Interventional Radiology Throughput Optimization

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Efficiency

Overview:

The interventional radiology (IR) section at Parkland Hospital in Dallas, TX was experiencing unacceptable wait times for elective outpatient procedures. Mediport placement scheduling delays were 43 days in December 2011. This delay causes decreased access to care for a vulnerable segment of Dallas County. Due to regulatory scrutiny of the hospital; physicians, nurses, technologists, and administration were aligned to resolve this problem. Initially, the delay was thought to be from a lack of procedure rooms. Plans to build another procedure room had been funded and was entering the design phase.

Aim Statement:

Reduce wait times for outpatient interventional radiology procedures by 50% by June 2012.

Measure of Success:

Decrease the scheduling delay for outpatient mediport placement as a proxy for all outpatient procedures.

Complete process analysis of the current IR service line including patient throughput and room utilization.

Use of Quality Tools:

Current and future states were process mapped and key data inputs were identified. (Figures 1A & 1B.) In the summer of 2011 changes to the EMR and to the process workflow were implemented and data became more reliable. (Figure 02.)

A Pareto analysis of the interventional radiology yearly volumes revealed that mediport placement was the most common procedure performed by IR representing 13% of the yearly volume. (Figure 3.) From this it was apparent that mediports are a good proxy for outpatient wait times. In addition a fishbone diagram was generated to better conceptualize contributing factors to the current state. (Figure 5.)

Volume analyses of the cases performed per day in the three IR rooms were analyzed by scheduling outcome (completed, no-showed, or canceled). Up to 25% of patients will no-show on a given day. (Figure 6.) A run chart of case volume was of limited utility due
to wide variation. (Figure 7.) In addition non-emergent inpatient cases are ‘bumped’ to the next day due to lack of room capacity. When a patient is rescheduled the order is canceled and then a new order is placed. Rescheduled cases then show up as canceled in the reports and are difficult to separate from cancelations.

Utilization was calculated daily for the three IR rooms. (Figure 8A-C.) This analysis showed current room utilization between 45 and 57% when turnaround time is not considered. When turnaround time is considered then utilization increases to 58-75%. This implied that there is unutilized capacity that was not being used efficiently. Room turnaround times are consuming a significant portion of room capacity. Previously, it was assumed by all involved that additional room capacity was needed to perform cases in a more timely fashion. A project had been funded to add a fourth IR procedure room. An additional room would not result in mediports being performed at a higher rate.

Room turnaround times and cleaning by environmental services (EVS) were audited and the median response time was 10 minutes and the median clean time was also 10 minutes for a total cleaning cycle time of 20 minutes. These times peaked at lunch and immediately before shift change at 3:00 pm. (Figure 9.)

Inpatient transport times were analyzed and a median transport time of 36 minutes was noted. (Figure 10.) Inpatient transport had been analyzed and optimized previously. Current state uses a dedicated interventional radiology transporter as well as department of radiology transporters and hospital transporters. Elevator availability in the current 60 year-old facility is a known constraint with up to 20 minute waits at peak times. The prep and recovery area can alleviate this by serving as a buffer for slow transport by acting as a holding area for inpatients. This allows inpatients to be called down before their procedure and wait in holding if there are enough beds. With 11 beds available for for 5 procedure resources it is not hard to imagine a situation where all the beds are taken up by recovering patients. This means that there is no room to bring down an inpatient to have them ready when a procedure room comes open. In that case the patient must be transported directly into the procedure room incurring a significant delay.

A previous quality project had maximized the capacity of the recovery space from 8 to 11 beds as well as increased the nursing ratio to 4:1. This proved to be inadequate as this area serves a CT procedure area, US procedure room, 3 interventional radiology suites, and occasionally patients from the 4 GI flouro suites. Most organ biopsies require a 4-6 hour recovery in this area that consumes significant recovery bed capacity. This routinely leaves the procedure modalities open without the ability to start another case because there are no patients immediately available to go into the room. Capacity in this area was identified as a rate-limiting step.

**Interventions:**

The improvement plan was to first understand and quantify the process. Second was to investigate unused procedure capacity in other cost centers. This was done in parallel with efforts to optimize the efficiency of current procedure resources within the department as well as investigate the need for additional capacity within the interventional radiology section. The analysis and data gathering was performed by the interventional radiology workgroup that consisted of the IR medical director, IR tech supervisor, IR nurse manager, and the radiology human resources business partner that
met weekly. Issues and data were communicated up to the hospital director of radiology and senior executive VP for the section, and to the radiology chairman. Individual members of the team also solicited and communicated information from the front line techs, physicians, and nurses.

There was early support from the hospital IT department in migrating the interventional radiology workflow into the radiology information system (RIS). This effort was recognized and members of the section were enrolled in the CS&E program to specifically leverage the anticipated new data to tackle the IR workflow issues. (Figure 11.)

The data model was revisited every three to four months in an ad hoc fashion and additional elements were changed as needed. In addition the department reporting resource was invaluable in writing a single monthly report that listed all process data points going back 18 months. Analysis was then performed in a spreadsheet.

Specific Interventions:

1. Lobbied other service lines to re-allocate unused capacity to placing mediports. After a several month effort general surgery began placing 4-5 ports per week starting 2/2012.

2. Discovered inefficient utilization of current procedure room resources.
   a. Room turnover identified as a rate-limiting step.
      i. Pilot project funded for dedicated EVS position starting 8/2012.
   b. Inpatient transport and elevators were a known constraint.

