Individual QI projects from single institutions

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Increasing Engagement of Imaging Professionals in Quality Improvement Using an Encounter-specific Quality-reporting Tool

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ABSTRACT

Introduction: The involvement of pediatric imaging professionals in quality improvement (QI) in our department was low, with few available informatics tools to report issues or suggest improvement opportunities in a timely and efficient manner. We aimed to increase QI engagement in radiology by creating a real-time, encounter-specific reporting tool embedded into the clinical imaging workflow. **Methods:** A multidisciplinary team outlined requirements for a new electronic quality-reporting tool, including point-of-care access during imaging workflow and simultaneous automatic capture of encounter-specific clinical information from the hospital information system. Information system experts created a user-friendly interface for categories based on stages of imaging workflow (Planning, Acquisition, Processing, Interpretation, Communication, and Data Collection). Team members trained all department staff. Quality coordinators sorted entries and monitored personnel engagement for two 36-week periods: immediately after launch and 3 years later. Descriptive statistics were used to analyze proposed and completed QI projects during these periods. **Results:** There were 1,498 entries during the first 36 weeks. Ninety-three percent of radiologists and 56% of technologists participated. Three years later, there were 1,251 entries in 36 weeks. Data collection entries for established QI projects increased from 380 (25%) to 487(39%). The engagement continued among radiologists but decreased among technologists over time. Submissions for QI projects increased from baseline. The project completion rate increased. **Conclusion:** We created a QI reporting tool embedded into the clinical imaging workflow, which improved the participation of our imaging professionals and increased the number of completed QI projects. *(Pediatr Qual Saf 2023;8:e673; doi: 10.1097/pq9.0000000000000673; Published online August 7, 2023.)*

INTRODUCTION

The initial steps in any quality improvement (QI) process are identifying and defining the process or problem.[1] In our large multisite pediatric radiology department, operational problems and other opportunities for improvement are presented either as a topic submitted for discussion at the daily readiness huddle[2,3] or as a report of a serious safety event via the hospital's system (CS STARS, CS Stars Enterprise, Chicago, Ill.). With only these methods routinely available, most of the hundreds of staff in our radiology department did not have opportunities to engage in QI. For example, not all imaging acquisition units across our enterprise have a technologist quality-reporting tool. There is no mechanism for imaging personnel unable to attend the huddle to report potential QI issues, and there is no formal feedback loop between technologists, radiologists, and clinicians. To fill this gap, we developed a user-friendly informatics tool that is readily accessible to all imaging professionals across the entire imaging workflow spectrum to communicate improvement opportunities. The tool must engage the entire team of imaging professionals, from leadership and management to radiologists, technologists, nurses, and nonclinical support staff. Furthermore, we sought to develop a tool accessible during the clinical encounter that automatically captures encounter-specific data and other relevant data from the patient record that can be tagged by categories and then reviewed by modality managers and clinical leaders for common themes.

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METHODS

Context

Our institution comprises a large urban pediatric tertiary care hospital with 2 freestanding emergency departments and 8 urgent care centers in surrounding communities. Imaging services are available at all locations.

Project Approval and Timeline

Hospital QI leadership and the legal office approved the project. The institutional review board waived review per institutional policy. Planning commenced in 2017, and information systems (IS) specialists tested menus for data input into the existing electronic medical record software (EPIC, Verona, Wis.) in the summer and early fall of 2018. Department-wide staff training and education followed a test period with a final launch date of November 5, 2018.

Project Team

Multiple members of the imaging department provided input and expertise. The core team members were the department chief, additional radiologists with QI training (2), IS specialists (2), and QI coordinators (2).

