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Improving Throughput in Interventional Radiology: A Team Collaboration

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A B S T R A C T

The project purpose was to reduce patient throughput to 15:00 minutes or less once the patient arrived in interventional radiology (IR). Ishikawa (fishbone) diagram and Plan-Do-Study-Act test of change scientific methodology were used. Baseline data, specifically the time the patient arrived to the holding area to the time the patient was ready to begin the procedure was collected. Focus groups, through brainstorming, provided fishbone categories and causes leading to delayed throughput. Kotter's (2019) eight-step process of creating change was used to transform the team and execute the change. Over 10 months, between August 2017 and June 2018, data for start time were tracked for 1188 inpatients procedures and 1708 outpatient procedures. Overall time reduction from a mean time of 25:30 minutes to a mean of 15:00 minutes was achieved for all cases. A new model of care delivery realigned IR roles and created a structured process, improving interprofessional members' communication of pertinent patient safety information. Creating and implementing a new care delivery model based on interprofessional collaboration can be accomplished without increasing the number of physician providers, IR technologists, RNs, or support staff. The decreased throughput time was directly influenced by realigning staff roles and responsibilities and creation of the charge nurse role.

Every industry measures throughput, but beyond profit or loss considerations, when health care systems focus on throughput, they measure between life and death. Without efficient and effective throughput, interventional radiology (IR) departments can jeopardize patient safety, delay timely diagnosis or treatment, and risk sustainability of the health care facility because of lack of funding. Improving the efficiency of IR throughput occurs when a healthy interdisciplinary work environment allows for team work, communication, and clear role responsibilities. This article will present findings from focus groups that uncovered impediments in the structured workflow processes and team member responsibilities, specifically lack of the charge nurse role.

After a successful performance improvement project for mock code blue drills increased team vitality and supported a healthy work environment (Sattler, Morrison, & Steele, 2019), the IR RNs consensus was the next project that would focus on improving throughput and patient safety. With morale high among physicians, advanced practice providers (APPs), RN, and IR technologists, and the relentless patient care demands consistently threatening to strain relationships, improving throughput as measured by the time to the first procedure was undertaken. The Association of Radiology and Imaging Nurses 2018 annual meeting had three teams presenting on the topic, the authors from this article at Emory Healthcare and teams from Mayo Clinic Arizona and Dartmouth-Hitchcock.

The purpose of the project was to reduce the first case on-time start patient throughput to 15:00 minutes from patient arrival in IR holding area to procedure initiation by implementing a new care delivery model and to improve an organizational quality goal.

Background

The project setting was a Magnet®- designated academic medical center in the southeastern United States in a typical inpatient and outpatient IR department where complex image-guided procedures are undertaken. Forty percent of procedures come from the inpatient setting and 60% are performed on outpatients. The team performs minimally invasive image-guided diagnosis and

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treatment procedures, including angiograms, implantable medication port placement, vascular angiograms, renal and iliac stenting, vertebroplasty, computed tomography–guided biopsies, and other preoperative and postoperative procedures. Departmental patient satisfaction scores at the time of the project were above average, at the top percent in the nation. Project participants included the IR team of 44 interprofessional health care providers who actively work full time (see Figure 1).

First case on-time starts are crucial in IR. Antidotal evidence leads us to believe that if first case is delayed, a cascade of unsatisfied patient experience surveys would follow, department revenue could be negatively impacted, and inefficiency observed as staff waiting around would demoralize team morale. The entire interprofessional team must work together, functioning efficiently like a fine-tuned operation. The throughput process incorporates the same three phases for both the inpatient and outpatient: (1) bedside RN preprocedure workup (intravenous [IV] started, lab work drawn, patient education, medications reviewed, and consent signed), (2) IR RN holding area procedure workup (identification check using the arm band, review of patient's history, and allergies, review of patient's knowledge of the ordered procedure and education, and explanation of what is going to happen once they enter the procedure suite, and (3) IR RN procedure suite workup (connect to the cardiac monitor, oxygen, and capnography initiated, insertion site prepped, and safety time out completed).

