Capturing Dose Indicators From Fluoroscopically-Guided Interventions

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Purpose and Rationale:
Recording indicators of radiation dose is a necessary cornerstone for the success of future PQI projects. Practices will need to reliably capture these metrics from every procedure. Since this project will help satisfy recent Joint Commission recommendations, radiologists can expect cooperation from technical staff and hospital administration when creating the systems needed to collect this data. Once the systems are established, work can focus on continually improving the reliability and accuracy of the resulting data.

Project Resources:
1. National Council on Radiation Protection and Measurement (NCRP) which recommends in NCRP Report 168 that Reference Air Kerma (K_{ar}), Dose-Kerma Product (P_{ka}) and fluoroscopy time should be recorded for all high dose procedures.
2. Guidelines from the Society of Interventional Radiology on recording recording radiation dose indicators and their role in quality improvement initiatives.
3. The Joint Commission Sentinel Event Alert 47 which provides a series of recommendations about recording radiation dose indicators and using them to improve patient safety.
4. Guides to creating and using control charts for quality/safety improvement. (Suggest creating a link to a page on the RSNA site that includes recent references on control charts – Radiographics article, Steele et al in Abujudeh/Bruno, Murray – Data guide)

Project Measure
Numerator - procedures where all three indicators are recorded
Denominator - all procedures performed

Eligible population
All patients undergoing fluoroscopically-guided interventional procedures (FGIs) in radiology

Data collection and auditing
This is a continuous process improvement project wherein data are continually collected. Progress should be tracked by periodically updating the control charts (eg every month). Sites are encouraged to develop methods of collecting and analyzing data that suit their workflow. Suggested methods include:

Option 1 (Analog):
Data is captured by manually entering radiation metrics into the radiology report. This could occur by dictating the values into the report. Compliance would be audited monthly by pulling all FGI reports from a randomly selected workday. The numerator would be determined by counting the reports that included all three metrics. The denominator would be determined by counting the all FGI reports for that workday.

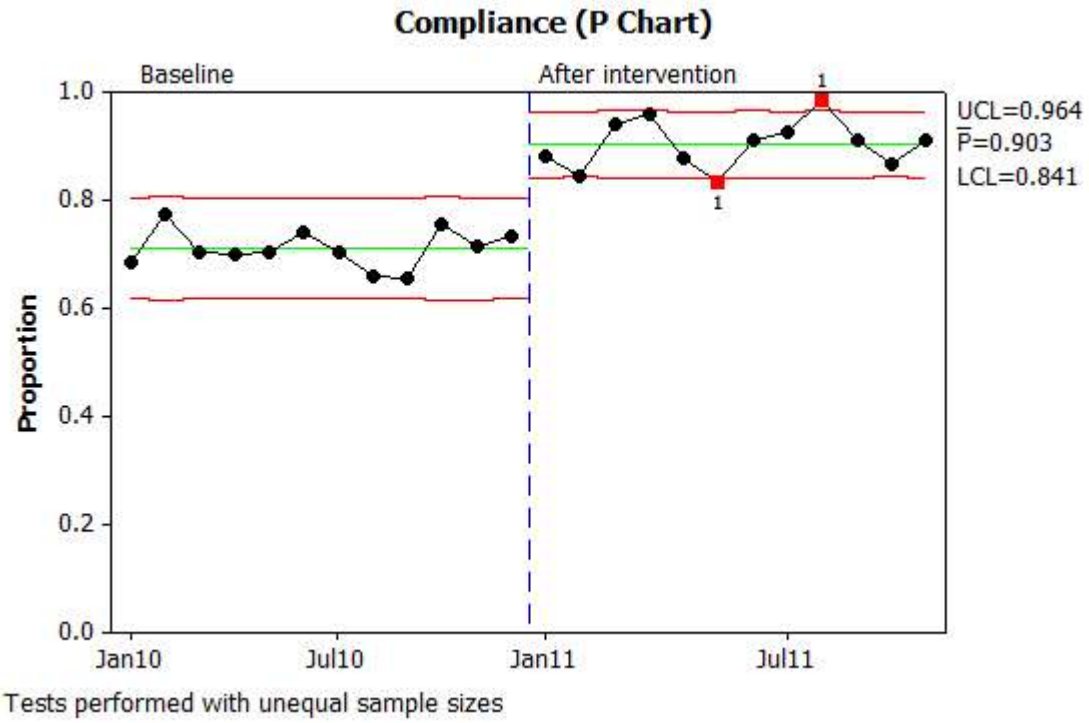
Option 2 (Digital)