Building the Tool

The tool, labeled Ongoing Professional Evaluation (OPEN), was envisioned as an informatics solution embedded within the radiology information system [radiology information system (RIS), RADIANT, EPIC Systems, Verona, Wis.] to allow any radiology staff member, including patient access representatives (registration clerks), technologists, nurses, radiologists, and administrators, interacting with the patient to make an entry at the point of care. The build process began with the team creating a list of desired data categories based on our stages of imaging workflow: planning, acquisition, processing, interpretation, and communication. IS specialists then created data point values for each category and access points within the RIS for all radiology professionals. A link to the OPEN tool was placed in the electronic medical record (EPIC Systems, Verona, Wis.), available on each radiology user's "home" page. When process problems or safety issues are encountered, the link to the reporting tool is immediately accessible. When reporting a problem, the user selects the phase of the imaging encounter from which the problem originated. Completing an entry requires choosing a category from a pick list and describing the incident/issue with suggestions in a short text box, a 15-30-second task (Fig. 1). The accompanying patient and encounter information is automatically captured from the RIS.

Test Period—User Experience Feedback and Iteration

During a 3-month prelaunch testing phase, test users made 419 entries: 15 radiologists (253 entries), 32 technologists (162 entries), and 3 clerical staff (4 entries) during routine clinical activities. Test users suggested several modifications for both aesthetic and functional purposes. They suggested adding an "Other Process Related" category to capture miscellaneous issues and expanding the use of the tool with a Data Collection category for entries for ongoing QI projects. Finalized input categories were Planning, Acquisition, Processing, Interpretation, Communication, Other Process Related, and Data Collection. Further modifications for screens and access points allowed modality users to document at various stages within their established workflow. To encourage participation without fear of legal or employment repercussions, we added a peer review/confidentiality statement. It is always visible. Centralized links allow

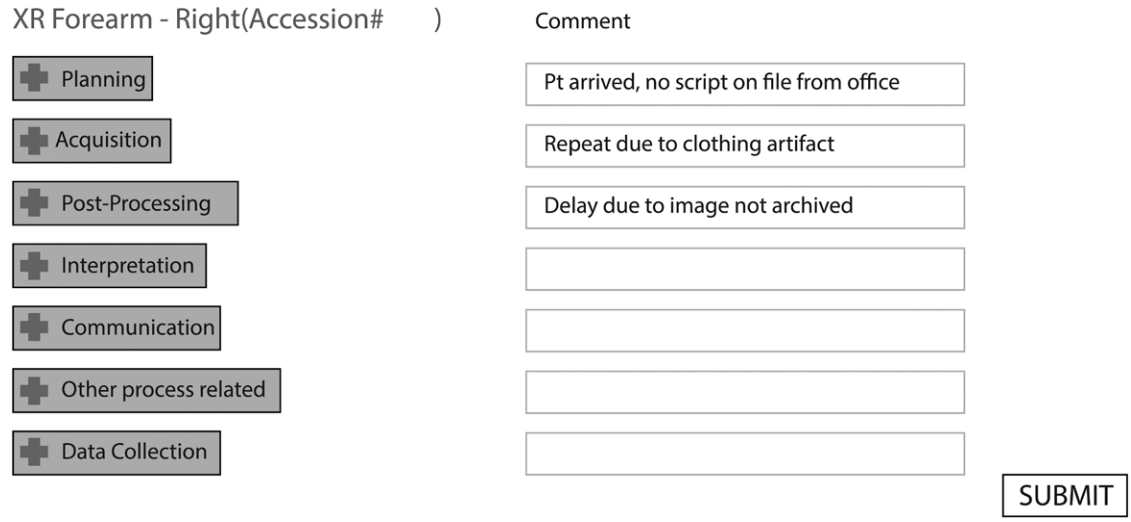

Fig. 1. Schematic of encounter-specific entry screen in the electronic medical record. In this example, the technologist made multiple entries for a forearm examination under 3 categories: *Planning*, *Acquisition*, and *Postprocessing*, with comments in the text boxes.

any department staff to report issues, submit suggestions, or submit prospective ideas for QI projects.

Data Collection and Analysis

Baseline (pretool) data included huddle and radiology-related CS STARS event statistics collected from October 6, 2017, to June 17, 2018 (period 1, 36 weeks). QI coordinators collected similar data for the first 36 weeks after the tool was made widely available (period 2, November 5, 2018–July 17, 2019) and again for another 36 weeks (period 3, August 22, 2021–April 30, 2022) 3 years later. Every new problem or event discussed at the daily readiness huddle is recorded by a QI coordinator and counted in the daily minutes. All CS STARS events for each period are also counted. In addition, huddle attendance data are counted when available.