Physical location of hospital IR departments is frequently not ideal. In the performance improvement project setting, the IR department is not adjacent to the admissions/recovery unit. First phase for inpatients is conducted by the bedside RN, but for outpatients, it is completed in the admissions/recovery unit. After the phase 1 preprocedure workup is completed, the patient is transported directly from their room or the admissions/recovery unit to the IR Holding area. Once the patient arrives to the IR Holding area, an IR RN greets the patient and performs phase 2 holding area procedure workup. The RN then gathers medications needed for the case. The goal is to have the procedure suite workup completed ready for a puncture time of 0800. Each step of this process is critical to prevent errors and halt a procedure before a sentinel event can occur. The project was initiated by implementing the test of change methodology to help guide the design a new care delivery model.

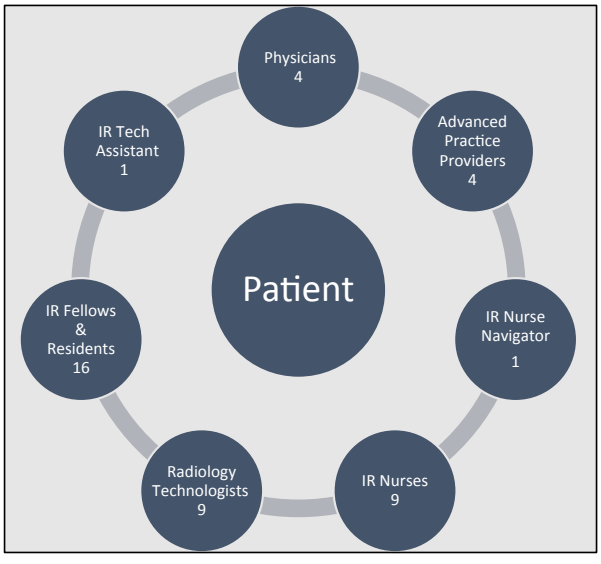

Figure 1. Collaborative IR team. IR, interventional radiology. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Methodology

The problem, expressed in the PICOT formula to identify the population (P), the intervention (I), comparison (C), and outcome (O), follows "In the IR department does identifying causes for delayed first case start time and implementing a new care delivery model make a difference in throughput as measured by time from a mean of 25:30 minutes to a mean of 15:00 minutes." The methodology of this time project is the Ishikawa (fishbone) diagram and Plan-Do-Study-Act (PDSA) test of change scientific methodology, first described by Walter Shewhart and Edward Deming (Taylor et al., 2014). PDSA guides the team to plan, try, observe results, and act on what is learned.

After identifying the problem statement, the next step was to collect and review baseline data, specifically the time the patient arrived at the holding area to exact time the patient was ready to begin the procedure. The times were measured using the physical clock that hung over the main IR desk. Time was recorded in hour and minute for each patient on the daily IR schedule. Data were collected for all cases from August 2017 to June 2018. With the quantitative minutes' data in hand, the next step was to identify the causes on which to develop the new care delivery model.

Fishbone

A causal fishbone diagram was created to identify possible causes of delayed throughput and helped the team visualize and sort the findings into six categories. Using focus groups, composed of IR providers and staff, brainstorming sessions began with communication paths and roles and responsibilities that impact time efficiency related to workflow processes. The final fishbone categories indicate the actual causes identified from the focus groups (see Figure 2).

The fishbone identified six categories of causes of throughput delay in IR: patient, clinical staff, provider, measurement, environment/resources, and documentation. The causes in patient category encompassed: (1) incomplete preprocedure workup histories (e.g., uncertain nothing by mouth [NPO] status, poor intravenous [IV] access, and lack of timely termination of anticoagulants), (2) unstructured notification to IR RNs related to unscheduled and add-on appointments, and (3) patient safety, personal needs such as toileting on arrival in IR, and lack of removal of undergarments.

