

# Computed Tomography Dose Optimization for Scans of the Adult Abdomen and Pelvis with Intravenous Contrast

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## Background

Salinas Valley Health Medical Center is a 263-bed, non-academic medical center. The Imaging Department conducts approximately 23,000 computed tomography (CT) scans per year, of which 26% are abdomen and pelvis CT scans with contrast. When technologists perform CT scans, they adjust certain parameters and settings based on patient size and specific body area being scanned, which affect the radiation dose. While most scanners have technology that automates the dose, radiology technologists (techs) must properly position the patient, verify the dose, and adjust as needed. Scanners may have different settings that techs must learn, and individual techs' choices in dosing may result in patients receiving more radiation than needed, or receiving suboptimal radiation doses that may affect image quality.

## Purpose Statement

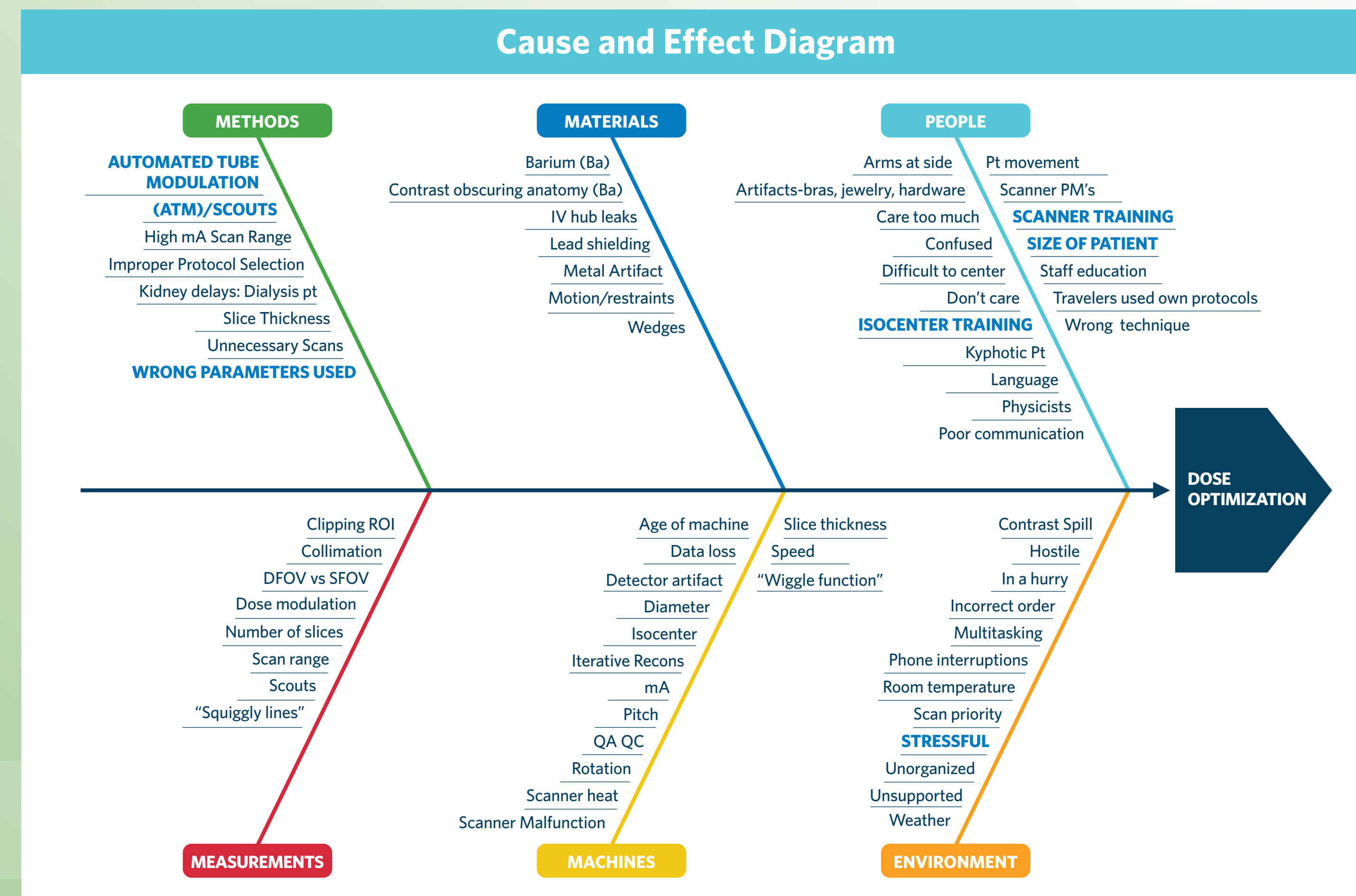
The purpose of this quality improvement project was to improve the safety and quality of routine abdomen and pelvis CT scans with intravenous (IV) contrast by reducing unnecessary radiation dose and ensuring consistent, patient-size-appropriate dosing while maintaining high image quality.

