Southern California CSU DNP Consortium

California State University, Fullerton
California State University, Long Beach
California State University, Los Angeles

IMPROVING FIRST CASE START EFFICIENCY IN INTERVENTIONAL RADIOLOGY: A QUALITY IMPROVEMENT

A DOCTORAL PROJECT

Submitted in Partial Fulfillment of the Requirements

For the degree of

DOCTOR OF NURSING PRACTICE

By

Paulo N. Jusay

Doctoral Project Committee Approval:

Elizabeth Winokur, PhD, RN, CEN, Project Chair
Jean O’Neil, DNP, RN, FNP-BC Committee Member

May 2017
ABSTRACT

On-time First Case Start (FCS) is significant because a delay in the first case causes a ripple effect of subsequent delays to the remaining scheduled Interventional Radiology (IR) cases for the day. Delays in the first case lead to prolonged patient wait times, case cancelation, staff frustration, increased staff workload, and decreased patient satisfaction. The purpose of this quality improvement project was to improve FCS in IR. Methods included evaluating FCS before and after implementation of checklist and team briefing for all scheduled cases. Metrics consisted of time reports that included outpatient arrival check-in to radiology reception, patient time-in the IR suite, and actual start time when FCS is delayed, as well as the reasons for delays. During a 3-month postintervention period, implementation for the IR checklist and team briefing resulted in a decrease of total case delays from 94% preintervention to 87% postintervention. On-time FCS increased from 14.3% preintervention to 52.4% postintervention. During this project, reasons for delays with FCS were identified. Causes of delays are often due to communication errors and lack of process standardization. Interdisciplinary team-based approach and implementation of improvement initiatives is an effective way to standardize the IR pre-procedural process thereby reducing delays. This project could improve the pre-procedural process and take the first step towards improving the IR workflow.
# TABLE OF CONTENTS

ABSTRACT ................................................................................................................... iii

LIST OF TABLES ......................................................................................................... vi

LIST OF FIGURES ....................................................................................................... vii

ACKNOWLEDGMENTS ............................................................................................. viii

BACKGROUND ........................................................................................................... 1

  Problem Statement ................................................................................................ 1
  Purpose Statement ................................................................................................. 6
  Supporting Framework ............................................................................................ 6
    Plan-Do-Study-Act Definitions ............................................................................ 7
    PDSA Literature Review ....................................................................................... 8
    Application of PDSA in Reducing Delays in Interventional Radiology ............. 11

REVIEW OF LITERATURE ........................................................................................ 15

  Overview ............................................................................................................... 15
  Delays ................................................................................................................... 15
  First Case Starts ................................................................................................... 18
  Communication Failures ....................................................................................... 19
  The Checklist ........................................................................................................ 20
  Briefings ................................................................................................................ 23

METHODS .................................................................................................................... 26

  Setting ................................................................................................................... 26
  Sample .................................................................................................................. 26
  Procedure .............................................................................................................. 27
    Project Team ....................................................................................................... 27
    Checklist and Team Briefing .............................................................................. 28
    Data Analysis .................................................................................................... 29
  Protection of Human Subjects ............................................................................. 30
RESULTS........................................................................................................................................... 31
First Case Start................................................................................................................................. 31
Post Implementation Survey............................................................................................................. 35
Cost.................................................................................................................................................. 36
DISCUSSION....................................................................................................................................... 39
Limitations......................................................................................................................................... 46
Implications....................................................................................................................................... 47
Conclusion......................................................................................................................................... 48
REFERENCES.................................................................................................................................... 50
APPENDIX A: INTERVENTIONAL RADIOLOGY CHECKLIST....................................................... 57
APPENDIX B: REVISED INTERVENTIONAL RADIOLOGY CHECKLIST.............................. 58
APPENDIX C: SURVEY..................................................................................................................... 60
APPENDIX D: INSTITUTIONAL REVIEW BOARD (IRB) ACTION NOTICE........................... 61
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number and Percentage of Total Case Delays</td>
<td>32</td>
</tr>
<tr>
<td>2. Number and Percentage of First Case Start Delays</td>
<td>32</td>
</tr>
<tr>
<td>3. Number and Percentage of Specific Reasons Delays</td>
<td>35</td>
</tr>
<tr>
<td>4. Cost Related to Delays and Savings</td>
<td>38</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PDSA cycle</td>
<td>8</td>
</tr>
<tr>
<td>2. First case on-time start trend</td>
<td>33</td>
</tr>
<tr>
<td>3. Delay types and duration</td>
<td>34</td>
</tr>
<tr>
<td>4. Survey at 1 month</td>
<td>36</td>
</tr>
<tr>
<td>5. Survey at 3 months</td>
<td>37</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

I would like to thank Dr. Elizabeth Winokur and Dr. Jean O’Neil for their support and mentoring during this project. A special thank you to Dr. Winokur, who spent countless hours with me since the beginning and through the end of completing this project. Thanks to the entire DNP faculty for the extraordinary support.

I also wish to thank my lovely wife Margaret and my children Mateo and Maiah, who wholeheartedly supported me during this entire program. A special thank you to my parents Proceso and Catalina Jusay, who taught me the value of hard work. And lastly, thanks to the entire IR team, who supported me throughout the doctoral program.
BACKGROUND

Problem Statement

The occurrences of case delays in Interventional Radiology (IR) have a significant impact on the delivery of high-quality medical care in hospital settings. Delays can contribute to frustration, additional workload among staff, and added cost (Wong, Khu, Kaderali, & Berstein, 2010). Even though not all delays have an impact on patient health, they can increase anxiety for patients and families leading to poor patient satisfaction with their care.

The department of Interventional Radiology is a complex environment that requires successful coordinated efforts of individuals within the team to produce good patient outcomes. Unlike surgical services, most IR cases are scheduled within days from the referring service request leaving a small window of time to ascertain whether patients are fully prepared for the specific IR procedure. The majority of IR procedures are performed on a variety of complex patients that have not been evaluated by the IR physician before the procedure. Due to the complexity of patients and IR procedures, the standard operating workflow is prone to unforeseen delays, which may lead to errors or an adverse event. These delays can consequently cause disruption in the IR department’s workflow, which impacts patient care and the overall department efficiency.

A 215-bed California tertiary medical center (CTMC) division of IR has increased its services and volume over the past five years. In the year 2010, CTMC decided to expand its IR service to improve care for patients and allow for access to advanced technological minimally invasive procedures. Before this expansion, the service was only performing routine procedures such as biopsies, paracenteses, and drain placements.
Since the appointment of a new chief of IR in 2010, the IR service has become capable of performing other complex procedures such as vascular angiograms, embolizations, arterial liver directed therapies, liver ablations, and tunneled central line placements (J. Park, personal communication, February 15, 2016). The growth of the service has led to the hiring of IR physicians, registered nurses, clinical care coordinators, technologists, and nurse practitioners. In 2015, the IR department completed a total of 3444 cases compared to a total of 511 cases in 2010 (V. Daniels, personal communication, February 2, 2016).

The increased volume of patients being referred to IR has made the current operating workflow challenging leading to a significant number of case delays. During the months of November 2015 to April 2016, on-time First Case Starts (FCS) was approximately 21 percent (V. Daniels, personal communication, May 23, 2016). On-time FCS is significant because a delay in the first case causes a ripple effect of subsequent delays to the remaining scheduled IR cases for the day. Delays in the first case mirror those reported in the literature. First Case Start delays lead to prolonged patient wait times, case cancelations, staff frustration, increased staff workload, delays in treating patients with acute illness (“add-on” case), and decreased patient satisfaction (Nundy et al., 2008). Moreover, delays can impact patient safety and increase cost (Porta et al., 2013). Some delays have been attributed to communication failures among staff. Often, staff are not able to access information they require in a timely manner. This can not only impact timely starts, but also patient safety (Braaf, Robin, & Mania, 2015). Lastly, delays cause IR inefficiency. During peak operating hours, interruption in flow causes the suite to be empty. As cases are shifted to later in the day, there occurs an increase in
overtime hours that have substantial cost implications (V. Daniels, personal communication, February 2, 2016; Porta et al., 2012;).

To identify the root cause of delays, there must be a general understanding of the current pre-procedure IR workflow (Villareal, Rostad, Wright, & Applegate, 2015). The main categories of IR procedures being performed include vascular angiograms, percutaneous drains, and tunneled central venous device placement. More than 70 percent of the IR cases are elective and scheduled as outpatient procedures (J. Park, personal communication, February 17, 2016). Urgent IR cases usually involve performing arterial embolization to stop an acute hemorrhage and thrombolysis of an acute pulmonary embolus or clot with the potential to cause limb compromise.