In the clinical staff category, two causes were identified: (1) accountability; the RNs were not assigned to cases rather handselected those cases of interest and (2) roles and responsibilities of team structure in the IR department were undefined (e.g., the attendings, APPs, fellows, and residents all participated in the patient consent process, with no consistency, and a glaring reason for poor throughput was the staff member sending the patient to enter the procedure area was not an RN but rather the IR technologist supervisor).

In the provider category, there were four causes: (1) poor team huddle communication; only the attendings, APPs, fellows, and residents and the IR technologist supervisor attended, so patient safety information was not shared with the RNs, who were not invited to the daily morning huddle. This lack of two-way sharing of patient information, such as change health status, cancellations, medications required in the procedure, abnormal lab results, and unassigned RNs to the cases often lead to delays, (2) the lack of a plan of care for the patient (e.g., postprocedure dialysis, discharge, or preadmitted inpatient stays), (3) unclear designated start times which hindered the team to adhere to the schedule, and (4) no provider was responsible for medication review (e.g., blood thinner end date, antibiotics needed before procedure, and allergies).

In the measurement category, the causes included the following: (1) identifying the staff were functioning as a reactive process by blaming, (2) incomplete data collection was exposed when it was

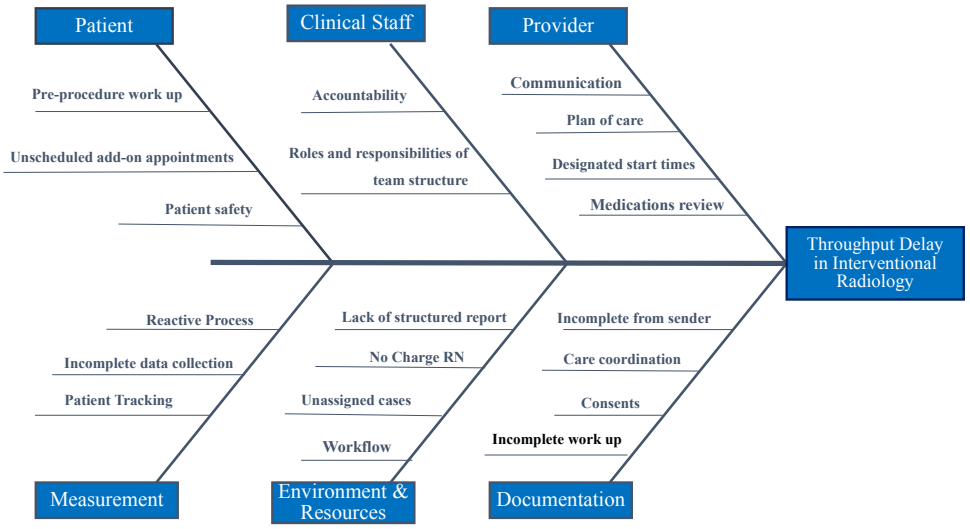

Figure 2. Ishikawa (fishbone) diagram of causes of throughput delay in IR. IR, interventional radiology. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

discovered the data collection tool for measuring quality was inconsistently completed and staff lacked the understanding of purpose, (3) no accountability for adjusting schedule to add on patients, and (4) the lack of a detailed patient tracking/communication system (e.g., inconsistencies on the white board included the lack of predetermined case start time, no indication of the RN or technologists assigned to the case, no indication of required medications needed, site to prep, and abnormal lab results).

Environment and resources category four causes were identified as a root of the throughput delays: (1) the lack of structured report, leading to unwarranted burst of inappropriate comments where a structured morning huddle could positively impact patient care, (2) the lack of a charge RN which led to no RN who had the overall picture of patient flow, (3) each day, cases were unassigned awaiting for an RN to volunteer, which leads to staff dissatisfaction, and (4) the lack of any workflow processes created an opportunity for staff to assist in what they liked rather than what was in the best interest of the patient.