## Methods

We partnered with the American College of Radiology (ACR) Learning Network, which offers a 6-month program that engages front line staff in improvement work. The roles included a sponsor, provider, coach, team leader, and team members, and all were filled by medical center staff with very specific boundaries and time commitments. The teams participate in a structured, time-bound program for process improvement. It teaches the participants how to select a project, create a goal, and how to use the A3 methodology to problem solve. All participants are required to watch videos, read articles, and participate in group discussions. Additionally, the coach and team leader are required to present bi-weekly updates to the Learning Network instructors. During October 2024 to March 2025, a team from the Salinas Valley Health Radiology Department participated in a radiation dose collaborative to decrease and provide consistent CT doses based on patient size.

Using the Learning Network's A3 for Quality Improvement problem-solving tool, the medical center team regularly visited the CT department and watched the technologists work. We collected and analyzed data in pareto charts, asked staff clarifying questions, and performed short surveys to better understand our CT team's practice and knowledge about CT. We created cause and effect diagrams (see Figure 1), defined root causes, identified key drivers, and then performed rapid Plan-Do-Study-Act (PDSA) cycles.

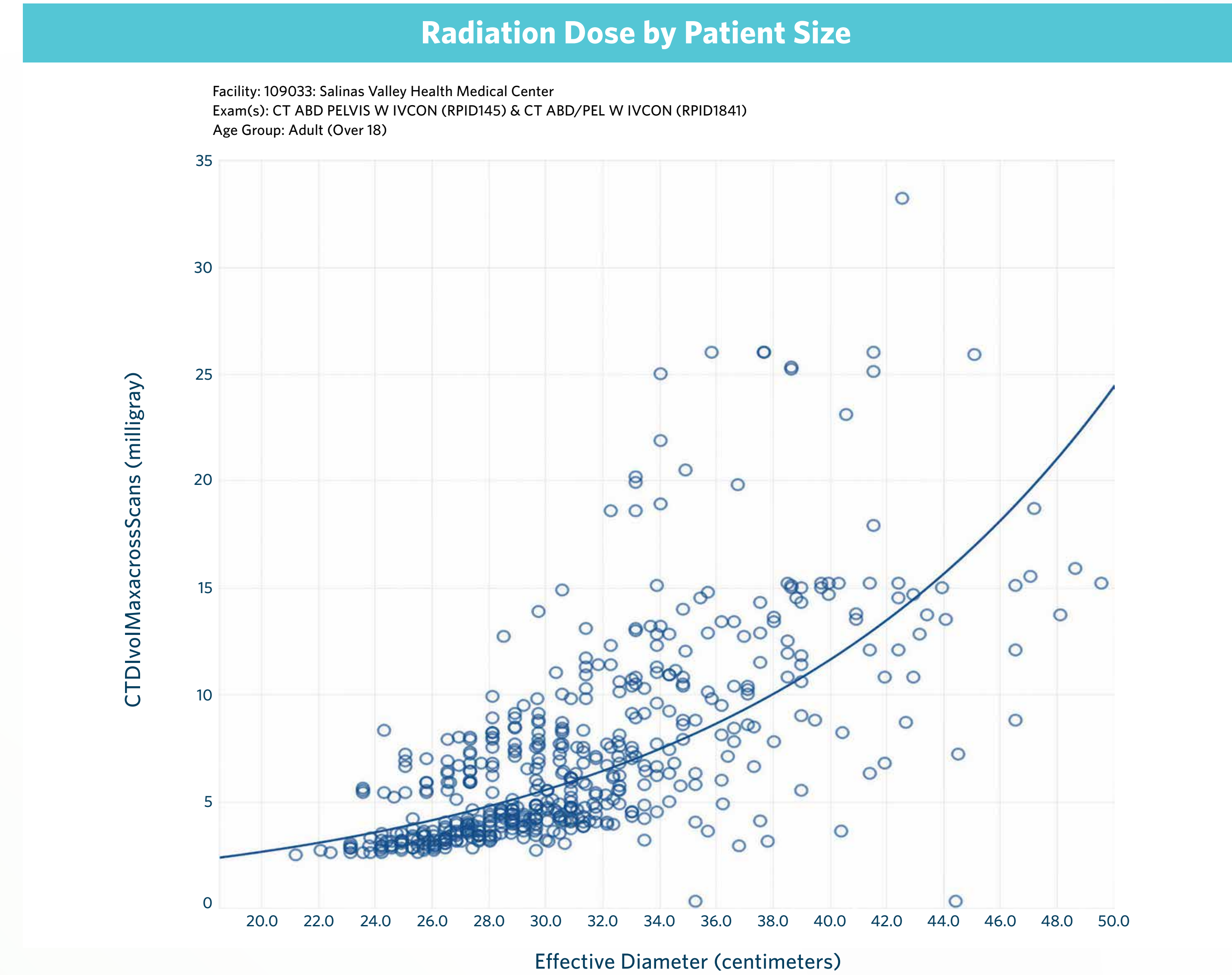
Figure 1



Note. The cause and effect diagram was used to explore potential root causes of issues related to CT scan dosing. Bold, blue-colored text represents areas selected for in-depth data analysis to determine their frequency as contributing factors.