Approximately six to eight IR cases are scheduled per day. Each case is allotted one to two hours of time. The process is usually initiated by the requesting primary service to arrange for the specific IR procedure. This initial request is acknowledged by the care coordinator. Elective IR cases are typically scheduled within a week once contact is made with the patient. During this initial phone contact by the care coordinator, patients are given pre-procedure instructions such as withholding blood thinners and fasting for eight hours. Patients are also given instructions on when and where to go for the procedure.

Interventional radiology nurses make a follow up a phone call to patients the day before the procedure to reiterate pre-procedure instructions including arrival time. On the day of the procedure, the patient typically arrives at the hospital two hours earlier to complete pre-procedure laboratory testing. After phlebotomy, the patient reports to the radiology department to check in and is seated in the IR waiting room. The IR nurse
performs the pre-procedure assessment and prepares the patient for the procedure. The IR physician meets and evaluates the patient immediately before the procedure and then obtains informed consent, after which sedation is administered and the procedure is begun. At any time of the day, there is also a potential to add on cases from inpatient units. Urgent cases are evaluated by either the IR NP or the IR physician before the procedure. Although the current workflow process appears quite simple, it is complicated by system changes and patient complexity.

Delays in IR are due to a variety of system and human factors (Morbi et al., 2012). The current IR pre-procedural workflow consists of many steps that present opportunities for delays or case cancellations. One of the weaknesses in the current process is the lack of a standardized communication procedure. Members of the IR team assume that the key steps in the workflow process have been executed without any form of verification. Another contributing factor to the delays is that the current pre-procedure workflow process relies completely on human memory. Currently, the process has no checklists or reminders to make sure that the key steps are addressed.

Most of the reasons for a delay in IR are delayed laboratory test results, abnormal laboratory values, physician tardiness, urgent inpatient case add-ons, and delays in patient’s consent for the procedure. Other factors contributing to delays include authorization delays from medical insurance, patient’s poor physical condition, medications for procedure not ordered, and change in patient’s clinical status during the procedure. The current system and reliance on human memory lead to lack of or poor preparation of patients, and unavailability of the IR physician (Koetser et al., 2013).
Methods to decrease IR case delays are important to patient care. One method that has been recognized to reduce delays is the utilization of a checklist (Jain et al., 2015). Checklists have been successful in other fields including aviation and other high-risk industries (Koetser et al., 2013). A checklist provides standardization in workflow and avoids reliance on human memory thus decreasing incidence of human error (Vries, Hollman, Smorenburg, Gouma, & Boermeester, 2016).

Another intervention that can potentially reduce IR delays is a team briefing (Lingard et al., 2008). Nundy (2008) measured the effectiveness of a pre-procedural briefing in the OR; this intervention was associated with a 31% reduction in delays from baseline data. Briefings are credited with reducing delays through improved teamwork and communication (Morbi et al., 2012). Team briefings and checklists in surgery have been reported to increase operating room efficiency and safety as well as improve communication (Mahajan, 2011). Because the IR workflow process shares several features with the OR process, a checklist and team briefing may be equally effective in decreasing case delays in IR.

In 2001, the Institute of Medicine’s (IOM) *Crossing the Quality Chasm* called for a commitment to improve the US health care system (Rawson, Kannan, & Furman, 2015). It focused on reinventing the health care system to influence innovation and improve delivery of care (Rawson et al., 2015). To attain this goal, the committee adopted six specific core aims for health care improvement; these include (a) Safe: avoiding injuries to patients, (b) Patient-centered: providing care that is respectful of the individual’s preference and ensuring that patient values guide all clinical decisions, (c) Timely: reducing wait times and harmful delays, (d) Efficient: avoiding waste, (e)
Equitable: providing care that does not vary in quality, and (f) Effective: providing service that is based on scientific knowledge (Institute of Medicine, 2001). These specific aims have promoted changes to the current health care system (Rawson et al., 2015). Quality improvement initiatives such as reducing IR delays will help meet these goals set by the IOM and improve overall health care to patients. Approaches such as using checklists and conducting briefings in IR can help achieve gains in these six major areas.

**Purpose Statement**

The goal of this Doctor of Nursing Practice Project was to improve first case starts (FCS) in IR. This quality improvement initiative proposed the implementation of a planning and preparation checklist for all scheduled IR patients. A team briefing that occurred the day before the scheduled case supplemented the checklist. The team briefing was led by the project leader and included all cases scheduled for the following day. A pre-post design was used to evaluate the impact of improvement initiatives on IR first case delays.

**Supporting Framework**

The use of a supporting framework is vital in implementing a quality improvement project (Bruno & Nagy, 2014; Rawson et al., 2015; Varkey, Reller, & Resar, 2007). A solid theoretical framework provides structure to the project, defines interrelated variables, and provides efficiency (Varkey et al., 2007). The Plan, Do, Study, Act (PDSA) cycle is the most commonly used approach for a quality improvement initiative in health care. The Joint Commission and Accreditation Council for Graduate Medical Education have adopted this model for process improvement (Rawson et al.,
This framework was advocated by and predominately credited to W. Edward Deming beginning in the 1950s (Bruno & Nagy, 2014). Shewart and others developed an earlier version of this framework in the 1930s; it was referred to as the plan-do-check cycle or the Deming-Shewart wheel (Bruno & Nagy, 2014). This framework was central to the quality improvement programs in Japan automobile manufacturing (Varkey et al., 2008). The PDSA framework is deceptively simple yet a powerful tool, which emphasizes that quality improvement is an iterative process, one in which quantitative data, planning, and action are all integral components (Bruno & Nagy, 2014).

**Plan-Do-Study-Act Definitions**

The PDSA framework has two components. The first component poses three questions: (a) What are we trying to accomplish? (b) How will we know that change is an improvement? and (c) What changes can we make that will result in improvement? (Powell, Rushmer, & Davies, 2009). The first question defines the aim of the project. The aim should be time-specific, measurable, and describe the setting and particular population that will be affected (Powell et al., 2009). The second question helps establish quantitative measures that will be used to evaluate if the change in process produces an effect (Powell et al., 2009). The third question identifies the organizational changes that are required for the improvement to occur (Powell et al., 2009).

The second component, by which these questions are put in to action and applied in the clinical environment, is the Plan-Do-Study-Act (PDSA) (Powell et al., 2009). The PDSA is a cycle for testing change. Esmail, Kirby, Inkson, and Boiteau (2005) called the PDSA framework a “trial -and-learn” approach. The Plan is developed from the three
questions, which provide objectives and metrics that will be utilized for the project. Changes are tested by developing a strategy (Plan), piloting the plan and collecting data (Do), evaluating the results (Study) and then translating what is learned into action (Act), leading to the next PDSA cycle (Esmail et al., 2005).

Figure 1. PDSA Cycle

**PDSA Literature Review**

**PDSA use in clinics to reduce patient wait times.** There are numerous studies in the literature that have utilized PDSA as the theoretical framework. Ugarte (2015) performed an improvement initiative to reduce waiting times and visit durations in an intravitreal therapy clinic. Intravitreal therapy is a form of treatment of retinal diseases
including diabetic retinopathy and retinal vein occlusion. These diseases are treated by way of intravitreal injections by Retinal Specialists. The aim of the study was to reduce waiting time in the intravitreal therapy clinic by optimizing appointment times through a new scheduling profile that included a 30-minute gap in the middle of the day to absorb any backlog accumulated during the first half of the day (Ugarte, 2015). The target population was patients scheduled in the clinic. The study used quantitative measures to assess the extent to which the goals were achieved. According to Ugarte (2015), the outcome measures included: (a) Time spent waiting to see the nurse, (b) Overall visit duration, (c) Process measures (number of slots available for appointment in each session), and (d) Balancing measures (were the changes causing new problems in other parts of service?). These four outcome measures and improvement initiatives described by Ugarte (2015) led to the Plan. This Plan was put to test using the PDSA cycle. In the Do phase, the new scheduling profile was implemented. During this phase, Ugarte (2015) assessed performance measures through data that was being collected. The collected data was evaluated through various in-depth discussions of findings in the Study phase. This initiative resulted in a significant improvement in some measures. The percentage of patients waiting more than 30 minutes reduced from 38.2% to 1.9% (Ugarte, 2015). In addition, visits with duration over three hours were reduced from 10.4% to 1.9% (Ugarte, 2015). In the Act phase, these findings demonstrated that the implemented change resulted in improved measurable outcomes; therefore, the activity was maintained, and the process change incorporated into the normal clinic function.

