

Assessing and Reducing FGD-PET/CT Radiotracer Infiltrations: Lessons in Quality Improvement Sustainability

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BACKGROUND

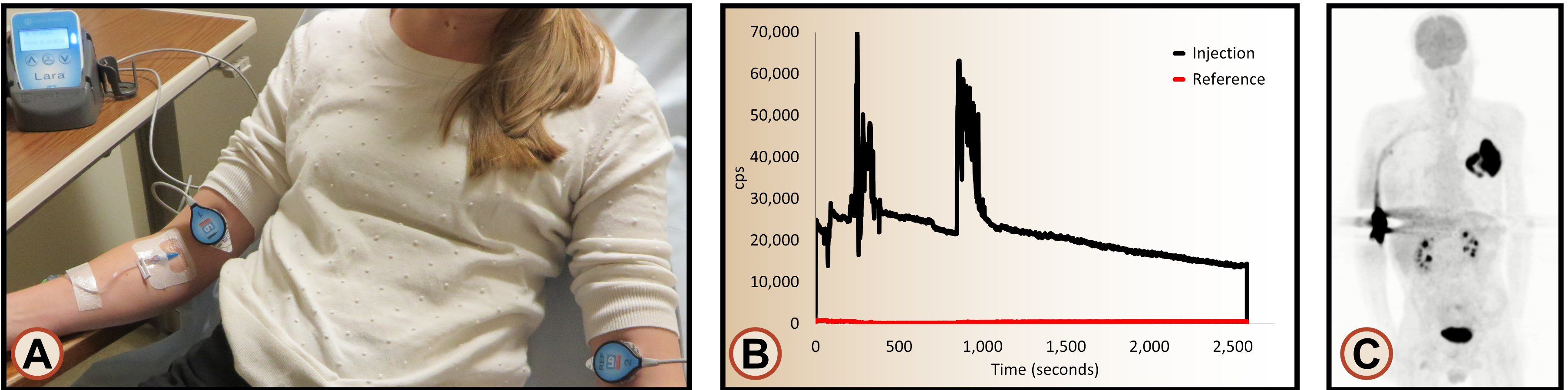
Accurate administration of the radiotracer dose is essential to PET image quality and quantification. Oncologic PET/CT studies require a prescribed 18F-fluorodeoxyglucose (FDG) dose delivered as a bolus prior to imaging; this same dose is used in the Standardized Uptake Value (SUV) calculation. A misadministration (infiltration) of the dose can impact PET/CT results and lead to unnecessary or inappropriate treatments and procedures. An infiltration leaves FDG outside the circulation and will result in underestimating the SUV. Interpreting and treating physicians are often unaware of infiltrations when the injection site is outside the imaging field of view (FOV). Despite existing quality control (QC) efforts to ensure accuracy of the administered dose, there is no routine QC method that confirms complete delivery of the dose into the patient's circulation.

Five technologists from our center participated in a quality improvement (QI) project using Design, Measure, Analyze, Improve, Control (DMAIC) methodology and new technology to assess and improve radiotracer infiltration rates. 263 injections were monitored in the Measure phase with a 13.3% infiltration rate. The new technology provided our team factors associated with infiltrations. Non-antecubital fossa injections (hands, wrists, forearms) were associated with increased probability of infiltration (28.6%) compared to antecubital fossa injections (8.5%). After implementing a quality improvement plan developed during the Analyze phase, which included the addition of an autoinjector, reassessing the injection room set-up and refresher training, another 278 injections were monitored in the Improve phase with a resulting 2.9% infiltration rate. The 78% decrease in overall infiltration rate was significant (p<0.001). The infiltration rate for non-antecubital fossa injections decreased to 7.0%, demonstrating a significant reduction (p=0.0026). Infiltration rates in antecubital fossa injections also significantly decreased to 1.5% (p=0.0039).

Infiltration Rates	Measure Phase	Improve Phase	p Value
Overall Infiltration Rate	13.3%	2.9%	p<0.001
Non-antecubital Fossa Injections	28.6%	7.0%	p=0.0026
Antecubital Fossa Injections	8.5%	1.5%	p=0.0039

OBJECTIVE

Our objective was to evaluate the Control phase to assess sustainability of improvements made during the Improve phase.