Three different methods are being used to capture data in computer-readable formats. The first process has fluoroscopy units send DICOM structured reports to an institutional archive. The second has technologists enter dose indicators in a local database such as the Radiology Information System. The third uses software to collect electronic and analog data from fluoroscopy units and the PACS and store this data in a radiation dose database. Compliance would be audited periodically by determining the number of FGI procedure records that include all three metrics with the number of FGI procedures performed.

Post intervention data collection

Data analysis

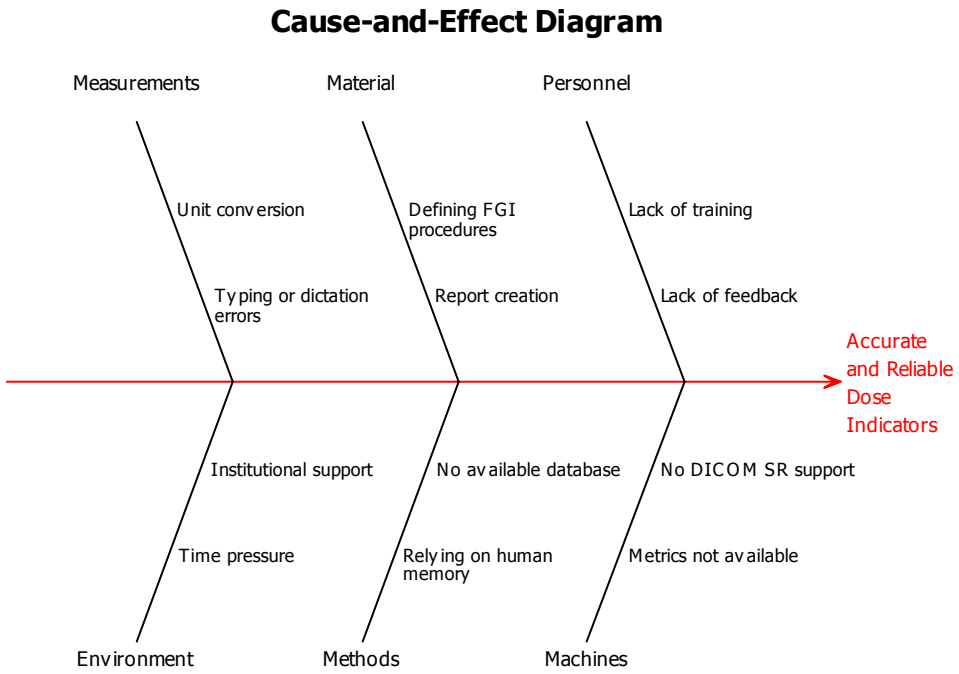
Results of each month's performance would displayed using a control chart that summarizes the proportion of compliant procedures and procedure volume (P chart). Such control charts can be created using software that works with data stored in spreadsheet applications. Some groups might choose to use software specificially designed for statistical process control (SPC). An example that uses hypothetical monthly data and a single intervention was created using Minitab 16 (Minitab Inc, State College, PA). The corresponding data table is also shown.



Date	J-10	F-10	M-10	A-10	M-10	J-10	J-10	A-10	S-10	O-10	N-10	D-10	J-11	F-11	M-11	A-11	M-11	J-11	J-11	A-11	S-11	O-11	N-11	D-11
Compliant cases	143	158	153	150	148	158	147	144	140	152	149	155	185	186	188	194	180	180	182	198	197	193	190	191
Monthly Procedures	209	204	217	214	210	213	209	219	213	201	208	211	210	220	200	202	205	216	200	214	200	212	219	210
Period	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2

Factors Potentially Influencing Performance

Ongoing pilot projects indicate that multiple factors can degrade accurate and reliable capture of dose indicators for fluoroscopic interventions. The resulting cause and effect diagram reflects only a fraction of factors that can diminish overall system performance.