**PDSA use in inpatient falls.** The PDSA theoretical framework has also been applied in numerous hospital inpatient settings. Nelson (2015) used the PDSA
framework with the aim of improving the assessment and documentation by junior and inexperienced doctors of a patient who had sustained a hospital fall. The time frame of this study was three months. Nelson (2015) used the percentage of completed assessment notes recorded by junior doctors after a fall as the quantitative measure to assess if the specific change had led to an improvement. The change in this study was the implementation of a teaching session on proper post-fall assessment and documentation to new doctors within the first month of employment. Once the three questions were addressed, the PDSA cycle was used to test the change. The Plan phase involved obtaining baseline data of patients sustaining an inpatient fall during the two previous months (Nelson et al., 2015). Data demonstrated that only 76% of the patients had been assessed, 35% received neurological evaluation, and 23% had a review of anticoagulation medication (Nelson et al., 2015). In the Do phase, the teaching session was delivered to the new doctors. Data was subsequently collected following the teaching session by randomly selecting 20 cases to review. In the Study phase, Nelson (2015) found that the majority of assessments and documentation improved; however, one critical assessment area, review of anticoagulation medication actually decreased. This necessitated a second PDSA cycle. Cycle 2 incorporated the use of a pro-forma, a document to act as a guide for what should be included in the medical assessment and notes. After Cycle 2, the review found that 88% of patient had initial observations, 65% had neurological observations performed and 38% of patients had a review of their anticoagulation medication (Nelson et al., 2015). The use of the PDSA framework in this study was effective in identifying key areas of improvement and allowing for modification of the intervention to improve outcomes.
Application of PDSA in the ICU (intensive care unit). In 2005, the Department of Critical Care Medicine, Calgary Health Region in Canada organized more than 20 teams from the United States and Canada with a goal to improve patient care in the ICU (Esmail et al., 2005). Objectives were focused on developing care process in the ICU to reduce harm and improve outcomes for patients and families (Esmail et al., 2005). The project tested numerous changes focusing on readmission to the ICU, adverse events, and family satisfaction (Esmail et al., 2005). This quality improvement initiative developed and implemented evidence-based guidelines and protocols (Plan). The guidelines and protocols implemented (Do) were a ventilator-associated pneumonia (VAP) protocol, deep venous thrombosis prophylaxis, stress ulcer prophylaxis, and nutritional support (Esmail et al., 2005). Quantitative measure outcomes were collected to evaluate the effectiveness of the interventions (Study). Results of the project were positive demonstrated by reductions in cardiac arrest, decreases in hospital mortality, and reduced length of stay (Esmail et al., 2005). These findings led to continuation of the project (Act) with multiple PDSA cycles complete over a five-year period.

Application of PDSA in Reducing Delays in Interventional Radiology

As with many quality improvement initiatives that have been implemented in healthcare, the use of PDSA framework is appropriate in reducing delays in interventional radiology as well. First, the three questions must be stated, which provide the project aims, outcome measures, and identify the required change that will likely result in improvement. These proposed changes are then tested using the PDSA cycle.

What are we trying to accomplish? The aim of this quality improvement project was to decrease the number of case delays in interventional radiology. This
project aimed at improving FCS compliance that will lead to overall decrease in number of delays. The project took approximately six months, including the time to acquire baseline data to compare to the results achieved at project completion.

**How will we know that a change was an improvement?** The process measures included: (a) determining the process for documenting patient time to the IR suite; (b) documenting actual procedure start time; and (c) determining the reasons for delays. Outcome measures included improving FCS compliance rate and an overall decrease in case delays. Additional outcome measures included decreasing staff overtime and cost of delays.

**What changes were made that resulted in improvement?** The practice of quality improvement is a team effort, requiring continuous input from all members of the team and other stakeholders (Bruno & Nagy, 2014). It is very difficult for a single person to carry out a successful quality improvement project; therefore, it is imperative that top leadership personnel endorse the goals of the project. To further develop this project, an IR quality improvement team was assembled that included the IR lead technologist, IR Charge Nurse, care coordinator, IR Chief and the director of Radiology, and Project Leader. The team was expected to meet on a weekly basis.

In order to reduce case delays in CMTC interventional radiology, the pre-procedure process was simplified. To streamline this process, a pre-procedure checklist was implemented. The pre-procedure checklist included all the major steps that must be verified and completed on the day before the scheduled procedure. The checklist included the most pertinent items of the pre-procedure workflow. Items such as scheduling recovery, insurance verification, patient pre-procedure call and instructions,
allergies, lab values, antibiotics, level of sedation, special equipment, indication for the procedure, and communication with referring service were among the basic components included in the checklist. All elective cases scheduled in IR were required to have a pre-procedure checklist. The primary users of the pre-procedure checklist were the care coordinators, nurse practitioners, and registered nurses.

The checklist was supplemented by daily team briefing. The briefing occurred the day before the scheduled procedure and took approximately five to seven minutes. The briefing provided an opportunity for the team to review all scheduled cases, identify issues, and set expectations for the day of the procedure (Jain, Jones, Simon, & Patterson, 2015). The checklist was used to guide the team briefing and included critical elements that needed to be considered prior to the start of the procedure (Jain et al., 2015).

**PDSA Cycle.** Once the *Plan* was established as described above, the intervention was implemented (*Do*). The *Do* phase included the implementation of the checklist and briefings. Interventional Radiology nurses performed documentation of patient room time, FCS start time, and delays to scheduled start time. In the *Study* phase, all the data collected from the *Do* phase were analyzed. What percentage of first cases actually started on time? What were the reasons for delays? In the *Act* phase, the IR QI team analyzed the data and determined whether to continue with the current process or make any modifications in order to reach the goal of the project.

**Project goals.** To achieve at least 50% on-time FCS in Interventional Radiology and to identify reasons for delays.

**Impact on Staff.** The staff members that were impacted by the project goal were the IR Physicians, IR nurses, IR technologist, IR care coordinators, and IR nurse
practitioners. The key drivers for this goal included: (a) support from the IR chief and radiology manager to drive the proposed change; (b) buy-in from the IR physicians, radiology manager, and IR staff to change the current pre-procedure workflow practice; (c) understand the causes of IR case delays; and (d) understand the cost of delays.

**Outcome and process measure.** The outcome measured in this project was the increased compliance with FCS. The process measures that addressed the FCS compliance included:

- establishment of an IR quality improvement group that consisted of IR physicians, IR charge nurse, IR lead technologist, care coordinator, and the project leader;
- IR documentation system that was used by the IR staff to document information to the start time of the case;
- documentation of the reasons for delays by the IR nurse or IR technologist; and
- occurrence of the usage of the pre-procedure checklist and implementation of team briefing.
REVIEW OF LITERATURE

Overview

A review of the literature was conducted in preparation for the development of this quality improvement project. Literature on the improvement of on-time starts and delay reduction is widely available but mostly limited to the surgical department setting. The following electronic databases included publications relevant to the topics of reducing delays in Interventional Radiology: CINAHL, PubMed, ScienceDirect, PsycINFO, Google Scholar, and Academic Search Premier. Databases were searched for articles published between 2005 to 2016. The timeframe was extended because little has been published in the field of interventional radiology. MeSH terms that were used included reducing delays and interventional radiology. Further search terms included, delays in the operating room, improving delays, improving communication, first case starts, checklist, patient satisfaction, quality improvement, and preoperative briefing. Peer-reviewed journal publications represented the majority of the articles selected for review. The reference lists of retrieved documents were also hand-searched to identify pertinent publications.

Delays

Interventional Radiology is a fast-paced and complex environment where patient outcomes depend on the successfully coordinated efforts of individuals in the team. Delays can have a significant impact on the delivery of high-quality care. Delays can affect patient and family satisfaction, increase workload and frustration among staff, and potentially add to the cost of the IR service (Mohmaoud, Koch, Jones, & Varughese, 2012; Porta et al., 2012). The causes of delays are usually traced to human and system
errors including problems with equipment, inappropriate preparation of patients, change of case schedule list to accommodate priority patients, and unavailability of physicians (Higgins, Bryant, Villanueva, & Kitto, 2011). Communication and teamwork failure were identified as the predominant cause of delays (Porta et al., 2012). Failure in communication and teamwork can also impact patient safety. In 1999, the Institute of Medicine (IOM) published a report examining medical errors which suggested that these errors result in up to 100,000 deaths annually (Porta et al., 2012). These authors identified communication and teamwork failure as the main source of the medical errors and adverse events. These overwhelming findings have been the impetus for the Institute of Medicine, the Joint Commission, and the Agency for Healthcare Research and Quality to make improving communication and teamwork a top priority (Porta et al., 2012). Improving lines of communication and teamwork are critical in minimizing delays.

Analyzing the types of delays is important to consider when performing a quality improvement project (Morbi et al., 2012; Villareal et al., 2015; Wong et al., 2010). Delays can be due to pre-procedure systems or human factors (Wong et al., 2010). Pre-procedure delays are due to failures in the workflow process or equipment, whereas delays that are due to human factors are related to experience or skill of the physician or other team members (Wong et al., 2010).