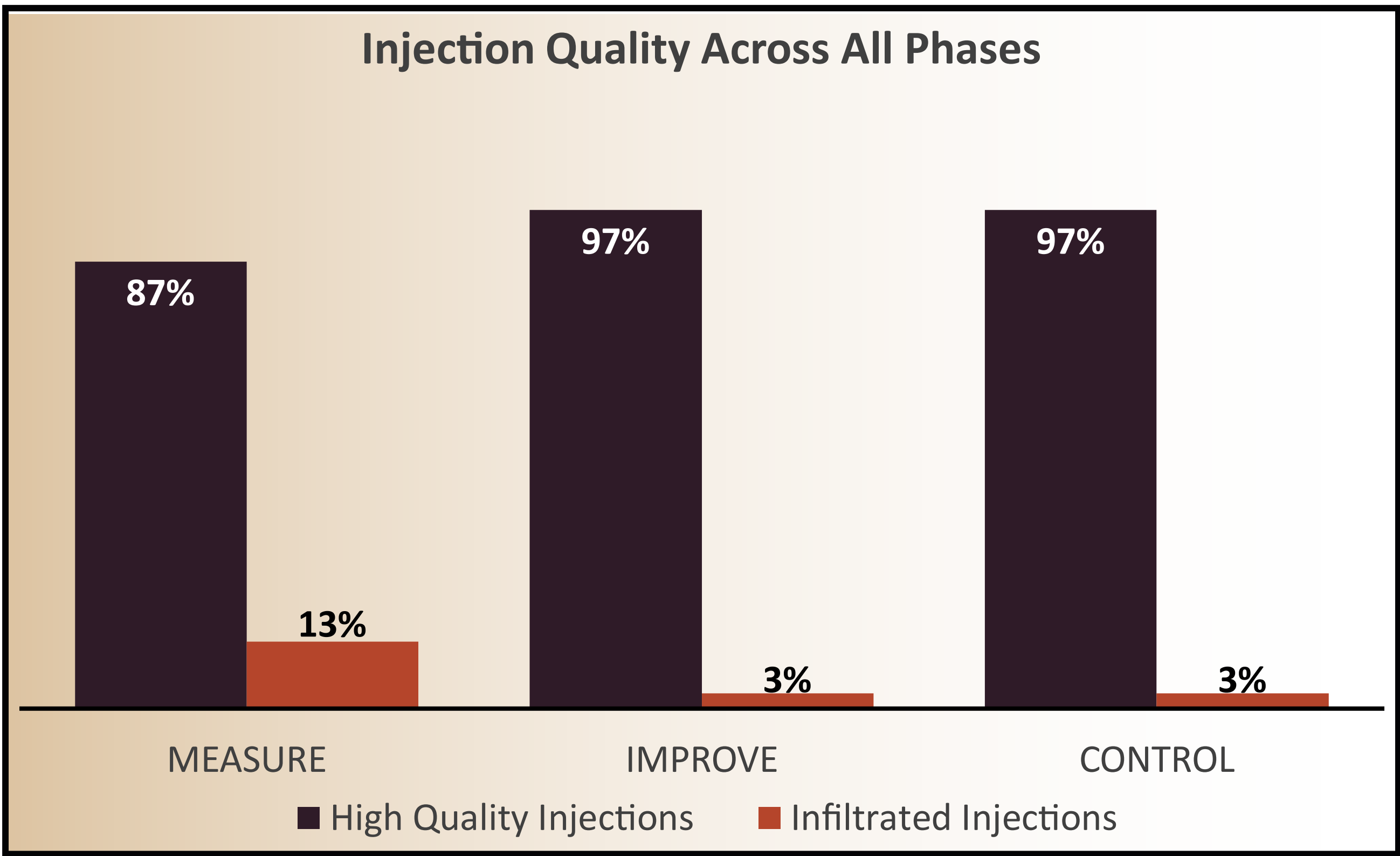
(A) - Device sensors placed on the injection arm and the contralateral arm. The system consists of 2 scintillation sensors, adhesive sensor pads, reader, and docking station. (B) - Time-activity curve (TAC) shows significant presence of radiotracer prior to imaging. (C) - Maximum Intensity Projection Image shows infiltration in the right antecubital fossa.

METHODS

After the Improve phase, seven new technologists joined the team. Infiltration rates in the Control phase were calculated, controlling for technologist- and patient-level correlations (SAS v. 9.4). Comparisons were made between the technologists who participated in the Measure and Improve phases and those who did not.

RESULTS

Monitoring of injection quality continued in the Control phase for approximately one year (10/7/2017 - 9/26/2018). During the Control phase, twelve technologists administered 1,240 injections with an overall infiltration rate of 3.1%. Five of the technologists were part of the Measure and Improve phases, and seven were new to the team.



The adjusted infiltration rate for the seven new technologists was higher (6.08%) compared to the Measure and Improve technologists (2.05%) and the difference in rates was significant (p=0.017).

Technologists	Infiltration Rate Control Phase	Standard Error	95% CI
Measure/Improve Technologists	2.1%	0.0055%	(0.83%,3.26%)
New Technologists	6.1%	1.31%	(3.19%,8.97%)

Needles larger than 22 gauge and not using an autoinjector were the factors associated with higher predicted probability of infiltrations during injections administered by new technologists.

LESSONS LEARNED

Rates Vary Among Technologists - We learned during the Control phase that the technologists who participated in the Measure and Improve phases continued to sustain and improve injection quality due to ongoing monitoring. However, new technologists who joined after the Improve Phase and had not been given the opportunity to improve, were shown to have lower quality injections.

Quality Improvement is an Ongoing Process - A quality improvement plan can significantly improve injection quality, but to ensure improvements are sustained, ongoing monitoring is needed. For instance, even when a key component of the improvement plan (the autoinjector) was not available 100% of the time, the new technology allowed us to monitor each injection to ensure continued quality.

CONCLUSION

New monitoring technology to drive radiotracer injection quality improvement was easily incorporated into our routine clinical practice. Understanding our unique factors associated with radiotracer infiltrations allowed us to sustain improvements while gaining insight into injection quality on both new and existing technologists. Ongoing monitoring allows us to repeat DMAIC cycles to understand if factors associated with our infiltrations change over time.

Previously our facility imaged patients ‘arms down’ to visualize infiltrations on routine images. We are now able to confidently image patients in the ‘arms up’ position due to the additional insight we now have into the quality of the injection and technologist practice patterns. Because proper injections are critical to PET/CT images, we intend to continue monitoring injection quality so that we continue to deliver high quality care to all of our patients.