITH STATISTICIAN - 20 hours @ $55/hr.	$ 1,100						
COSTS		**$ 7,920**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 7,920**
CANCELLED (TRANSPORT & HOSPITALIZATION)	$ 4,503	$ 10,807	$ 10,807	$ 10,807	$ 10,807	$ 10,807	$ 54,036
DELAYED (HOSPITALIZATION ONLY)	$ 1,227	$ 14,724	$ 14,724	$ 14,724	$ 14,724	$ 14,724	$ 73,620
DELAYED DONE SAME DAY (HOSPITALIZATION ONLY)	$ 1,227	$ 2,945	$ 2,945	$ 2,945	$ 2,945	$ 2,945	$ 14,724
TOTAL BENEFITS *		**$ 28,476**	**$ 28,476**	**$ 28,476**	**$ 28,476**	**$ 28,476**	**$ 142,380**
TOTAL COST SAVINGS		**$ 20,556**	**$ 28,476**	**$ 28,476**	**$ 28,476**	**$ 28,476**	**$ 134,460**
**data based on 7 patients over five month period = average per event over five year period*							
Cancelled or Delayed;	Frequency	Benefits	Cost				
Cancelled	2.4	134,460	7,920				
Delayed one day	12						
Delayed done same day	2.4						
Yearly Average	16.8						

Relationship of Results to Framework, Aims and Objectives

The aim of this QI project to decrease the delays and cancellations by 25% was not met in fact there was an increase in delays and cancellations. There was cost savings to the receiving facility as previously discussed. The reasons for delays and cancellations were identified during the development of the checklist. Those reasons were then included in the checklist. The checklist has increased communication between the sending RN and the CVL staff including the interventionalists. The checklist has also increased the communication between the sending RN and sending cardiologist, resulting in no unnecessary transfers. The staff at the sending facility now see a consistent plan when caring for patients being sent for a scheduled LHC. A process has been created where there was not one before. They now know who they can contact with questions or concerns and are aware that those issues on the checklist can result in the patient being delayed/cancelled. Prior to the checklist the sending RNs had no idea that some of the patient's they sent for a LHC were being delayed or cancelled due to things that are preventable. Now with the checklist the sending RN is aware of the issues, those on the checklist that could delay or even cancel the LHC. After speaking with the sending cardiologists at ELCH they have verbalized multiple times throughout the five months of the program that they have been contacted by the sending RN regarding issues that may delay or cancel the patient's LHC. When those concerns are voiced, it provides the sending cardiologist the opportunity to address those issues to provide a seamless transfer to the receiving facility. By the receiving facility consistently requesting the checklist and communicating with the sending RN prior to transporting the patient, unnecessary transfers have been delayed until the issues were addressed/resolved. The result translates to cost savings to the receiving facility by transporting the patient when the patient has been medically optimized. Family and patient have a positive

experience when the LHC is done as scheduled and not delayed or cancelled that creates a hardship on the family due to issues like work and transportation scheduling to allow them to be with their family member during the LHC.

Impact of Results on Practice

The results imply that further investigation regarding the use of the checklist and its effect on delays and cancellations should be pursued. The effects of the checklist; increasing communication, educating staff, bridging gaps in information are all positive but require continued use of the checklist along with frequent updates and adjustments as necessary to continue to provide the most updated, comprehensive care. The checklist developed for this pilot QI project is not a finished project but a template that can be adjusted based on new guidelines, and research. The idea of having a tool to help facilitate the transfer of a patient safely and efficiently cannot be completely quantified. The impact of the checklist includes increased safety, patient satisfaction, collaboration resulting in the patient undergoing a LHC at the right time under the most optimal conditions.