A quality improvement study by Villareal et al. (2015) examined one Interventional Radiology workflow process and identified the main reasons for delays in IR as: 1) physician’s need for consent or order clarification (26.2%); 2) miscellaneous (i.e. IR room not available) (19%); and 3) laboratory testing delays (12.4%). An interdisciplinary team composed of representatives from IR worked together to develop
and implement a standardized data collection process. This intervention resulted in an increased number of on-time first case starts; compliance increased from 23% to 56% ($p = <0.01$) (Villareal et al., 2015). The number of patient care delays was reduced from 46.6% to 40.1% (Villareal et al., 2015). On-time start times increased utilization of the procedure rooms and improved the quality of service provided to the patients (Villareal et al., 2015).

A prospective study conducted in an operating room arena demonstrated that the majority of delays were due to the preoperative system that led to unavailability of instruments needed for the surgery, and inadequate optimization of the patient’s clinical condition to safely proceed with surgery (Wong et al., 2010). All perioperative delays were recorded and categorized. This became the basis for developing appropriate solutions for improving operating room delays. Overall, preoperative system errors were responsible for 33% of delays, and 51% of all cases experienced at least one delay (Wong et al., 2010).

In a prospective observational study by Morbi et al. (2012) in a vascular interventional radiology setting, the main sources that produced system failures were planning error(s) (19%), staff absence(s) (16.2%), equipment unavailability (12.2%), and communication errors (11.2%). They concluded that the system failures were largely due to ineffective planning and equipment difficulties, rather than patient-related or technical issues (Morbi et al., 2012). Pre-intervention data demonstrated that 54% of errors were preventable (Morbi et al. (2012). Implementation of a Pre-procedural Team Rehearsal (PPTR) decreased errors from 54% to 27.3% ($p = <.01$). Pre-procedural Team rehearsals were done at the start of every procedure led by the interventional radiology physician
with all team members present (Morbi et al., 2012). The physician went through the key steps of the procedure, and all members were encouraged to ask questions (Morbi et al., 2012).

**First Case Starts (FCS)**

The percentage of first cases of the day that start on time as scheduled is critical in evaluating efficiency (Saw et al., 2014). First case of the day is one of the most commonly examined metrics in the operating room (Saw et al., 2014; Villareal et al., 2015). Analysis of the first case of the day is considered important because any delay in the first case produces a domino effect on the remaining scheduled cases for the day (Villareal et al., 2015). Timely start also renders predictability and facilitates flow of patients from post-anesthesia care unit to the hospital floors. According to Saw et al. (2014), first cases of the day were more likely to be delayed than the cases to follow, and these first case delays can increase delays in the subsequent cases.

Mahmoud et al. (2013) performed a quality improvement study aimed at reducing delays in Magnetic Resonance Imaging (MRI) imaging in the radiology department with the sub-aim of improving first patient scheduled start time. The improvement team identified the key drivers to delays and implemented interventions aligned with the key drivers. The two major contributing factors to delays in this study were late patient arrival, and patients with complex medical histories that were missed in the screening process (Mahmoud et al., 2013). Therefore, Mahmoud et al. (2013) created a more efficient screening for patients with a complex history, and implemented a process for the staff to call 24 hours before scheduled start times to confirm the appointment. First patient scheduled on time start improved from 36% to 84%; the average delay improved
from 20 minutes to less than 10 minutes (Mahmoud et al., 2013). The authors concluded that On-time First Case Start (FCS) allows for a better utilization of procedure rooms, which can prevent staff overtime particularly on a busy day (Villareal et al., 2015). On-time start can also boost morale among staff, and even more importantly, improve the quality of service provided to patients (Mahmoud et al., 2012).

Delays also have a significant financial impact. With the skyrocketing cost of health care in the United States, now totaling to 18% of gross domestic product, health care providers are pressured to control expenditures (Mathew et al., 2015). Research examining specifically at cost burden have suggested that staffing alone in a single operating room can cost $3-7 per minute (Porta et al., 2013). One estimate suggested that a minimum of approximately $1500 per hour of revenue is lost due to delays and cancellations (Correll et al., 2006). Delays also contribute to staff overtime, which is a key driver of increased cost and lost revenue (V. Daniels, personal communication February 2, 2016). One observational study in surgical setting reported a total of 2800 total delays that amounted to 48,386 minutes over a one-year period (Porta et al., 2013). At a suggested cost of staffing at $3 per minute, this loss of productive time amounts to a financial loss of $145,000 in a year (Porta et al., 2013).

Communication Failures

Optimizing the communication process among healthcare professionals is fundamental to patient outcomes (Braaf et al., 2015). Many healthcare professionals establish communication through written forms. Documentation is used to convey vital patient information to the health care team; this may help identify potential problems that alter patient safety and quality of care. Existing evidence suggests that communication
failures are common in the hospital surgery setting, and these failures have led to increased complications and inefficiency (Pugel, Simianu, Flum, & Dellinger, 2015). Sentinel and adverse events are associated with a lack of clear verbal and nonverbal communication in the preoperative surgical setting (Joint Commission on Accreditation of Healthcare Organizations [TJC] 2011; National Patient Safety Agency 2009). A qualitative study by Braaf et al. (2015) reported that communication failures occurred because important information was difficult to locate, insufficient in scope, inaccurate, or not verbally reinforced. Patient outcomes were adversely affected resulting in inadequate care and delays in treatment (Braaf et al., 2015).

Dedhia, Shwaish, Snyderman, Monte, and Eibling (2013) performed a prospective, four-week observational study to understand the leading causes for process errors and delays in the otolaryngology operating room. One hundred process errors were recorded (average 4.3 per case), 34% of which were determined to be communication failures (Dedhia et al., 2013). Furthermore, communication failures represented the most common etiology for delays totaling 336 minutes during the course of study (Dedhia et al., 2013).

**The Checklist**

A checklist can serve as a valuable communication tool and improve collaboration among team members (Patel et al., 2014; Russ et al., 2013; Wong et al., 2015). Wong et al. (2015) performed a quality improvement study that examined the impact and culture of an Interventional Radiology department after the implementation of a pre-procedural checklist. After 12 months, a post-implementation survey among staff
found that the pre-procedural checklist was an important communication tool and presented an opportunity to identify critical issues (Wong et al., 2015).

Russ et al. (2013) performed a systematic review that assessed the impact of a surgical safety checklist on the quality of teamwork and communication in the surgery setting. Twenty articles formed the basis of this systematic review. Results suggest that safety checklists improved the quality of operating room teamwork and communication (Russ et al., 2013). The safety checklists provided a method to identify critical issues related to the procedure and reduced observable errors related to poor team skills (Russ et al., 2013).

In another study investigating pre- and post-implementation scores using the Safety Attitudes Questionnaire (SAQ), respondents agreed that checklists were more likely to be used in settings where the culture encouraged team members to voice concern (4.02 vs 4.21, \( p = 0.0225 \)) and more likely to agree that checklists are important for safety (4.58 vs 4.79, \( p = 0.0055 \)) (Pugel et al., 2015). Additionally, the number of miscommunication events declined to 50% with use of checklist (Pugel et al., 2015).

Checklists have also been proven to significantly improve patient outcomes (Leschied, Glazer, Bailey, & Maturen, 2015; Patel et al., 2014). A systematic review by Patel et al. (2014) reported that the implementation of the World Health Organization (WHO) checklist decreased post-operative complications by 36%. Mortality rates demonstrated a substantial decrease of more than 45% (Patel et al., 2014). This study demonstrated that factors including poor judgment, memory, communication and lack of equipment have caused incidents that have led to malpractice claims (Patel et al., 2014).
Leschied et al. (2015) implemented a quality improvement project demonstrating the value of a pre-procedural checklist for fluoroscopy. The checklist was implemented in a gastrointestinal/genitourinary suite to assist radiology residents in performing optimal fluoroscopic techniques with a goal of decreasing the radiation dose delivered to patients and operators (Leschied et al., 2015). After implementation of the checklist, the mean fluoroscopy time decreased by 41.1 seconds ($p < .0001$), resulting in a decrease in overall radiation dose exposure to patients undergoing fluoroscopic procedures (Leschfeld, et al., 2015).

Vries et al. (2009) evaluated a comprehensive checklist that was compiled from 11 different types of checklists dealing with issues with preoperative preparation, intraoperative and postoperative care, communication of orders between health care providers, and discharge instructions. The comprehensive checklist completed by staff
resulted in reduction in complications from 15.4% to 10.6% and drop in mortality from 1.5% to 0.8% (Vries et al., 2009).

The use of a checklist has also been shown to improve efficiency in the OR settings (Panni et al., 2013). The authors (2013) undertook an 18-month quality improvement project focusing on first case start efficiency and identifying components of each delay. The project implemented a checklist and a pre-operative facilitator. The role of the pre-operative facilitator was to intervene whenever there were any missing items on the checklist (Panni et al., 2013). Delayed first starts declined steadily each month after project implementation, resulting in a decreased average number of delayed first cases from 10.07 to a low of 4.95 per day after six months ($p = <0.001$) (Panni et al., 2013).