The last fishbone category for delayed throughput was documentation. Four causes were identified: (1) incomplete information and documentation from the sender (e.g., any team member answered the IR department phone to receive a consult, often, there was a lack of information for care coordination), intake information was missing such as date of birth to look up the patient, the ordering physician's name, and the phone number to call them back, (2) lack of care coordination, such as postprocedure transportation, support at home first 24 hours, and follow-up care, (3) incomplete consents up to the time patients entered the procedure suite, and the IR providers lack of consistent procedure consent processes (e.g., providers were consenting in the inpatient room or in the outpatient clinic visit, preprocedure area, or in the holding area), and (4) the RN workup was incomplete, unstructured, and not completed in a timely fashion.

Avoidable causes identified on the fishbone clearly indicate why the first patient was not ready for their case. Unavoidable causes were not mentioned on the fishbone, such as, unexpected lab results, late arrivals, and changes in conditions, as patients are not predictable. Franklin and Franklin (2017) Lean Six Sigma multidisciplinary health care team and management engineers found these same categories and causes interrupted workflow patterns and throughput in the perioperative area.

The fishbone diagram, which kept the team focused on the causes of lengthy throughput, rather than the symptom, clearly indicated that lack of an authentic leader in the IR disincentivized the staff to take ownership in their work environment. Shirey (2017) systematic review of 10 research articles identified four themes of leadership practices for creating and sustaining a healthy work environment: quality leadership, relational exchanges, environmental elements, and contextual factors. The performance improvement project setting lacked these leadership practices. Her previous work also associated personal ownership of the work environment, stating it fosters healthy working relationships within an interprofessional team (Shirey, 2006). This empowerment creates a strong sense of trust between leaders and employees, allowing staff to make decisions, be risk takers, and collaborators (Shirey, 2006). Lomax and White (2015) found that health care reform has transformed care delivery models, to interprofessional collaborative care practice models that support frontline nurses to embrace a structured format that defines their role in the team. The fishbone illuminated, through categories, the causes that the collaborative team could address, such as re-evaluation of current tools and process, communication methods, and role clarification. The team was excited to not only improve throughput but also patient safety and their work environment.

Implementation Plan-Do-Study-Act

To accomplish the project purpose, to reduce first case patient throughput to 15:00 minutes or less from arrival in IR Holding area to procedure start time, the PDSA test of change was undertaken. The Plan phase was three parts: (1) creating the new care delivery model, (2) designing qualitative focus group questions to address issues of incorporating the new model, and (3) revising and encouraging the completion of the Blue Sheet, a unit-created blue piece of single-sided paper to document variable IR to improve outcomes.

The Do phase included incorporating the model, conducting the focus groups and extracting the data. In the Do phase, the staff chose to use Kotter's (2019) eight-step process of creating change.

New Care Delivery Model

The new care delivery model had five parts: (1) optimizing the patient tracking board; (2) defining a communication method; (3) defining and disseminating interprofessional team member's roles and responsibilities; (4) reevaluating the staff schedule; and (5) creating a charge nurse position.

Optimizing the Patient Tracking Board. Incorporating the new care delivery model began with optimizing the patient tracking board by adding more patient information, such as, allergies, medications to be used in the case, the nurse assigned to the case, and triaging the priority of the cases.

Defining a Communication Method. Next part of new care delivery model was the creation of the Quality Dashboard, placed on the IR team bulletin board, found in the staff break room. On the Quality Dashboard bulletin board, inspirational educational pictorials and meeting minutes were posted, besides the dashboard which displayed the Blue Sheet data and throughput time results. The bulletin board was updated monthly, and results were shared at staff meetings.

Defining and Disseminating Roles and Responsibilities. Early in the project in a staff meeting, the entire team was tasked to write on a piece of paper all of their day-to-day responsibilities. For example, most of the 24 providers wrote down obtaining consents, and the nine radiology technologists wrote stocking supplies. The only group that had a consistent list of tasks presenting a systematic process were the RNs, who identified they were responsible for the workups, medication administration, and care of the patient. What the RNs neglected to identity was their role in care coordination and interaction with technologists.