Strengths and Limitations of Project

The limitations include lack of interest and collaboration from the sending hospital's administration. There are many thoughts to why the collaboration was limited but the one that I think is front and center includes the fact that the sending organization like some many other small community hospitals with limited resources may not see the value in evidenced based care and the projects that allow that research to be passed along to the patient. That type of involvement in evidenced based care requires a commitment of not only time but money and many organizations are not willing or unable to allocate those resources. The cardiology groups prior to this organization may not have invested any time or resources into the facility. Another

hurdle is the fact that some many different organizations have provided cardiology care before my organization, and it can frustrate the staff to constantly keep up with the changes and demands that the new organization requires from the staff. The idea that some other organization has come in and changed the way things are being done could be frustrating to staff and administration. That frustration from the staff and administration could be one thing that was holding them back from investing more time and effort into this project.

On a positive note, the checklist created an environment of collaboration with the RN staff at the sending and receiving hospital, it also was a catalyst for the RN's at ELCH to engage with the cardiologists. Those types of conversations can lead to an increase in exchange of information and the development of trust that may not have been present if it was not for the interaction made possible by the checklist. A few of the cardiologists have approached me stating that the checklist has brought issues to their attention via the staff's increase in communication about what they see filling out the checklist. Increasing the exchange of patient information from the bedside nurse to the cardiologist and or the receiving CVL staff can only benefit the patient and improve patient outcomes including patient and staff satisfaction.

Dissemination Plan

The findings were discussed and relayed to the CVL manager, and to the CVL staff (via a staff meeting). The cardiologists received an email detailing the findings, requesting feedback for any action that could be taken to improve the outcomes moving forward. Dissemination of new evidenced based knowledge is part of my DNP role. My dissemination plan includes submitting in 2023 to the annual OAAPN conference for a poster presentation. The audience is very diverse including many different NP specialties. Even if they are not cardiology NP's other specialties can see the importance of the checklist in this situation and possibly create a checklist that could

help bridge a gap in communication or education in another specialty. The exchange of information during the conference may provide me with additional feedback that could improve my process with the checklist. I am also considering a poster presentation at my facility during their yearly research day in 2023, historically it has been mostly residents presenting but I would consider sharing my findings of my QI project with others in my organization other than just cardiology and the CVL staff.

Another way of disseminating the findings includes a submission to the Journal of Cardiovascular Nursing (JCN), the impact factor in 2021 was 1.90 (1.0 is average, a 3 or more is considered good). The impact factor is a measure of citation frequency and continue to be the standard about how nurses should be informed (Polit & Northam, 2011). JCN publishes information that is practical for day-to-day use in the clinical setting. One of the regular columns in each publication includes Progress in Prevention, and Outcomes Research, which I feel fits into the use of a checklist in the CVL to prevent delays and cancellations. The JCN provides up to date information that is practical for advanced practice providers in their daily care of patients. Specific interests for JCN include the development of clinical practice and the changing patterns of inter-professional workings. The development and initiation of a checklist like the one developed for this project do change clinical practice based on evidence-based data. Looking at the concept of a checklist that could increase communication, decrease errors, and result in increased fiscal responsibility is a subject that would meet the goals of this journal.

Another journal to consider is the Journal of Clinical Nursing (JCN) that promotes the development and exchange of knowledge that is relevant to all areas of nursing. Some of the topics include the nature of nursing need, intervention, social interaction, and models of service delivery, along with application and dissemination of clinical knowledge and theory. The

application of a checklist in the CVL applies those ideas of current research applied to a certain area of healthcare and how that application can improve patient care, safety, and be fiscally responsible. The impact factor of this journal in 2021 was 4.423 which is considered good, with the impact factor steadily increasing over the last 8 years.