Koetser et al.’s (2013) observational study assessed the effect of a planning and preparation checklist called Radiologic Patient Safety System (RADPASS) in Interventional Radiology. After a 6-month period, the percentage of delayed and canceled procedures decreased from 10% to 0% (Koetser et al., 2013). Process errors per intervention decreased from 24% to 5% ($p = <0.001$) (Koetser et al., 2013). The RADPASS checklist reduced process errors and was associated with fewer case delays (Koetser et al., 2013).

**Briefings**

In addition to checklists, briefings have also been used as a tool to improve patient outcomes. The use of briefings has been shown to improve team communication, decrease disruption to workflow, and increase efficiency (Hicks, Rosen, Hobson, Ko, & Wick, 2014). Lingard et al.’s (2008) prospective study used a pre-intervention/post-
intervention design to assess whether team briefing improved operating room communication. One hundred seventy-two procedures were observed. After implementing briefings, the mean number of communication failures per procedure declined from 3.95 pre-intervention to 1.31 post-intervention (Lingard et al., 2008).

Jain et al.’s (2015) quality improvement project in the operating room setting evaluated the impact of pre-operative briefing before the start of the first case by measuring delays, interruptions, and questions. The briefing was led by the attending surgeon and was completed before the first case (Jain et al., 2015). The pre-operative briefing resulted in a decrease in unexpected delays from 23% to 6.45% per case and 78.9% to 21% per day (Jain et al., 2015). Daily briefings also improved the flow of the surgeons’ day and increased their satisfaction (Jain et al., 2015).

A pre-post study by Nundy et al. (2008) reported that implementation of a pre-operative briefing tool can improve quality of patient care. The attending surgeon led a two-minute briefing using a standardized checklist that included the critical components of each case (Nundy et al., 2008). The OR Briefing Assessment Tool (ORBAT) was used to evaluate delays at the end of the procedure. There were 422 respondents including attending surgeons, circulating nurses, surgical residents, CRNAs, and medical students (Nundy et al., 2008). Surgeons reporting unexpected delays decreased from 38% to 7%, \( p = <.01 \) (Nundy et al., 2008). Furthermore, briefings were associated with 31% reduction in overall OR delays (Nundy et al., 2008).

Tadeo (2015) performed a 15-week quality improvement DNP project that implemented a pre-operative briefing with the aim of improving OR efficiency. The project resulted in 34% decrease in FCS delays, leading to 55% of cases starting on time.
(Tadeo, 2015). These studies demonstrate that briefings can create a favorable and predictable work environment that results in increased communication, teamwork, and performance.
METHODS

This chapter outlines the project’s methodology. This project was comprised of three interrelated tasks: (a) team building; (b) data collection; and (c) analysis and improvement interventions with repeat data collection. Interventions included a planning checklist and team briefing. A staff survey was administered to determine attitudes and beliefs with the process.

Setting

This project was conducted in a single Interventional Radiology (IR) angiography suite, fully equipped for a full range of elective and emergency interventional radiology procedures. Standard team structure for each IR case consisted of an interventional radiology physician, two IR technologists and two IR registered nurses. Department staff consisted of five IR technologists, six registered nurses, two care coordinators, four IR physicians, and two nurse practitioners. The role of the IR nurse practitioner included assisting in new patient consultations, post-procedure care, patient follow ups, patient education, in-patient rounds, performing minor procedures, and coordination of patient care.

Sample

The sample consisted of archival data related to delays with first case starts (FCS) in IR. Data was collected from June 1, 2016 to December 30, 2016. First Case Starts were defined as the time the first patient of the day completed the consent process with the IR physician. Evaluation of FCS included all elective IR procedure.
**Procedure**

The compliance rate with on-time FCS was calculated by the total number of days with on-time FCS divided by the total number of first cases of the month. Monthly FCS data, including Tables and graphs, were strategically posted in the IR suite and other areas of the radiology department. These graphs and Tables showed the compliance rate with FCS, delays, and reasons for delays.

Metrics consisted of time reports that included outpatient arrival check-in to radiology reception, patient time-in the IR suite, and actual start time when FCS is delayed, as well as the reasons for delays. Daily documentation of metrics was performed by either the IR nurse or technologist and entered in pre-existing electronic database. The electronic database was password protected and only available to the IR team. No patient identifiers were collected. All urgent or emergent IR cases were excluded.

**Project Team**

An interdisciplinary quality improvement team representing all stakeholders was formed. The team met weekly in person. An agenda was used to communicate the proposed meeting content. During project initiation, patient workflow was reviewed and mapped, and appropriate metrics to be collected were defined. Reports and metrics were used to analyze and evaluate workflow processes and identify causes of delays. During later phases of the project, minutes of previous meetings were distributed and data were discussed.
Checklist and Team Briefing

A checklist was developed with inputs from IR care coordinators, IR nurses, nurse practitioners, IR physicians, and IR technologists. It consisted of the steps necessary to fully plan and prepare for IR procedures. Members of the IR team were provided the opportunity to critique the checklist to assess its accuracy.

The electronic checklist was used for all scheduled cases and completed the day before the procedure. The checklist was located in an Excel document and attached to the case schedule in the department Outlook procedures calendar. The calendar was only available to members of the IR team. Care coordinators, nurses, and nurse practitioners were the primary users of the checklist. Each item on the checklist was marked off when staff member verified that the step had been completed. Password protection was added to the checklist to prevent users from accidentally changing or deleting important data. The password was only available to the IR team. The checklist did not contain any patient identifiers. The Project Leader monitored compliance with the checklist.

Introduction of and education regarding the checklist was delivered in the weekly IR team meeting. An initial 30-minute presentation covered background and elements of the quality improvement project. An additional 30 minutes was allotted for the staff to ask questions and express concerns. Education and training of the IR staff occurred from September 1, 2016 to September 30, 2016. Poster-size checklists were made and hung in the IR suite, nurses’ office, and care coordinators’ office. These posters served as a reminder and were used to ensure consistency in the steps.

A team briefing, led by the IR nurse practitioner, was conducted the day before the procedure and included all cases scheduled for the day. The checklist assigned to
each case was printed in paper form and was used to conduct the briefing. All members of IR team were invited for the team briefing; however, physicians and IR technologist did not participate in the team briefing due to time conflicts. The briefing took place in the IR suite and took approximately five to seven minutes. Compliance with performing the team briefing was tracked by the Project Leader.

At 1 and 3 months after implementation, the entire IR team was invited to complete a survey to identify attitudes and beliefs regarding the checklist. The survey consisted of 16 questions relating to the use of the checklist. A Likert-like scale was used for the response. The survey was anonymous. A disclaimer was placed on the staff survey stating that completion of the survey indicated consent to participate in the survey.

**Data Analysis**

Data was compared from before and after the institution of the project to assess the effectiveness of the quality improvement initiative. A frequency distribution Table and graph was used to illustrate delays to FCS in IR. Statistical analyses were completed in SPSS Statistics software, version 22.0.

The cost of delays was determined by the number of delayed minutes times the hourly cost to run the suite ($1,560 per hour) (J. Park, personal communication, January 16, 2016). This amount was calculated from total labor costs and fixed costs divided by the total hours of operation per year. Labor costs reflected the IR staff base salaries while fixed costs covered basic equipment and repair. This hourly rate excluded the cost of supplies for specific IR procedures.

Team members, whose salaries were included in this project were a physician ($160), two nurses ($55 per nurse), two technicians ($45 per technician) and a
coordinator ($20), which totaled $380 per hour. Thus the cost to run the IR suite was estimated at $26.00 per minute

**Protection of Human Subjects**

Patient consent was not required because the project was deemed to be quality improvement. No patient identifiers were collected in the course of this project. Protection of subjects was sought from the Project Leader’s home institution and California State University, Los Angeles Institute Research Ethics Board (IRB) for approval before beginning the project. A determination was made that the project did not meet the definition of research according to Federal Regulation 45 CFR 46 (Appendix D). This project met all requirements regarding Health Insurance Portability and Accountability (HIPAA) compliance.
RESULTS

This chapter presents the results of data analysis including delays with First Case Starts (FCS), survey results, and cost analysis related to FCS delays. Staff compliance using the IR checklist was 92% (N = 57) during this project. Team briefings occurred for the following day cases 84% (N = 52) of the time. Interventional Radiology nurses, nurse practitioners, and coordinators were the main participants of the team briefing.

First Case Starts

Data were obtained for 146 FCS in the project period from June 1, 2016 to December 30, 2016. Pre-intervention data, comprising 63 first case starts were collected from June 1, 2016 to August 31, 2016. Post-intervention data, totaling to 62 first case starts were collected from October 3, 2016 to December 30, 2016. Education and training to IR staff was provided during September 1, 2016 to September 30, 2016. A start time was recorded as “delayed” if the procedure began more than 15 minutes after the scheduled start time. Start time was defined as when sedation is first administered at the start of the procedure.