To understand and improve the radiation doses, we used the ACR's Dose Index Registry (see Figure 2). This system helped us record and track patient size and the dose calculations being used. Since patient information was deidentified, we carefully cross-referenced the dates and times of the scans with patient size and dose information to ensure accuracy.

Figure 2



Note. We obtained baseline radiation dose data over a 2-month period for all abdomen and pelvis scans with intravenous contrast by utilizing the ACR's Dose Index Registry before the project started. The x-axis represents the average patient size, and the y-axis represents the associated radiation dose. Considerable variation in dose was noted among patients of the same size. CTDIvol = Computed Tomography Dose Index Volume.

Once data were confirmed, we sorted doses by patient size, and then adjusted the CT scanners' settings based on this size data. After each change, we checked the image quality to make sure it was sufficient for clinical evaluation and diagnosis.

Using the following methods, we evaluated if our changes were working:

- Created a goal, or "target curve," for the ideal radiation dose based on a patient's average size (effective diameter in centimeters).
- The radiation output is measured in a unit called Computed Tomography Dose Index Volume (CTDIvol), which is calculated in milligray (mGy).
- Tracked the difference between actual doses and our target curve.
- Plotted the doses over time on a chart to see trends and identify when a significant change occurred.
- Compared the average dose and the variation in dose before our adjustments to the results after our adjustments to confirm the improvement.