Future Implications

The results of this pilot QI project are not robust but are a jumping off point to continue the use of the checklist and continue to compare data pre- and post-checklist. The checklist has been a staff satisfier for the CVL staff and interventional cardiologists. They have voiced how much time it has saved them not having to call and recall getting labs, medications, and other vital pieces of patient information that effect's when and how they proceed with the LHC. The communication has increased with the RNs from the sending facility with the CVL staff. The CVL charge staff speak to the sending RN on each patient being transported and the questions (those on the checklist) are looked at and if further explanation is needed a conversation is initiated by CVL charge RN with the sending RN. The interventionalists stated on more than one occasion to me, that they have a better idea of what issues may be of concern regarding the patient coming for the LHC like renal function, allergies, vital signs, and recent medications administered. Looking forward the checklist can then be applied to our other facilities that utilize the same EMR EPIC. The checklist can be built into the system so the RNs and providers are aware of what could possibly delay or cancel a heart catheterization and address those issues as they arise, real time. The ongoing consistent use of the checklist with ELCH will continue to keep the lines of communication open and increase communication between the RN and the cardiologists at the sending facility resulting in best practice and ultimately providing the patient

with safe, and timely care. Hopefully in the future there can be more involvement and collaboration with the sending facility.

Conclusion

The goal of this QI Pilot Project is to decrease delays and cancellations but to also increase communication between facilities. The checklist did not decrease delays and cancellations by 25% but it did show cost savings for the facility factoring in that the transportation and unnecessary admission was delayed until the patient was ready to undergo the LHC safety. Allowing staff to have a point of contact with the receiving facility bridged a gap in communication that over the last several years has led to delays in cancellation for patients awaiting a scheduled heart catheterization. Although I did not formally study the staff and if they felt empowered, I can say that the CVL staff feel more in control about what type of patient will be transferring to their CVL and how best to care for them because of the checklist after talking with them during the project and at the project completion. The development and use of the checklist has decreased frustration by the CVL staff regarding fragmented care of patients scheduled to undergo a heart catheterization creating a seamless, consistent, safe way of treating that population of patients. The families that are the caretakers and support system for those patients undergoing a LHC were also saved undue stress, and money by not having the patient transferred until they were able to undergo the LHC safely. The goal of all providers is to provide safe, efficient, cost-effective care to the patients we serve, but also being mindful of the patient's family/caregivers. Even without decreasing delays and cancellations by 25%, with the initiation of the checklist, this project has saved money, improved communication with both the sending and receiving facilities, and kept patients at the facility with the providers that are familiar with the patient until such time as the LHC can be done safely to minimize

complications. The ongoing use of the checklist will allow for additional data to be examined, allowing for future adjustments hopefully resulting in a reduction in delays and cancellations from the sending facility. I had said before you do better when you know better, and I think this checklist allows the staff to delivery better care to their patients and both the receiving and sending facilities.

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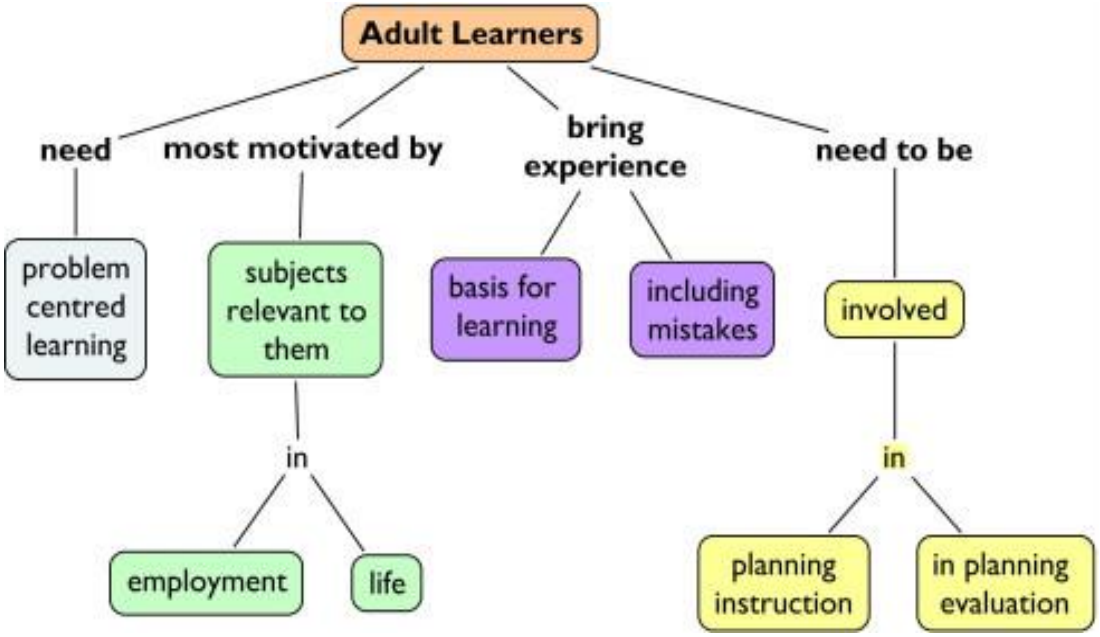
Appendix A