Table 1 shows the number and percentage of FCS delays and total IR case delays before and after the practice change. Interventional Radiology total case delays decreased from 94% pre-intervention to 87% post-intervention. The total volume of IR cases decreased slightly from 711 pre-intervention to 681 post-intervention. There were three first cases that were canceled pre-intervention compared to one first case that was canceled post-intervention. In the pre-intervention period, two of the three first case cancelations were due to the patient not being clinically stable to undergo IR procedures and one was because general anesthesia was not pre-arranged for the procedure. After practice change, general anesthesia was not arranged for a first case on October 2
resulting in cancelation. It was noted that the checklists were not utilized for cases scheduled on October 2; this resulted in two additional case cancelations for that day.

Table 1

Number and Percentage of Delayed First Case Starts and Overall Case Delays Before/After Practice Change

<table>
<thead>
<tr>
<th></th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed first case starts</td>
<td>17</td>
<td>18</td>
<td>18</td>
<td>16</td>
<td>10</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>(80%)</td>
<td>(90%)</td>
<td>(82%)</td>
<td>(70%)</td>
<td>(47%)</td>
<td>(40%)</td>
<td>(48%)</td>
<td></td>
</tr>
<tr>
<td>Total first case</td>
<td>21</td>
<td>20</td>
<td>22</td>
<td>23</td>
<td>21</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>*Total case delays</td>
<td>273</td>
<td>206</td>
<td>194</td>
<td>233</td>
<td>185</td>
<td>231</td>
<td>182</td>
</tr>
<tr>
<td>(97%)</td>
<td>(93%)</td>
<td>(92%)</td>
<td>(93%)</td>
<td>(86%)</td>
<td>(88%)</td>
<td>(88%)</td>
<td></td>
</tr>
<tr>
<td>Total IR cases</td>
<td>282</td>
<td>222</td>
<td>211</td>
<td>250</td>
<td>215</td>
<td>261</td>
<td>205</td>
</tr>
</tbody>
</table>

* Cumulative delays throughout the day

Table 2

Number and Percentage of First Case Start Delay Minutes Before/After Practice Change

<table>
<thead>
<tr>
<th>First Case Delayed Minutes</th>
<th>Pre (June-August)</th>
<th>Post (October-December)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤15</td>
<td>10 (16%)</td>
<td>34 (55%)</td>
</tr>
<tr>
<td>15-30</td>
<td>17 (27%)</td>
<td>13 (21%)</td>
</tr>
<tr>
<td>30-60</td>
<td>24 (38%)</td>
<td>15 (24%)</td>
</tr>
<tr>
<td>&gt;60</td>
<td>12 (19%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>
Overall, 85% of first cases (n = 53) were delayed before practice change: 15% (n = 10) by ≤ 15 minutes, 32% (n = 17) by 15-30 minutes, 45% (n = 24) by 30-60 minutes and 19% (n = 12) by > 60 (see Table 2). First Case Starts delayed by 30-60 minutes decreased from 38% (n = 24) to 24% (n = 15). First Case Starts delayed by > 60 minutes were reduced from 19% (n = 12) to 0.

Average first case delays improved from 36 minutes to 25 minutes. Total first case delay minutes were reduced from 2,231 to 1,340 post-intervention. Average monthly first case delay minutes decreased from 744 minutes to 446 minutes. Overall, on-time FCS increased from 14.3% pre-intervention to 52.4% post-intervention. Figure 2 represents the trend of the monthly on-time FCS percentage and FCS delay minutes from August to December; on-time FCS peaked at 60% in October.

Figure 2. First case on-time start trend from June 2016 to December 2016
Analysis of the causes for FCS delays in the pre-intervention period demonstrated that the most common reasons for delay were IR physician late (55%), lab delays (11%), scheduling (9%), and patients not optimally prepared for the IR procedures (8%) (Table 3). All types of delays demonstrated reduction in delayed minutes after practice change except the physician induced delays. Approximately 1,079 FCS delay minutes were caused by physician delay during pre-intervention and was noted to increase to 1,143 minutes post-intervention despite fewer cases.

Figure 3. Delay Types and Duration of Delay Minutes.
Table 3

Number and Percentage of Specific Reasons of Delays Before/After Practice Change

<table>
<thead>
<tr>
<th>Delay Reasons</th>
<th>Pre (June-August)</th>
<th>Post (October-December)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR Physician delay</td>
<td>29 (55%)</td>
<td>23 (82%)</td>
</tr>
<tr>
<td>Patient with no lab/lab delay</td>
<td>6 (11%)</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Medications/Orders</td>
<td>3 (6%)</td>
<td>0</td>
</tr>
<tr>
<td>Consent</td>
<td>2 (4%)</td>
<td>0</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>2 (4%)</td>
<td>0</td>
</tr>
<tr>
<td>Patient not optimally prepared</td>
<td>4 (8%)</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Scheduling</td>
<td>5 (9%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Patient</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Post Implementation Survey

A 16-question survey about attitudes toward the checklist was distributed at 1 month and 3 months after implementation. A total of 10 (100%) surveys were returned at 1 and 3 months. Most IR staff agreed that the checklist served as an important communication tool (mean, 4.2/5 at 1 month, 4.8/5 at 3 months) and that it was in the patient’s best interest (mean, 4.7/5 at 1 month, 4.9/5 at 3 months (see Figure 4 and Figure 5). It was appreciated as a tool to improve collaboration among staff (mean, 4.5/5 at 1 month, 4.7/5 at 3 months) and improve patient safety (mean, 4.3 at 1 month, 4.6/5 at 3 months). Finally, the checklist allowed staff to bring up concerns (mean, 4.1/5 at 1 month, 4.4 at 3 months).

Staff attitudes toward the checklist also changed at 1 and 3 months. At 1 month, a mean of 3.7/5 felt that the checklist “increases efficiency” and received more
appreciation at 3 months with a mean of 4.2/5. At 1 month, most staff was somewhat neutral about the checklist to “improve team morale” with a score mean of 3.5/5 and was regarded as having greater effect in improving team morale at 3 months with a mean score of 4.6/5.

![Survey at 1 Month](image)

**Figure 4.** Survey 1 month after implementation from 10 anonymous team members

**Cost**

The highest cost related to delays with FCS was attributed to physician issues. This totaled $28,054 pre-intervention and $29,718 post-intervention. First Case Start delays due to the patient not being optimally prepared for the procedure accounted for $11,388 pre-intervention and was reduced to $5,434 post-intervention. Lab delays were responsible for $7,540 and scheduling issues for $6,370 in additional costs before the practice change. No FCS delays were attributed to lab delays or scheduling after the practice change.
Figure 5. Survey 3 months after implementation from 10 anonymous team members

Staff were paid time and a half for overtime. The average overtime hours and approximate cost for the interventional radiology nurse were 95 hours per month ($7,837) during pre-intervention and reduced to 77 ($6,352) per month post-intervention. Interventional radiology technologists averaged 89 hours per month ($6,007) before and 62 hours per month ($4,185) after project implementation. There were in all 71 fewer cases during post-intervention, which is a possible reason for decreased overtime costs. Table 4 shows costs related to sources of delays and potential savings during pre-intervention versus post-intervention. Delayed minutes were multiplied by $26, the fixed cost per minute to run the IR suite.
Table 4

**Cost Related to Delays and Savings**

<table>
<thead>
<tr>
<th></th>
<th>PRE</th>
<th>POST</th>
<th>Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff OT</td>
<td>$41,532</td>
<td>$31,611</td>
<td>$9,921</td>
</tr>
<tr>
<td>MD delays</td>
<td>$28,054</td>
<td>$29,718</td>
<td>$0</td>
</tr>
<tr>
<td>Patient not prep</td>
<td>$11,388</td>
<td>$5,434</td>
<td>$5,954</td>
</tr>
<tr>
<td>Lab delay</td>
<td>$7,540</td>
<td>$0</td>
<td>$7,540</td>
</tr>
<tr>
<td>Scheduling delay</td>
<td>$6,370</td>
<td>$0</td>
<td>$6,370</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$29,785</strong></td>
</tr>
<tr>
<td><strong>Annual Potential</strong></td>
<td></td>
<td></td>
<td><strong>$119,140</strong></td>
</tr>
</tbody>
</table>

Total case delays, although not reduced as substantially as first case delays, demonstrated improvement. Average total delays pre-intervention were 224.3 versus post-intervention 199.3.
DISCUSSION

Delays with FCS have a significant impact on the delivery of high quality medical care. On-time FCS is significant because of the domino effect of subsequent delays to the remaining IR cases for the day (Saw et al., 2014). First Case Start delays lead to inefficiency, delays in treating patients, increased staff workloads, and increased costs at the project institution. The standardization of data collection and performance feedback in the weekly IR meetings helped detect causes of delays. Implementation of the IR planning checklist has been shown to improve IR efficiency in managing issues in the pre-procedure preparation, improving communications between IR staff, and helping prevent human errors (Russ et al., 2013). In addition, the checklist facilitated teamwork and created a predictable environment. These improvement initiatives for this project had a positive effect on service and efficiency metrics particularly with FCS.