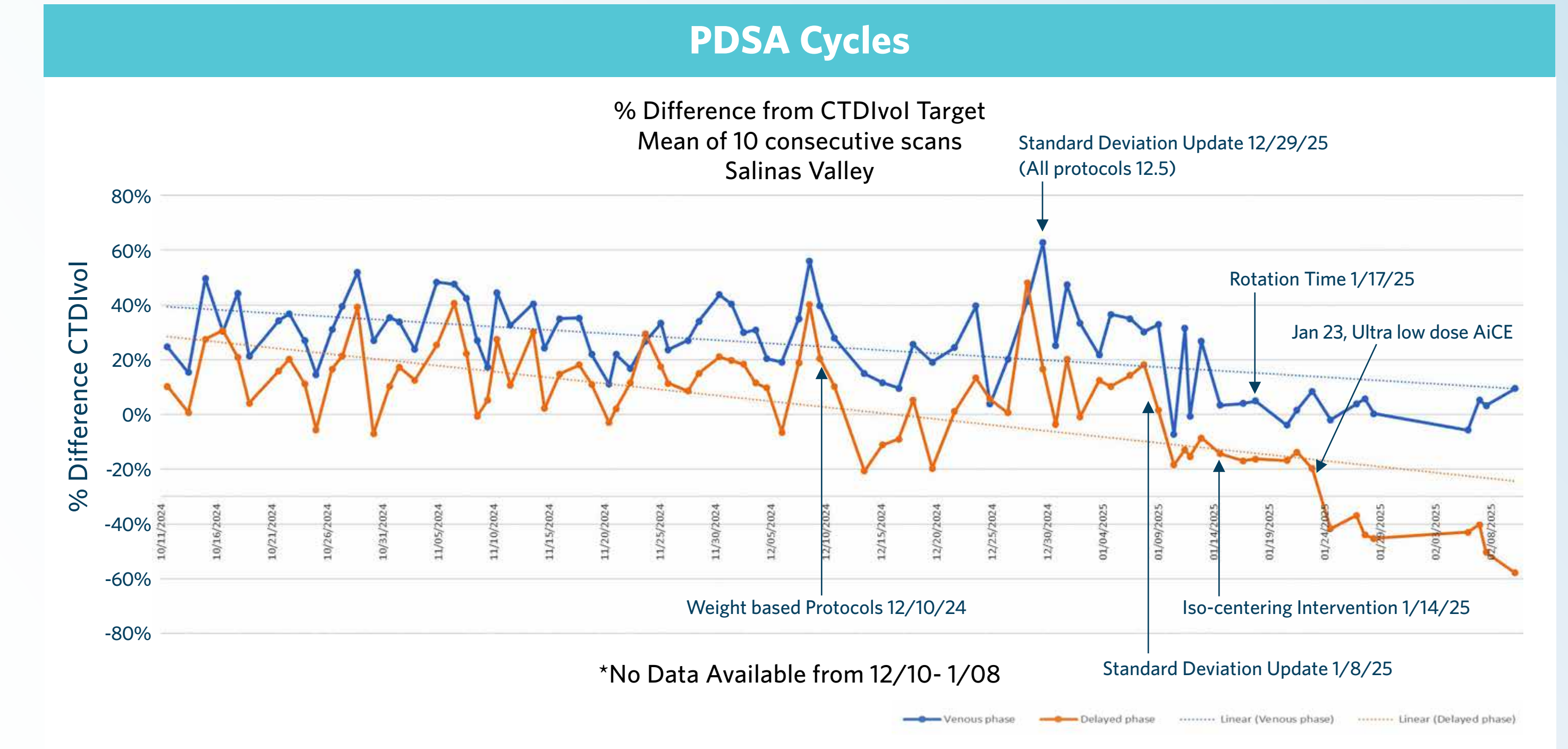
Several interventions were implemented to optimize the dose including technologist education, and weight-based protocols. These protocols included specific patient centering, the radiation rotation time, and consistent parameters for our adult populations. Furthermore, the team worked with our onsite radiologists to ensure that exams met diagnostic standards.

## Results

In addition to baseline data, we tracked the CT scans from October 9, 2024, to April 18, 2025. After we trained the technologists and adjusted the scanner settings for a second time on January 8, 2025, we noted significant improvement (see Figure 3):