The IS team creates a report of entries and forwards it to the radiology QI team. One of 2 coordinators import data to an electronic project management form (Smartsheet Inc., Bellevue, Wash.) and determine the modality and tag entries to organize data into specific themes. For example, for OPEN entries, coordinators determined the entering staff category (patient access representative, technologist, nurse, radiologist, or administrator) and the number of entries made for ongoing quality projects for periods 2 and 3. They also counted the number of proposed QI projects during all 3 time periods and the number of completed projects during periods 1 and 2, and determined the total number of examinations performed in the department during each period.

RESULTS

The number of radiology CS STARS entries, problems, or departmental issues discussed at the huddle and department examination volumes was each similar across the 3 time periods (Table 1). Huddle invitations with a virtual option are sent to 340 staff each day. Attendance records are only available for the last 3 months, averaging 7 (range, 5–9) staff attending in-person with an additional average of 9 (range, 2–16) virtual participants daily.

In the first 36 weeks after launch (period 2), there were 1,498 entries to OPEN (Table 2). Technologists (752, 50%) and radiologists (722, 48%) submitted most entries, with a small number (24, 1.6%) from nursing and other staff. Twenty five of 27 (93%) radiologists made entries during this period (mean: 29 entries per radiologist, median: 12 entries, range: 1–90), and 107 (56%) of 192 technologists made entries during this period. During period 3, the staff made 1,251 entries to OPEN (Table 2). Radiologists (693, 55%) submitted most entries during this period, with 44% (553) from technologists and 1% (5) from other staff. Radiologist participation (93%) was unchanged, while technologist participation decreased to 32%.

Table 1. Total Huddle Topics and Radiology Safety Events Reported and Examination Volume per 36-week Time Period

	Period 1 (baseline)	Period 2	Period 3
Huddle topics	1,211	1,277	1,295
Radiology safety events	153	164	197
Total examinations	158,847	163,201	163,199

Table 2. OPEN Entries and Staff Participation per Period

	Period 2	Period 3
Total entries	1,498	1,251
Entries by staff role	Technologists 752 (50%) Radiologists 722 (48%) Other 24 (2%)	Radiologists 693 (55%) Technologists 553 (44%) Other 5 (1%)
Participation	Radiologists 25/27 (93%) Technologists 107/192 (56%)	Radiologists 25/27 (93%) Technologists 72/224 (32%)

During period 2, users submitted entries as *Acquisition* (36%) or *Communication* (19%) most commonly (Fig. 2), with 73 (5%) entries labeled as *Data Collection* for ongoing research or quality projects. During period 3, users submitted most entries as *Acquisition* 470 (38%) or *Planning* 218 (17%) (Fig. 2), with 66 (5%) entries as *Data Collection*.

QI coordinators sorted entries into 22 themes (**Table 1, Supplemental Digital Content,** which describes QI coordinators sorted OPEN entries into 22 themes, ***http://links.lww.com/PQ9/A507***) for dissemination to appropriate leadership. For period 2, 380 entries (25%) were sorted into a *Reference QI* category and tagged as associated with an ongoing project. Sixty-six imaging professionals [47 (71%) technologists and 19 (29%) radiologists] made these project-related entries. During period 3, QI coordinators tagged 487 (39%) entries as *Reference QI* and related to 20 ongoing projects. Sixty-six staff [41 (62%) technologists, 23 (35%) radiologists, and 2 (3%) others] made these entries.

Nonproject-related entries are also common (Table 3). During period 2, there was a high volume of entries related to radiologist availability or bandwidth issues, that is, the radiologist covering 2 services and being unavailable for one of the services such that there is a delay in examination interpretation that exceeded the prescribed turnaround time for a given service (272, 18%). Other common themes include incorrect or missing clinical information (163, 11%) and protocol deviations (148, 10%). Both technologists and radiologists utilized the tool to provide positive feedback (40, 3%), prompting the creation of a *Kudos* theme.