The three main elements of this quality improvement project that reflect the Plan-Do-Study-Act framework are team building, data collection and analysis, and implementation of improvement initiatives such as the IR planning checklist. The PDSA framework emphasizes that quality improvement is an interactive process, one in which quantitative data, planning, and action are all integral components (Bruno & Nagy, 2014).

The project team consisted of personnel from all levels of the IR team. This interdisciplinary approach provided insight into the IR workflow and expert advice from those in administrative positions. The project team also helped to increase awareness of the project and its goals. In addition, the project team met weekly to review the data, and continuous modifications were made regarding the checklist and timing of the team briefings.
The project leader had ongoing communication with the entire IR team throughout the project to discuss progress. Effective communication was a critical component and vital to establishing a practice change (Braaf et al., 2015). Weekly meetings, continuous education about the project, and providing open communication prevented communication failures (Braaf et al., 2012). Recognizing the value of communication aided with identification of problems and increased the quality of care to patients (Braff et al., 2012).

The project had a significant impact on improving on-time FCS starts from 14.3% to 52.4%, thus achieving the project goal of at least 50% on-time FCS. However, total case delays during the project showed minimal improvement from 94% pre-intervention to 87% post-intervention. Data analysis revealed that 55% (N = 29) of FCS delays were caused by physician delays; this did not improve after practice change at 82% (N = 23) shown in Table 3. Although physician delays accounted for a greater percentage of all delays, physician delays actually improved marginally from 4% of the time the physician started the case late in the preintervention versus 3.3% of the time postintervention. A monthly average of 463 delayed minutes with FCS from physician delays contributed to inefficiency throughout the project (Figure 3). This project, however, did improve FCS delay minutes by > 60 minutes, which were reduced from 19% (N = 12) to 0.

These findings demonstrate the complexity and different factors contributing to delays within the IR department. The most likely reason for the less than optimal improvement in total case delays is due to the persistent physician delays. Physician delays were the only source of delays with FCS that did not demonstrate any significant improvement after implementation of improvement initiatives. Wright, Roche, and
Khoury (2010) determined that the most common reasons for delays in the operating room were due to physician’s unavailability and a lack of preparedness of patients. In the same setting, Panni et al. (2013) identified attending surgeon’s tardiness as the most common reason for FCS delays. Main causes of physician related delays were changes in their morning schedules and “poor booking” of cases (Wright et al., 2010). Currently, the project site has no standardized system to collect and analyze data relating to physician related delays. Data related to identifying physician delays could promote process optimization moving forward in achieving improvements in practice (Wright et al., 2010).

To improve physician compliance with on-time FCS, data was made transparent and reasons of delays were discussed in our weekly meetings throughout the project. In addition, a biweekly FCS performance report was distributed to the IR team through electronic mail and monthly FCS trends (Figure 2) were posted in the IR suite. However, physician’s behavior was not impacted by the project. Mostofian et al. (2015) reported that multifaceted interventions were the most effective approaches to changing physician behavior. These identified interventions were financial incentives, supportive local opinion leaders, audit and feedback, reminders, and active educational methods. Fezza and Palermo (2011) developed interventions to modify surgeons’ late arrival behavior by requiring them to arrive 20 minutes before their first case and documenting their arrival times in the operating room. These strategies focused on physician’s accountability, which resulted to improvement in on-start start times.

Other methods to improve total case delays are to implement a data driven and performance feedback process that will help identify workflow bottlenecks by tracking process times, identifying key problem areas, and developing improvement interventions
based on metrics (Villareal et al., 2015). Porta et al. (2013) reported that a postoperative
debriefing system was valuable in identifying and reducing overall operating room
delays. These interventions may need to be considered to further improve IR efficiency
and decrease the number of total case delays. This challenge will be addressed as a next
step.

The problems of delays with FCS relating to patient care were identified and
improvement initiative resulted in reduction of FCS delays. As shown in Table 2,
laboratory delays, scheduling, and patients not optimally prepared for the IR procedures
were the most common reasons of FCS delays relating to patient care. Wong et al.
(2010) found that the two major reasons for delays in an operating room setting was due
to equipment failures and delays in getting the patient into the operating room; however,
it was noted that data collection and analysis was performed by a surgeon. Koetser et al.
(2013) identified that the main causes of delays and cancelations in interventional
radiology were missing patient information (history, laboratory results, relevant imaging,
etc.), unavailability of physician, and patient not optimally prepared for the procedure
which mirrors the main causes of FCS delays at the project site. It was determined by the
entire project team that implementation of the planning checklist and team briefing would
focus attention on these types of delays with FCS. During the education period, the
checklist was modified, and inputs from the entire team regarding the checklist were
accepted (see appendix B). This was a vital period since it put the checklist to test.
Koetser et al. (2013) first issued a checklist in interventional radiology and then tested it
in practice for 3 weeks. During this period, subsequent evaluations and modifications
were made to the checklist, leading to a prototype checklist ready for dissemination (Koetser et al., 2013).

The delays related to patients not optimally prepared for the procedure were responsible for 438 delay minutes with FCS during pre-intervention. Patients not optimally prepared for the procedure either needed blood product transfusion, IV hydration, or medications prior to starting the procedure that caused the delay. An uncorrected anticoagulative status was the main reason for patients requiring blood product transfusion in IR (Koetser et al., 2013). By October 2016, the checklist could identify these patients who were arranged to come in the day before their procedure to either receive blood transfusion or IV hydration. Patients requiring additional medications for the procedure were instructed to come in three to four hours before the procedure start time instead of coming in the usual two hours before. This type of delay was reduced to 142 minutes post-intervention.

The third most significant delay with FCS was a delay in obtaining laboratory results. Predominately, this occurred with patients that were not permitted to have laboratory work performed in the project facility due to insurance coverage. Intervention initiatives assisted in recognition of patients that had laboratory work completed at another facility. The clinical coordinator or a department nurse was charged with obtaining these results on the day before the scheduled procedure. In the event the patient had no recent laboratory work completed, they were instructed to have blood drawn at the project facility in the morning before the procedure. This issue was identified during the implementation period and was resolved. The director of Radiology agreed to absorb the laboratory cost from these types of situations to minimize delays.
with FCS. Laboratory delays with FCS were consequently reduced from 290 to 0 minutes.

FCS delays related to scheduling were reduced from 245 to 0 minutes. Delays related to scheduling totaled 14% of FCS delays in an operating room arena (Panni et al., 2013). Scheduling delays previously occurred when cases were not booked for recovery, double booking of physician’s schedule, or when insurance authorizations were not cleared. The checklist reminded our coordinators to ensure that scheduling conflicts were resolved before the day of the procedure.

Implementation of the checklist refined the IR preparation process and demonstrated a direct impact on on-time FCS. On-time FCS not only improved IR efficiency, but also boosted morale of the staff and, most importantly, improved the quality of service provided to patients. The surveys implemented at 1 and 3 months demonstrated that the checklist served an important tool for communication, and improved collaboration among team members. Team moral improved throughout the project. Russ et al. (2013) suggest that checklist helps establish a platform for communication, encouraging the sharing of vital information, enhancing team coordination and team cohesion. Survey results demonstrate that the improved processes improved team morale with a mean score of 4.6/5 at 3 months compare to 3.5 at 1 month.

Staff reported that the checklist increased efficiency; survey results demonstrated a mean score of 4.2/5 at 3 months compare to a mean score of 3.7/5 at 1 month. The checklist introduced a culture that valued consistency. By ensuring that the team consistently followed a few critical steps, it was possible to minimize common mistakes and reduce unforeseen delays. The use of the checklist helped ensure that relevant
patient data were brought to the forefront before the day of the scheduled procedure. Based on this experience, the checklist had positive effects on team communication and collaboration. Moreover, the checklist promoted significant involvement and awareness of patient safety among the IR team members.

The implementation of the project with improvement on FCS resulted in earlier finish and more efficient use of the IR suite throughout the day. This can have a direct impact on cost. The United States spent $2.5 trillion on healthcare in 2009, and several studies that examined the cost burden have suggested that staffing alone in a single operating room costs approximately $10 per minute (Correll et al., 2006; Porta et al., 2013). These costs can be significant over the course of the year. Implementation of this project has saved the IR division nearly $30,000 for three months that can potentially amount to approximately $120,000 during the course of a year (see Table 4). Clearly, delays add costs, and implementation of our improvement initiatives can have significant cost savings.