The process of collating the day-to-day responsibility papers helped define the interprofessional team member's roles and responsibilities. From this list, the team huddle was restructured to include RNs, rules of attendance, and expectations of patient information to be shared. Every team member began to see how they were accountable to the team. Two-way sharing of patient information was amplified, not only in the morning huddle but also through a daily group text messaging system.

Reevaluating the Staff Schedule. It was apparent from the fishbone findings that the staff schedule needed adjustment. For example, APPs concluded taking on responsibility for a consistent consent process was most efficient, thereby moving their arrival time up by 30 minutes, allowing for patient consents before morning huddle.

Creating a Charge Nurse Position. The unexpected discovery was the lack of one RN to manage the flow of patients in the IR. The IR technologist supervisor was burdened with patient care coordination for which she did not have time or training to assess patient needs. Her primary role was ensuring IR suites were operational, managing radiology technologist's skill mix, and schedule daily, in addition to ordering supplies and billing.

Conducting the Focus Groups

Focus groups supported the incorporation and allowed for continuous evaluation of day-to-day events. Lomax & White (2015) toolkit for frontline nurses to develop interprofessional collaborative care skills was used to help IR RNs transition away from working in silos to incorporating and embracing an interprofessional collaborative care practice model.

Extracting the Data

Extracting the data was completed through manually collecting documentation from the updated Blue Sheet, unit-created paper data collection tool, capturing the following pertinent throughput project demographic and time indicators:

1. Inpatient or outpatient;
2. Time the patient was called for from with admissions/recovery unit or inpatient unit;
3. Time the patient arrived in IR Holding;
4. Time the patient arrived at completion of IR RN procedure suite workup;
5. Reason for delay, if total time over 10 minutes.

The Blue Sheet was attached to each patient's workup history sheet. The RNs and IR technologist were both accountable to complete the Blue Sheet as it moved throughout the case. Times were recorded from the minute the patient was called for to the IR department to the minute the patient left. Staff initialed each notation to allow for follow-up and data validation. At the end of the day, the IR technologist supervisor was responsible to collect the sheets and deliver them to the team member assigned to quality for auditing. Lee et al. (2014) identified that incorporating a checklist-styled daily morning huddle serves as consensus-building performance improvement record and error reduction process. “The checklist is a deceptively mundane instrument whose potential for affecting process improvements and minimizing errors belies its fundamental simplicity “(Lee et al., 2014, p. 437).”

Kotter's eight-step process of creating change

With the new care delivery model and data collection in place, the staff chose to use Kotter's (2019) eight-step process of creating change (see Table 1). At each of Kotter's steps, the team identified the issues (or a Kotter says, the success factors) needed to transform the team and execute the change.

Once the Do phase of PDSA was completed, the collected data were analyzed (Study phase), and it was identified that another PDSA cycle was not needed (Act). The activities to implement the care delivery model were conducted as a single PDSA cycle.

Results

Over 10 months, between August 2017 and June 2018, data for start time were tracked for 1188 inpatients procedures and 1708

Table 1
Kotter's change steps applied to IR throughput project

Kotter's change step	Issues addressed in each change step
1. Create a sense of urgency	• Unstructured workflow • Role and responsibility confusion • Patient safety concerns
2. Build a guiding coalition	• Developed collaborative relationships within the interprofessional team • Executive sponsor, who was the unit director, addressed outside stakeholders
3. Form a strategic vision and initiatives	• In focus groups, examined roles and responsibilities and workflow processes • In staff meetings, reviewed and disseminated the related literature
4. Enlist a volunteer army	• In staff meetings, shared findings • Designed charge nurse position • Reevaluated and reeducated use of workup form • Improved communication method on tracking board • Initiated daily huddles
5. Enable action by removing barriers	• Authentic leadership empowered staff to support project • Held frequent staff meetings
6. Generate short-term wins	• Instituted quality dashboard bulletin board using inspirational educational pictorials and meeting minutes • Asked for feedback
7. Sustain acceleration	• Revised, refined, scaled, and built on the change
8. Institute change	• Addressed throughput data at staff meetings • Submitted project success to leadership • Incorporated project participation in performance appraisal

IR, interventional radiology.
Kotter, 2019.