Regarding QI project ideas, there were 18 project submission ideas submitted by radiologists, clinical managers, QI team members, and leadership during period 1. The number of submitted project ideas increased to 48, a 166% increase during period 2. The total number of participating staff increased from 14 to 30, and while radiologist and clinical manager submissions increased, there were also submissions from technologists, physicists, and

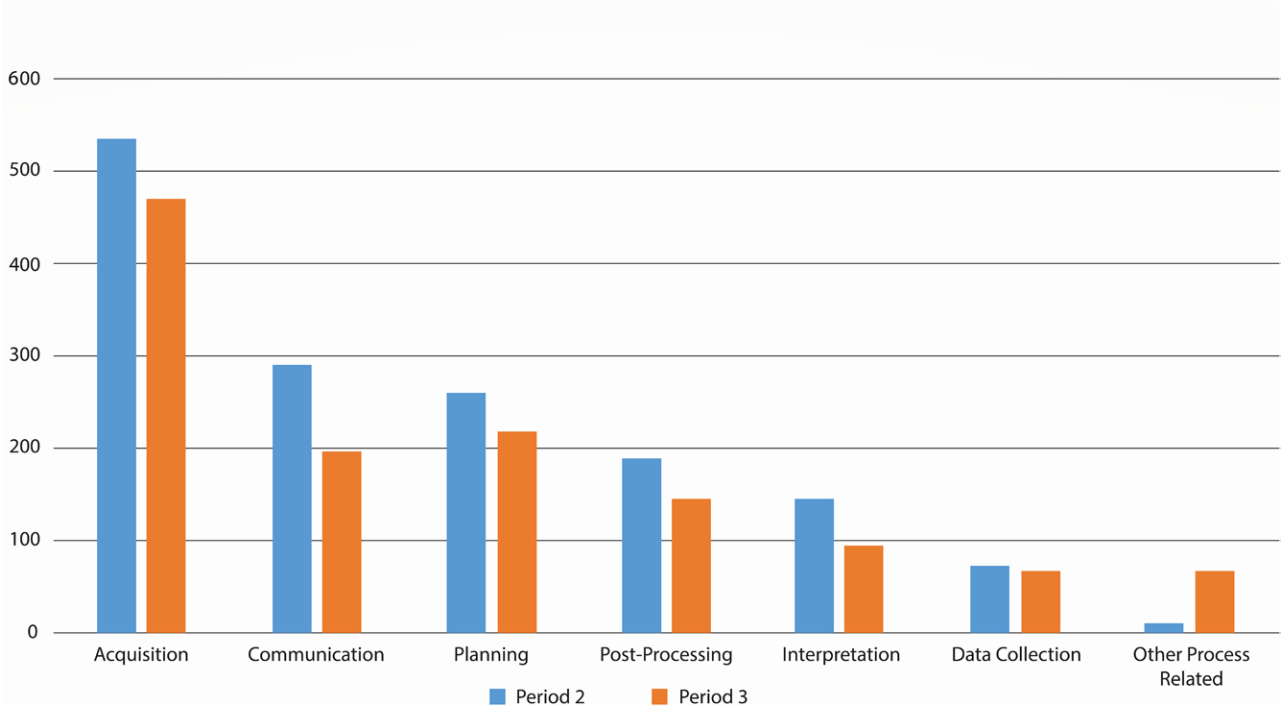

Fig. 2. OPEN entries by category during periods 2 and 3.

Table 3. Sample Submissions to OPEN by Category

Category	Entry Comment
Planning	Laboratories were not done prior Same day add on combo with MRI Patients brought to X-ray fully dressed in street clothes, bra, jacket, etc. Special needs child needing child life assistance arranged Wrong order placed by physician. 2 view skull only needed. Was not communicated to X-ray until during examination.
Acquisition	Mislabeled left leg with right marker Beautiful films!!! Scan time was increased due to patient's implant restrictions Underpenetrated ap view Radiologist changed coverage, direction of scan, and dose of examination Not completed before verified—delay to dictation
Postprocessing	Axial and coronal recons not correct angle
Interpretation	Took an hour and a half for examination to be read Missed categorized radial neck fracture Not verified, not dictated, ED called for report after rad left for day Clavicle fracture missed on nov 10 chest radiograph
Communication	Pt positive for c-diff, no sign on door or warning on chart Initially received a protocol from radiologist, then different radiologists added on Sag T2s
Other process related	This was a complex case, requiring considerably more effort and time than is typical. We need to work the appropriate modifier code into our workflow. Radiologist in fluoro when attempting to present case Dr. requests 25 G needles to be stocked in all rooms. Delay because off-site NICU never sent paperwork