Appendix B

CVL Cancellations and Delays
Total LHC in 2020 from ELCH= 90

Dye Allergy Not Treated	5
OAC Not Held	3
AKI	4
Pregnancy Test Not Done	5
Febrile/Positive Blood Cultures	1
Hgb<8.0	4
CHF/Respiratory Issues	1
Code Status	1
Refused	1
TOTAL Delayed/Cancelled	25
Percentage Delayed/Cancelled	27.7%

Appendix C

Healthscope

CATH LAB CHECKLIST TRIAL

Attach patient identification label

Patient Details

UR Number: .....

Surname: .....

Name: .....

Date of Birth: ..... Gender: .....

Dr: .....

Date:	Procedure:			
Relevant past history discussed ☐ Yes ☐ No Refer Medical Record				
	Ward Nurse		**Cath Lab**	
Correct patient name: DOB: UR no: 1 band in place (1 limb - non-op site)	☐ Correct ☐ Yes		☐ Correct ☐ Yes	
Alert / Allergy present	☐ Yes	☐ No	☐ Yes	☐ No
Consent form complete	☐ Yes	☐ No	☐ Yes	☐ No
Fasting from food / fluids	Food time:	Fluid time:	Last Void:	
Presence of pacemaker / prosthesis / ICD	☐ Yes Brand of Device:	☐ No	☐ Yes Brand of Device:	☐ No
Hb _____ *Notify* Dr if Hb <100	K+_____ *Notify* Dr if K+ <3mmol/L or >5.5mmol/L			
Creatinine_____ *Notify* Dr >200umol/L	Platelets _____ If on Warfarin: INR	Date: _____		
Aspirin in last 12 hours ☐ Yes ☐ No	Anti platelet ☐ Yes ☐ No	Drug _____		
Antibiotics: Given: ☐ Yes ☐ No ☐ N/A	Enoxaparin: ☐ Yes ☐ No	If yes, last dose Date: _____	Time: _____	
Anti coagulation ceased ☐ Yes ☐ No ☐ N/A	Drug: _____	Last dose: Date_____	Time:_____	
IV Infusions ☐ Yes ☐ No	Type: _____			
Procedure site prepared	☐ Yes	☐ No	☐ Yes	☐ No
Pedal Pulses marked	☐ Yes	☐ No	☐ Yes	☐ No
Pregnancy: possibility excluded (cath lab only)		☐ Yes	☐ No	☐ N/A
Current ECG available	☐ Yes	☐ No	☐ Yes	☐ No
IV Cannula: Date: _____ Insitu site: _____ ☐ Flushed At least 22G, preferably left arm N/A for GA cases				
Nail polish/makeup/contact lenses Jewellery/piercings Caps/crowns/loose teeth Aluminium hair extensions / tampons Dentures/glasses/hearing aids	☐ Removed ☐ Not removed ☐ Removed ☐ Taped ☐ Yes ☐ N/A ☐ Yes ☐ No ☐ Removed ☐ Removed ☐ In situ		Comments: Pt Valuables checked ☐ Yes ☐ No	
Recent Observations Height: _____ cm Weight: _____ kg BP _____ Pulse _____ Rhythm _____ O_2 Sats _____ Temp _____ Resp _____ BSL _____				
Anti embolic stockings (for GA cases)	☐ Fitted	☐ No	☐ N/A	
VTE Risk ☐ Low ☐ High	Falls: ☐ Low ☐ Med ☐ High		Pressure: ☐ Low ☐ Med ☐ High	
☐ Chest pain ☐ Angina ☐ NSTEMI ☐ STEMI ☐ SOB ☐ Pre-Valve surgery/TAVI work-up ☐ Syncope ☐ Palpitations				
☐ Previous Angiogram ☐ Stress Test ☐ CT Angiogram ☐ ECHO				
☐ Previous CABG/Valve replacement Date: ☐ Previous PCI Date: ☐ Stroke ☐ DVT				
Other:				
Diabetes ☐ Type 1 ☐ Type 2 ☐ Diet ☐ Insulin ☐ Oral & Insulin				
Dyslipidaemia ☐ Yes ☐ No ☐ On Rx ☐ Cholesterol >5mm/L Hypertension ☐ Yes ☐ No ☐ On Rx				
Name and Signature of nurse completing the checklist:				
Designation				
Date				