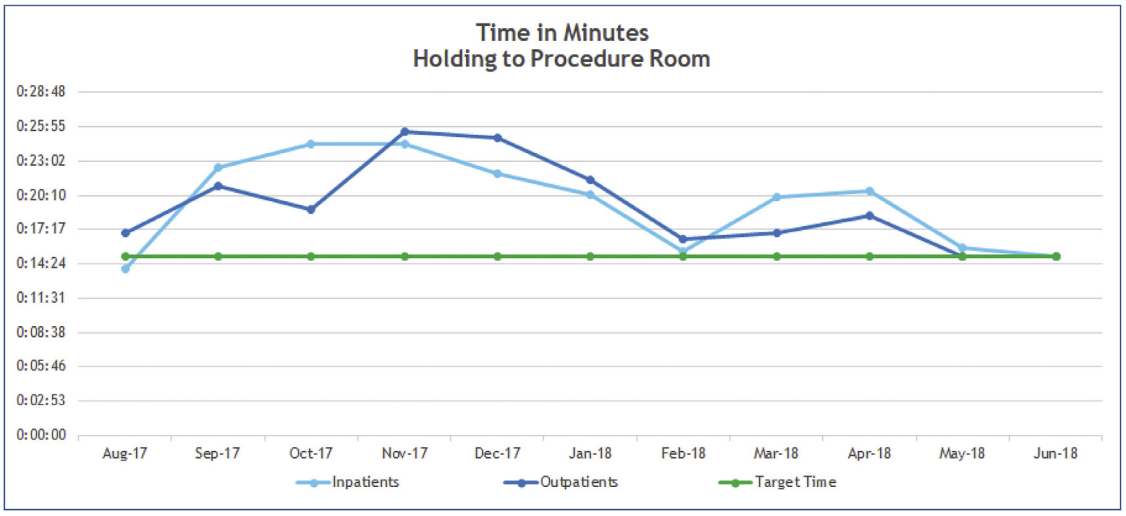

Figure 3. Timeline indicating reduction of start time of all cases from holding to the procedure room.

outpatient procedures. Overall time reduction from a mean time of 25:30 minutes to a mean of 15:00 minutes was achieved for all cases (see Figure 3).

Discussion

The overall time reduction is believed to be directly related to the introduction of a new care delivery model. The key element to success is the interprofessional collaborative team effort to create and support the charge RN role. In this complex IR work environment, improving the efficiency of IR throughput occurs when a healthy interdisciplinary work environment allows for team work, communication, and clear role responsibilities. But we found without a charge RN controlling the day-to-day operations, the throughput will not improve. Sherman, Schwarzkopf, and Kiger (2013) conducted an assessment of charge nurses to learn about their role and concluded the role of charge nurse has evolved to "air traffic controller." In the IR, the charge nurse can be the orchestrator of daily events, such as running team huddle, creating the RN patient assignment, communicating with other health care providers, monitoring admissions and discharges, providing in-time education, and playing a pivotal role in patient satisfaction. The charge nurse must be a multitasker to manage flow in IR, reduce the chaos, and trouble shoot problems, allowing for a more organized care delivery. To help the charge nurse cope with this role, Shirey (2009) found in her qualitative descriptive study that a positive healthy work environment can lower stressful situations. Overall, the charge nurse role worked well in the new interprofessional collaborative team model, improving the efficiency of IR throughput.

Conclusion

Delayed start times were identified as being caused by the multiple roles of IR department team members' play and the impact on the workflow processes. Instrumental to the success of the project was using the PDSA standard quality-improvement process, along with Kotter's change step framework. Creating and implementing a new care delivery model based on interprofessional collaboration can be accomplished without increasing the number of physician providers, IR technologists, RNs, or support staff. The decreased throughput time was directly influenced by realigning staff roles and responsibilities.

Conflict of interest

The authors have no conflict of interest, and no financial assistance was received.

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