a nurse practitioner during period 2. Department leadership later categorized project ideas into 30 complex issues (defined as a problem that requires an organized approach with multiple stakeholders but does not include data metrics) and 8 QI projects (requires an established aim, a measured baseline, calculated interventions, and measured progress) (**Figure 1, Supplemental Digital Content**, which describes QI in radiology, ***http://links.lww.com/PQ9/A506***). Example QI projects are listed in **Table 2, Supplemental Digital Content**, which describes examples of QI projects by theme, ***http://links.lww.com/PQ9/A508***. Leadership rejected 10 (21%) submissions due to redundancy with existing policies or lack of strategic plan alignment. No safety-related projects were rejected. As of May 2022, 24 of 38 (63%) complex issues and QI projects are complete or in a sustain mode, 3 (8%) are

Table 4. QI Ideas Submitted by Staff

	Period 1	Period 2	Period 3
Total ideas submitted	18	46	6
Total QI projects started	16	38	4
Projects completed or in sustain mode at 3-year follow-up	6 (38%)	24 (63%)	N/A

in progress, with another 4 (11%) in the final stages. Six (17%) are stalled or on hold for future evaluation, and 1 (3%) was rejected after reevaluation. QI project ideas submitted during period 3 totaled 6, with 4 approved and in progress, now 3 months later (Table 4).

DISCUSSION

Our tool builds upon the ongoing push toward improving organizational performance through increased staff engagement and the capture of frontline ideas for effective problem-solving.[4,5] High-performing idea systems are a major factor in successful lean initiatives because they create a "lean culture" of daily improvement and address improvement opportunities that are difficult for managers to recognize and promote rapid organizational learning.[4,6] Initially developed by managers in manufacturing and business settings, these management concepts are applied to health care delivery to improve quality.[7,8]

Diagnostic imaging professionals face multiple communication and participation barriers in improvement opportunities in a large multispecialty radiology department. The established daily readiness huddle or hospital-based mechanisms that track patient safety events and near misses capture only a small number of potential opportunities for improvement, leaving managers and departmental leadership without data to support policy creation or changes. Although daily readiness huddles meet the needs of urgent operational issues in radiology, it does not routinely engage the rank and file of the department across multiple imaging sites due to ongoing patient care commitments, even with a virtual attendance option. Clinical duties limit huddle attendance to less than 5% of staff in our department.

While the number of daily huddle entries and the number of radiology-related safety events were similar before and after the launch of the reporting tool, the OPEN tool captured hundreds of additional entries relating to specialized operational issues that affected a wide array of imaging professionals, including physicians, trainees, technologists, nurses, analysts, and schedulers. Since the patient and encounter information is prepopulated, completing an entry requires only choosing a category, describing the incident/issue and making suggestions in a short text box, typically taking less than 30 seconds. Two additional points further strengthened the argument for engagement: the data are considered peer review/confidential and are not discoverable for legal purposes, and the data are nonpunitive. It is used strictly for QI purposes and not for personnel evaluation. In the first 36 weeks after the tool's launch, 93% of our radiologists and 56% of our technologists used the tool to make entries, and 3 years later, engagement remained high.

Opportunities for improvement in a large imaging department span a spectrum of categories, including study planning, scheduling, image acquisition, reconstruction, postprocessing, interpretation, and communication. This tool provided an efficient means for any staff member to highlight a problem with an opportunity to suggest a solution. For example, when a theme emerged regarding radiologist accessibility in a busy dual rotation, these data helped managers and section leadership identify perceived service gaps and make scheduling adjustments, including redundant staffing during busy hours and backup coverage for certain days based on clinic schedules. The QI team also alerted other departments and hospital leadership about system-wide issues that could compromise patient care. Kudos entries are forwarded to managers who share them with their staff, who greatly appreciate positive feedback.