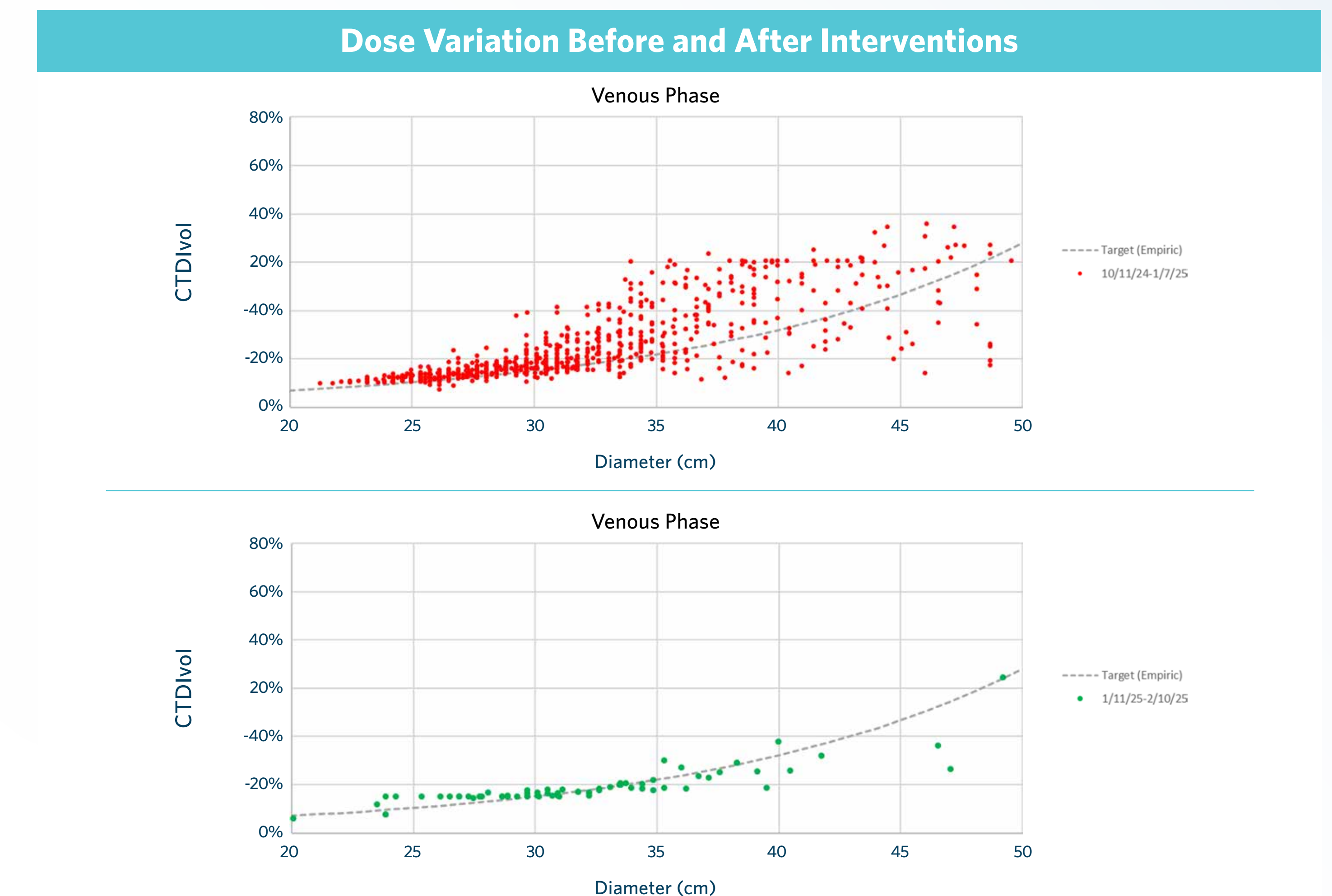
- Average Radiation Dose:** The average dose a patient received dropped from 7.5 mGy to 5.6 mGy, a 23% reduction.
- Dose Consistency (Variation):** The variation in dose between patients decreased from a difference of 1.6 mGy to 0.5 mGy from our ideal target. This means the dose is more consistent and tailored to the patient's size (see Figure 4).
- Image Quality:** The quality of the images remained high enough for the physicians to make an accurate diagnosis.

Figure 3



Note. The blue line represents the radiation doses over time for the venous-phase scans of the abdomen and pelvis, acquired approximately 60 seconds after contrast injection. The orange line represents the radiation doses over time for the delayed-phase scans of the kidneys, acquired approximately 3 to 4 minutes after contrast injection. Arrows indicate when PDSA cycles were introduced. CTDIvol = Computed Tomography Dose Index Volume (mGy); AiCE = Advanced intelligent Clear-IQ Engine.

Figure 4



Note. The x-axis represents the abdomen and pelvis size, and the y-axis represents patient dose. The first graph shows the venous-phase data before the start of the project, and the second graph shows the data after the interventions. CTDIvol = Computed Tomography Dose Index Volume (mGy).

## Conclusions

This quality improvement initiative, conducted in collaboration with the ACR Learning Network, successfully reduced the average CT radiation dose from 7.5 mGy to 5.6 mGy and improved dosing consistency across all patient sizes, reducing variation from 1.6 mGy to 0.5 mGy, while ensuring adequate image quality. We will monitor outcomes on a quarterly basis to ensure that we are maintaining consistent doses. We will continue to review additional protocols in our scanner and apply the appropriate changes to make the scans more uniform.

By using this methodology and understanding the institution's scanners, this same model may be used by other organizations to improve CT radiation dose accuracy and variation.

## References

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