3. Prep and recovery buffering capacity for transport limitations was identified as a serious limitation.
   a. 11 prep/recovery beds for 5 high volume procedure rooms (1 US, 1 CT, and 3 IR) was deemed grossly inadequate.
   b. New procedure room project was not needed and was canceled. ~$700,000 savings.
   c. Used funds from canceled procedure room to expand recovery area by 3 beds, 6 pre-op chairs, and 2 RN FTEs: ~$650,000
   d. Net savings of $50,000

Results:

Median mediport wait time from at the initiation of the project in December 2012 was 43 days. By May 2012 the wait time was down to 23 days. This represents a 46% reduction in 5 months and near the goal set forth in the aim statement. This trend has continued through the summer with the third next available schedule availability for outpatient cases ranged between 13 and 19 days for June and July 2012.

(Figure 14.)

(Figure 15.)
Revenue Enhancement:

This project has saved the Parkland Radiology department nearly $700k in waste on unneeded resource allocation and ~$50k is actual savings after the recovery area expansion project had been funded. Although the specific improvements of this project are not generalizable the aggressive data collection through the EMR/RIS has been incorporated into the RIS at UT Southwestern. This is set to go-live 9.2012. This will empower process improvements at both the UT Southwestern and Parkland campuses.

Conclusions:

The electronic medical record is a valuable tool for generating data to support quality improvement in medicine. Robust data collection allowed the IR process problems to be understood at a granular level. This detailed understanding allowed the needs of the section to be communicated to the executives involved. The alacrity at which the resources were re-deployed was surprising and a near 50% reduction in wait time was achieved. The ability of the surgical subspecialties to place a portion of the mediports accounted for the majority of the decreased wait times. This has not increased the efficiency at which the IR section operates. However, the data has allowed the rate limiting steps to be identified. The EVS pilot program for room turn around and expanded recovery area will be monitored for how they impact the room utilization and patient throughput over the coming months.
Figure 1A: Process mapping- Initial State

Note that the color coded data entry points do not align with the actual procedure steps making data collection through the EMR problematic. i.e. exam begin and end steps have no temporal relation to when the exam was started or ended.
Figure 1B: Process mapping- Current State

Colored data point entry into the EMR is now aligned with the workflow process step. Additional roles were included in this expanded analysis.
Figure 2: Data Collection Change - On 8.11.2011 the collection of data in the EMR was changed and the intra procedure time and the pro-procedure wait times were able to be reliably measured for the first time. Mediport procedure length dropped from many hours to a more realistic 1.2 hours and the pre procedure and post procedure wait times were able to be quantified.
Figure 4. Pareto Chart - 2011 volume analysis by procedure. Mediports represent 13% of the years cases.
Figure 5: Fishbone Diagram- Allowed for the collection of factors that contributed to the current state of the IR process.
Figure 6: Room Throughput- Cases completed per day are in red above. Canceled cases in green represent cases that were canceled outright in addition to those that were rescheduled. Inpatients who could not be performed on a given day and were rescheduled are included in this number. No shows are in blue and represent up to 1/4th of the book of business on a given day. Of note this volume is approximately ½ inpatient and ½ outpatient.
Figure 7: Cases Per Day Control Chart: This includes neuro-interventional cases and venous access cases. The wide control limits indicates a wide variation in the process.
Figure 8A. Room 1 Utilization- Median utilization is 58% including a 20 minute room cleaning per case by environmental services. If room cleaning times could be decreased to 10 minutes then the theoretic utilization would be 52%. If cleaning discounted completely then down to 45%. This assumes an 8 hour day.

Figure 8B. Room 2 Utilization- Median utilization is 75% including a 20 minute room cleaning per case by environmental services. If room cleaning times could be decreased to 10 minutes then the theoretic utilization would be 67%. If cleaning discounted completely then down to 58%. This assumes an 8 hour day.

Figure 8C. Room 3 Utilization- Median utilization is 71% including a 20 minute room cleaning per case by environmental services. If room cleaning times could be decreased to 10 minutes then the theoretic utilization would be 64%. If cleaning discounted completely then down to 57%. This assumes an 8 hour day.
Figure 9. Room Turnover- Median room turnover cycle time (response time + cleaning time) was 20 minutes. Response time was 10 minutes. There are increases in response time around lunch and in the 30 minutes prior to shift change at 3 pm. There continues to be a small (3%) but substantial (>40 min) group of outliers where the room cleaning is unacceptable. The delay in response time and outliers could be eliminated by a dedicated EVS FTE.
Figure 10: Inpatient Transport Time- Month of January 2012 plotted by time of day. Median transport time was 35 minutes. One St Dev was 15 minutes. Inpatient transport is limited by availability of patient elevators in our aging facility. Transport times are mitigated by a prep and recovery area that serves as a waiting area for inpatients awaiting their procedure.
Figure 11. Computerization of the IR workflow Process: Early and continued support from the hospital and radiology IT departments provided the resources to build out the IR workflow in the RIS as well as aided in the writing of the monthly workflow report. This report included all process data from every case going back 18 months and was invaluable for process analysis. Shown above is the migration from analogue wipe boards to the digital "status board".
**Figure 12. Current Radiology Pre & Recovery Area** - 11 bed bays (only 10 functional) to support 3 IR suites a CT procedure room and an US procedure room. Light blue shading denotes area to be used in the expansion project.
Figure 13. Future Radiology Prep & Recovery Area - Light blue area represents the addition of 5 pre-op chairs, an IV station, and three recovery bays. This is in addition to the current 11 recovery bays. For a total capacity of 16 patients plus an IV station.
Figure 14. Raw Mediport Schedule Delay: Graph represents raw data from order entry to begin exam for the initial phase of the project. All outlier data points are included for transparency.
Figure 15. Median Mediport Schedule Delay By Month- Median wait time December 2011 was 43 days. Median wait time May 2012 was 23 days. This represents a 46% decrease in 5 months.