This tool provides a means to both suggest and complete new QI projects. There was an increase in the number of projects proposed after the tool's launch, with an increase in the proportion of established projects with each period. The tool then served as a data collection means for these formal and informal QI projects. For example, sonographers made entries to identify and comment on abdominal ultrasound examinations during a trial that eliminated the fasting requirement for patients referred from the emergency department, eventually eliminating this requirement. One radiologist used the tool to track compliance with a project requiring technologists to amend an insufficient clinical history on an imaging order, now standard practice in our department. Another radiologist used it to tag examinations when working on a new magnetic resonance imaging protocol. The overall number of QI project idea submissions increased, and submissions came from various imaging personnel with the engagement of technologists, physicists, and a nurse practitioner. On 3-year follow-up, most of these projects were completed or in sustain mode.

Although the OPEN tool represents an improvement over the current status quo regarding capturing QI opportunities in an imaging department, there are some limitations. The desire to create an efficient data entry method also limits the information gathered at the point of care. A triaging process with manual input by a QI coordinator is needed to process the entries, associate each entry with relevant themes, and generate sensible reports for interested stakeholders. A process that replaces this manual step is desirable and may be achievable with an intelligent data-capture approach that uses context tags to create the themes and reports and/or additional drop-down menus and pick lists. This process would also decrease the lag between entry and quality coordinator reviews.

We note that while radiologist participation was maintained at a high level (93%), technologist participation decreased (from 56% to 32%) between the immediate postlaunch and 3-year follow-up periods. Imaging volume was similar during the study periods, and radiologist staffing was unchanged. Yet, we had numerous technologist staffing shortages and new hires during the later period, which may have contributed to decreased participation despite the readily available format provided for entries during the workflow. The decrease in proposed QI projects in period 3 may also be related to staffing shortages or the high number of ongoing, not yet completed projects proposed and started during period 2. But, despite the drop in engagement, technologist participation was significantly increased compared to the baseline, which shows the value of making the process as easy as possible to promote engagement of the rank and file in QI.

Another limitation of this tool relates to the confidentiality of the peer-review information. We currently restrict access to the OPEN data to departmental leadership and clinical managers to prevent unauthorized access and potential misuse of QI data for other purposes that may breach the nonpunitive expectations from this process. In addition, the current format does not allow the capture of nonencounter-specific opportunities for improvement in radiology and thus is complementary to the daily readiness huddle.

CONCLUSIONS

We created a reporting tool to engage imaging professionals in QI across our radiology department. With this tool, our imaging professionals had a high level of participation and an increased number of completed QI projects.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Kruskal JB, Eisenberg R, Sosna J, et al. Quality initiatives: quality improvement in radiology: basic principles and tools required to achieve success. *Radiographics*. 2011;31:1499–1509.
2. Donnelly LF. Daily management systems in medicine. *Radiographics*. 2014;34:549–555.
3. Donnelly LF, Cherian SS, Chua KB, et al. The daily readiness huddle: a process to rapidly identify issues and foster improvement through problem-solving accountability. *Pediatr Radiol*. 2017;47:22–30.
4. Robinson AG, Schroeder DM. The role of frontline ideas in lean performance improvement. *Qual Manag J*. 2009;16:27–40.
5. Phillips J, Hebish LJ, Mann S, et al. Engaging frontline leaders and staff in real-time improvement. *Jt Comm J Qual Patient Saf*. 2016;42:170–183.
6. Liker J. *The Toyota Way: 14 Management Principles From the World's Greatest Manufacturer*. McGraw-Hill; 2004.
7. Amaratunga T, Dobranowski J. Systematic review of the application of lean and six sigma quality improvement methodologies in radiology. *J Am Coll Radiol*. 2016;13:1088–1095.e7.
8. Mannon M. Lean healthcare and quality management: the experience of ThedaCare. *Qual Manag J*. 2014;21:7–10.