BINDING MARGIN – DO NOT WRITE IN THIS AREA

HS0000047

Print Media Group HSHGXFMR092D 01/16

CATH LAB CHECKLIST TRIAL

HMR 9.2D

HSHGXFMR092D.indd 1 2/02/2018 4:03 PM

Appendix D

CVL Checklist

Name *Can place patient sticker here*
DOB

Height_____ Weight (please weigh patient day of LHC) _____

Dye Allergy: YES Or NO

If Dye allergy was patient pre-treated? YES or NO

CODE STATUS:

Current Vital Signs: BP____/_____ HR_____ Rhythm_____ Temperature_____

RR_____ O2 saturation_____ Supplemental O2/liters_____

Bun/Cr. Admission_____/_____ Current_____/_____

If Hgb <8.0 notify CVL charge RN prior to transport
If INR >1.8 notify CVL charge RN prior to transport

Date/time of last dose of oral anticoagulant (Eliquis, Pradaxa, Xarelto, Coumadin, Lovenox/enoxaparin): _____

Date/time of last dose of Metformin (Glucophage)_____

Dialysis Patient: Yes or No. If on dialysis date of last treatment_____

On Antibiotics currently: Yes or No. POSITIVE Blood cultures: YES or NO
Is Patient in isolation? _____
Medications given this am (fax current medication list)
Pregnancy Test for female </= to 50 years old? YES or NO. Tubal ligation/Hysterectomy? YES or NO

Appendix E

Pre-Checklist Data

Date of Service	Age	Gender	Floor	(A)dmit/(D)ischarge	Cancelled/Delayed	Reason	Intervention/CABG
11/1/21	76	Female	5	A	Delayed 1 day	Elevated BP	Yes/PCI
11/8/21	51	Male	5	D	No		No
11/9/21	52	Male	4	A	No		Yes/PCI
12/3/21	87	Male	4	A	No		N/Med.Adjustments
12/13/21	28	Male	4	A	No		Yes/CABG
1/12/22	54	Male	ED	A	No		Yes/PCI
1/17/22	87	Male	5	D	No		No
1/21/22	54	Male	5	A	No		Yes/PCI
1/21/22	50	Female	5	A	No		Yes/CABG
1/25/22	61	Male	ED	D	No		No
1/26/22	72	Male	ED	A	No		Yes/PCI
2/3/22	67	Female	5	D	No		No
2/10/22	77	Female	5	A	No		Yes/Med.Adjustment
2/18/22	57	Male	5	A	No		Yes/Med.Adjustment
2/21/22	53	Male	5	A	Delayed 1 day	SOB	Yes/PCI
2/24/22	61	Male	5	A	No		Yes/CABG & MVrp
2/28/22	47	Female	ICU	A	No		Yes/PCI
3/4/22	73	Female	ICU	A	Delayed 1 day	Staffing	Yes/PCI
3/8/22	52	Male	5	A	No		Yes/PCI
3/10/22	68	Female	5	A	No		Yes/PCI
3/11/22	66	Male	4	A	No		Yes/PCI
3/15/22	74	Female	4	D	No		No
3/22/22	84	Female	ICU	A	No		Yes/PCI
3/30/22	81	Male	4	A	Cancelled	elevated INR & AKI	No/Medical management