Measurements

1. Data entry errors occur, especially when attempting to record a series of multidigit numbers by dictation or typing into a database. This is one of great strengths of a completely electronic system such as automatic archival of DICOM-SR files.
2. Some databases limit certain fields to integers rather than decimal numbers and manual entry then requires rounding and/or conversion to different units (minutes instead of seconds for fluoroscopy time).

Materials

1. Confusion can occur with procedures that typically do not require fluoroscopy (eg line removal, venous ablation). Pilot work has suggested that overall system performance improves if dose indicators are required for every procedure. When fluoroscopy is not used, zeros are recorded. This need to decide whether dose indicators should be recorded any particular procedure and allows wider use of standard work and forcing functions.
2. Recording dose indicators for all procedures simplifies report creation since it allows report writers to count all procedures occurring in a particular room or area. Report writers can also generate tallies of all reports attributed to a particular physician or technologist.

Personnel

1. For any task that requires manual data entry (typing into a database or dictating into a report) compliance will vary from person to person. Regular and specific feedback, especially when it compares an individual's performance to his/her peers, tends to improve compliance. Individualized feedbackCompliance initially varies from person to person.
2. Lack of training also degrades performance. This is particularly true for systems that continually rotate new personnel into the team (eg resident rotations, per diem workers, etc). This also occurs when training is delivered to personnel working the day shift but not the night/weekend shifts.

Environment

1. Time constraints will impact performance. This effect can be minimized by minimizing the steps needed to enter the data. Rather than recreating a database that includes date of service, procedure type, and dose indicator, pilot work found that adding dose indicators to the billing interface that occurs before the case is completed in the Radiology Information System was an effective strategy that not only improved compliance but also linked the data to the other elements found in that database. For example, rather than asking technologists to enter a procedure name, we have used the billing codes to identify specific procedure types.
2. Institutional support includes not only the resources devoted to designing the new workflow but also time and energy spent providing feedback to frontline teams. Frontline teams might endure a poorly designed workflow for a short period if their supervisors demonstrate the importance of the data via feedback. However, lack of feedback and a poorly designed workflow will soon to the task being perceived as "busy work" or bureaucratic waste rather than a vital part of the overall quality/safety mission.

Methods

1. Tasks that rely on human memory are prone to failure. This can include relying on personnel to remember to complete the task and/or storing dose indicators in memory before database entry. Forcing functions such as an interactive data entry form that must be completed before the billing process can be completed led to marked and sustainable increases in one pilot project's compliance measure.
2. Recording data on scraps of paper that are later aggregated and entered into a database invites transcription and compliance errors.

Machines

1. Only the newest fluoroscopes support the DICOM SR standard. Older fluoroscopes may not be able to report reference point air kerma (K_{ar}) or kerma area product (P_{ka}). It is hoped that the resulting decrease in compliance might prompt hospital administrators to update equipment. While sites should track their overall compliance, they might also separately chart compliance in the rooms that support K_{ar} and $P_{ka.}$. The improvement goal for the latter would be creating processes that reliably attain 100% compliance and the goal for the former would be equipment upgrades.

In summary, while periodic audits of analog and manual systems might suffice in the short run, sites are encouraged to invest in automated/electronic systems capable of continually monitoring system performance.

Post intervention data collection: Completing one PDSA cycle and starting the next

The first graph example illustrates how collecting data from before and after an intervention constitutes a PDSA cycle. An updated graph shows how a second PDSA cycle might use the same data collection scheme and focus on another improvement opportunity. For example, the first improvement cycle might have improved the feedback given to technologists who must remember to manually record the data after each procedure. The second improvement cycle might achieve even higher results by including a forcing function where technologists cannot complete the billing process without entering data. While compliance should be 100% in the latter, the definition of compliance might also be updated to count obvious data entry errors as noncompliance. This can occur when technologists enter nonsensical data such as 000 or 9999 is entered just to satisfy the forcing function.