Patient satisfaction can also affect financial remuneration. Reducing delays in patient care can directly impact patient satisfaction. Wait times and delays in care are the number one complaints from patients (Villarreal et al., 2015). Therefore, improvement in on-time FCS can equate to less wait times for patients, which is a key predictor of level of patient’s satisfaction (Sorenmekun et al., 2011). It is imperative for our healthcare system to provide high quality-care to patients especially since the Hospital Consumer Assessment of Healthcare Providers and Systems (HCHAPS) scores have been tied to reimbursements (Lang et al., 2013). With increasing healthcare cost at stake,
implementation of evidence-based strategies as demonstrated by this project can improve patient satisfaction to improve HCHAPS scores.

**Project Limitations**

It is important to mention the limitations that are associated with this project. This is a pilot study. Implications of the project findings are limited because practice changes were implemented for only 3 months. The entire IR team, including those who recorded the delay data, were aware of the project goals to improve FCS and efforts to reduce delays and this may have biased performance.

The project leader also served as the “pre-procedure facilitator” throughout the project ensuring that the planning checklists were completed and briefing occurred. It is posited that some of these improvements are partly due to having a facilitator to enforce implemented practice changes. A quality improvement project by Panni et al. (2013) had demonstrated that a dedicated pre-operative facilitator could make a substantial improvement in on-time FCS in a surgical setting. Finally, total case delays were not significantly improved despite improvements in on-time FCS. Knowing that on-time FCS has a ripple effect on the subsequent cases, it was anticipated that the overall total case delays would substantially improve. A definite cause for the lack of improvement in total delays was not established; however, these results were likely caused by physician delays because their delays did not improve during the project. This project had no control over the physician group tardiness behavior. In addition, the improvement with on-time FCS may not directly result in improving patient satisfaction. Patient satisfaction was not measured in this project as the focus was improving on-time FCS.
Implications

Several factors enabled improvements in the IR department. First was focusing on improving First Case Starts. Buy-in was obtained from the senior leadership including department manager, charge nurse, and chief of IR. This focus was communicated to all levels of the IR team including front line staff. The second key factor was the one-month educational period. During this time, multiple adjustments were made in the checklist and timing of team briefing. This time created a sense of team building and commitment to achieving the project goal. Having a transparent data was the third key success factor. A performance report was presented during the weekly IR meeting and distributed to all members of the IR team through email. The report displayed reasons for delay to FCS and the length of delays in minutes.

Although the quality improvement project made significant improvements during the 3-month intervention, the project did encounter some barriers to success. The culture of inefficiency that had not been challenged for years was the most challenging barrier. This project served as a catalyst to help transform the department culture to improve overall patient care. The transparency of data and sharing it among the IR team and stakeholders created a higher level of accountability that did not exist before project implementation. Another barrier was the misperception that the IR technologists were not part of the improvement initiatives. This was rectified early in the process. Perception was changed from a “nursing project” to a department project. When data sharing began, it became evident to most of the IR technologist that they had a major role in ensuring on-time case starts. This further illustrates the concept of improving accountability simply by providing transparent data.
This quality improvement project was the first step to improve patient workflow in an Interventional Radiology division. After the project implementation and the achievement of the project goal of at least 50% on-time FCS, the team felt the need to continue with the practice change. One finding that was not anticipated was that our total case delays were not significantly impacted. The most challenging barrier moving forward is to obtain buy-in with the improvement initiatives from all our physicians. Multiple interventions need to be examined to facilitate change in physician behavior. Prior to determining interventions, a stakeholder meeting including physicians will be scheduled to evaluate policies to improve physician related delays. Ongoing data collection will be continued to track progress toward goals. The use of the checklist in the IR department has shown positive results; this supports the limited literature for the use of checklists in non-operating room procedural areas (Koetser et al., 2013). In addition to improving flow, the checklist fosters a culture that promotes team communication and minimizes human errors. The checklist demands everyone to accept and be involved with the change, including coordinators, nurses, physicians, and technologist. Checklists should be evaluated periodically and revised as needed to accommodate changes in practices.

Conclusion

The Interventional Radiology division is a complex environment with many different factors that contribute to patient delays. Causes of delays are often due to communication errors and lack of process standardization. Interdisciplinary team-based approach and implementation of a checklist is an effective way to standardize the IR pre-procedural process thereby reducing delays. By applying these quality improvement
initiatives, this project was able to improve the pre-procedural process and take the first step to improving the IR workflow. This project has improved compliance with on-time FCS and has the potential to decrease overall total delays. However, further interventions need to be examined to improve total case delays. Lastly, this project was responsible for developing a culture of improvement within the department. This change of department culture will be vital, as quality improvement is a continuous process that requires sustained commitment from everyone in the team, to sustain the improvement.
REFERENCES

doi:10.1016/j.jacr.2014.08.028


doi:10.1111/j.1365-2702.2012.04228.x


# APPENDIX A

## INTERVENTIONAL RADIOLOGY CHECKLIST

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Comments/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requisition form</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case scheduled</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visit number created</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery booked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case confirmed and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>instructions given to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient has a driver</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticoagulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medication stopped</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anesthesia necessary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/Anesthesia clearance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant medical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>history</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indication for</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>procedure clear</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relevant imaging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>studies present</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALLERGIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contrast allergy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>checked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIN prophylaxis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recent pertinent labs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coagulation screen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>checked: PT...INR...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR premedication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ordered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-interventional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ICU) bed required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B
REVISED INTERVENTIONAL RADIOLOGY CHECKLIST

<table>
<thead>
<tr>
<th>IR PLANNING CHECKLIST</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requisition form</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Scheduled</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visit # Created</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery booked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient informed the procedure date and time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient has a driver</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticoagulation medication stopped</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| NPs                                 |     |    |     |          |
| Anesthesia Necessary/ (PAT)         |     |    |     |          |
| Relevant Medical History            |     |    |     |          |
| Indication for procedure clear      |     |    |     |          |
| Relevant imaging studies present   |     |    |     |          |
| Contrast Allergy Checked            |     |    |     |          |
| CIN Prophylaxis                     |     |    |     |          |
| Recent pertinent Labs Results       |     |    |     |          |
| Coagulation screen checked: PT.....INR... | |    |     |          |
| Medications /labs ordered for the procedure | | | | |
| Post-interventional (ICU) Bed Required | | | | |
| Home Health                         |     |    |     |          |
| Other                               |     |    |     |          |</p>
<table>
<thead>
<tr>
<th>IR Nurse Call Day Before Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checklist reviewed</td>
</tr>
<tr>
<td>Patient contact info</td>
</tr>
<tr>
<td>Instruction given to</td>
</tr>
<tr>
<td>NPO</td>
</tr>
<tr>
<td>Anticoagulant last dose</td>
</tr>
<tr>
<td>ALLERGIES</td>
</tr>
<tr>
<td>Diabetes medication holding</td>
</tr>
<tr>
<td>Driver confirmed</td>
</tr>
<tr>
<td>Lab appointment at</td>
</tr>
</tbody>
</table>
### APPENDIX C

**LIKERT SCALE QUESTIONNAIRE**

Attitude questions towards IR checklist.

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Increases delay between cases</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2 Is a waste of time</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3 Is an opportunity to identify problems</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4 Provides important patient information</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>5 Increases efficiency in department</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>6 Has good support in department</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>7 Improves team morale</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>8 Has improved communication in IR</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>9 My suggestions are acted upon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Effective channel for patient care issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Decreases medical errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Improves patient safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Improves collaboration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Allows me to bring up concerns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Serves patient’s best interest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Useful communication tool</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

INSTITUTIONAL REVIEW BOARD ACTION NOTICE

INSTITUTIONAL REVIEW BOARD (IRB) ACTION NOTICE

TO: Paulo Jusay, M.S., Principal Investigator
City of Hope - Interventional Radiol

FROM: Diana Shycoff, BS, IRB Operations Manager
Office of Human Research Subjects Protection

DATE: June 13, 2016

STUDY TITLE: Improving first case start and decreasing delays in interventional radiology- A quality improvement project

IRB#/REF#: 16224 / 131075

SUBMISSION: SUBMISSION EVALUATION

IRB ACTION DATE: 06/13/2016

IRB ACTION:

The information provided for the above submission was evaluated and determined to not involve human subjects research (45 CFR 46.102 (d)(f)). Therefore, it does not need to be approved nor does it need to undergo continuing review by the Institutional Review Board (IRB).

Please note that if any changes occur on this project, notification to the IRB is required to determine if the status of this project should be updated to be under the purview of the IRB.

NOTE:

IF ANY CHANGES IN THE RESEARCH INVOLVING HUMAN SUBJECTS ARE PLANNED, A SEPARATE SUBMISSION UNDER A NEW IRB NUMBER MUST BE MADE ACCORDING TO REGULAR SUBMISSION REQUIREMENTS. NO CHANGES INVOLVING HUMAN SUBJECTS MAY BE INITIATED UNTIL REVIEW HAS BEEN OBTAINED.

If you have questions or concerns about this submission, please contact Suzanne Kelly.