Post-Checklist Data

Date of Service	Age	Gender	Floor	(A)dmit/(D)ischarge afte	Cancelled/Delayed	Transporte	Reason	Intervention	Checklist Done
4/7/22	59	Female	5	A	No			Yes/CABG	Yes
4/28/22	74	Female	5	A	No			Yes/CABG	Yes
5/11/22	68	Female	4	A	No			Yes/MV mass excision	Yes
6/6/22	33	Female	ED	D	No			No	No
6/8/22	54	Male	5	D	No			No	No
6/22/22	79	Female	4	D	Delayed 1 day	No	Dye Allergy	No	Yes
6/23/22	36	Male	5	A	Delayed 1 day	No	Transportation	Yes/PCI	Yes
6/30/22	73	Female	4	A	Delayed 1 day	No	Staffing	No	Yes
7/1/22	84	Male	5	A	No			No	Yes
7/1/22	72	Male	ICU	A	No			Yes/PCI	No
7/8/22	68	Female	5	A	No			Yes/Med. Adjustment	Yes
7/13/22	64	Male	4	A	Delayed 1 day	No	Staffing	Yes/PCI	No
8/1/22	62	Female	ICU	D	Delayed 1 day	No	Staffing	No	Yes
8/16/22	59	Female	5	A	Delayed done same day	No	Dye Allergy	Yes/PCI	No
8/18/22	60	Male	4	D	No			No	No
8/23/22	64	Male	5	N/A	Cancelled	No	Positive blood cultures	N/A	Yes
8/30/22	65	Female	5	D	No			No	Yes

Appendix F

Reasons for Delays / Cancellations

Pre Checklist

Reason	Frequency	Percent	Floor	Transported
AKI	1	4.17	4	Y
Elevated BP	1	4.17	5	Y
SOB	1	4.17	5	Y
Staffing	1	4.17	ICU	Y

Post Checklist

Reason	Frequency	Percent	Floor	Transported
Dye Allergy	1	14.29	4th Floor	N
Dye Allergy	1	14.29	5th Floor	N
Positive blood cultures	1	14.29	5th Floor	N
Staffing	1	14.29	ICU	N
Staffing	1	14.29	4th Floor	N
Staffing	1	14.29	4th floor	N
Staffing	1	14.29	5th Floor	N

Appendix G

MERCYHEALTH

Research Department
St. Elizabeth Youngstown Hospital
1044 Belmont Ave., Youngstown, OH 44501

January 12, 2022

Institutional Review Board

Brenda Ginder
Kent State

RE: *Quality Improvement Initiative*

Dear Ms. Ginder:

Thank you for your letter regarding the Implementation of a Pre-op Catheterization Checklist in East Liverpool City Hospital, a quality improvement and quality assurance initiatives. This information will be presented to the IRB at their meeting on January 19, 2022.

As per the Code of Federal Regulations (CFR), the study is exempt. According to the federal definition of research, Title 45§46.102(d), a systematic scientific inquiry or investigation which contributes to generalizable knowledge is subject to IRB oversight. Quality improvement studies are not research thus; your project is exempt from IRB oversight.

If your future plans change, including posters, presentations or patient level data, you will be required to re-submit your project for IRB oversight.

Thank you for your submission and best wishes in your endeavor. If you have any questions, please do not hesitate to contact me at 330-480-3610.

Sincerely,

Timothy J. Barreiro, D.O.
Chair, Institutional Review Board
Mercy Health Youngstown Hospital

TJB/cal