

Background

Use of computer tomography (CT) scans for patient diagnosis has tripled since 1993 to approximately 70 million scans in the United States annually, which has led to increased cost and concern for potential for radiation-related cancer risk [1]. While the benefits are great, a single chest CT scan exposes patients to 350 times more radiation than a conventional X-ray image.

Unlike CT angiography (CTA) exams, acquiring non-contrast images prior to contrast enhanced images for routine chest CT (double CT) exams is rarely useful. The non-contrast portion of the double CT is superfluous and it adds to radiation dose, without significant overall patient benefit, and adds to healthcare expenses.

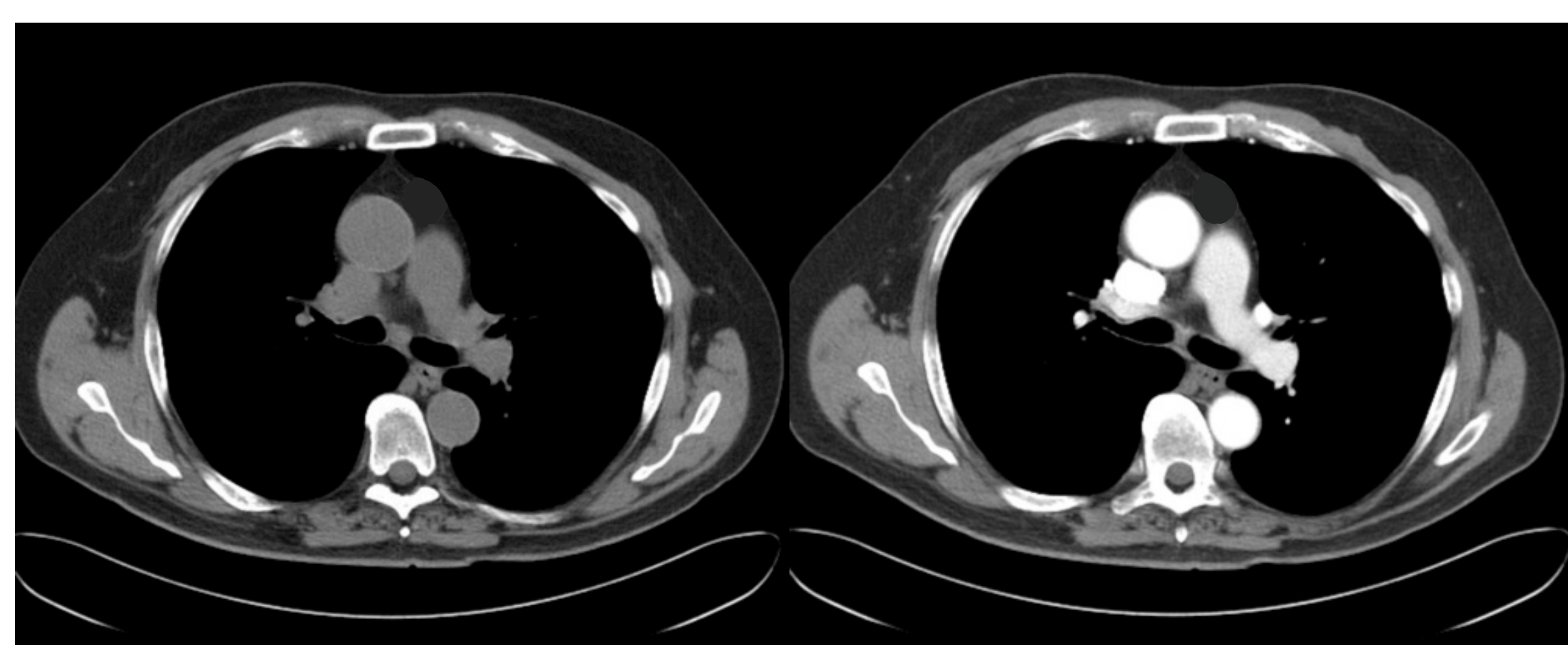


Figure 1. Non-contrast (left) and contrast (right) axial CT images through the chest. No useful additional diagnostic information is gathered from the non-contrast study leading to unnecessary radiation delivered to the patient and increased cost.

In light of growing healthcare costs, Medicare's *Hospital Compare* website publishes hospital rates of double CT chest use for public transparency. Centers for Medicare & Medicaid Services (CMS) uses state and nationwide percentage comparison of outpatient double CT exams as one of the quality measures for hospital grading. For Thomas Jefferson University Hospital, the outpatient use of double chest CT was above state average (1.2%) and slightly below national average (1.5%) at 1.3% [2].

Objectives

To analyze the variables resulting in double chest CTs being ordered and performed, with the aim to reduce the amount of ordered double chest CTs at Thomas Jefferson University Hospital.

Methods

Our-IRB approved retrospective and HIPAA compliant study was done using PDSA quality improvement methodology. We reviewed double CT chest exams ordered and performed between 04/2017-12/2017 (pre-intervention), and after implementation of improvement measures. We repeated our review for the exams performed between 01/2018-08/2018 (post-intervention).

We analyzed patient charts for exam indications and CT study details, as well as exam ordering locations. We reviewed the data with department leadership, CT technologists, and physicians. Subsequently, we deployed ongoing review of the daily CT chest schedule to capture double CT orders which were modified as appropriate. We assigned a default report template for separate CTA chest exams.

Results

Prior to intervention, there were 165 double chest CTs ordered out of a total of 12,018 ordered chest CT studies (1.3%) from April 2017 to December 2017. After intervention, the number of double chest CTs ordered decreased to 44 out of 15,884 total ordered chest CTs (0.3%) from January 2018 to November 2018. There was a 73% overall reduction of double chest CTs ordered between the pre- and post-intervention periods.

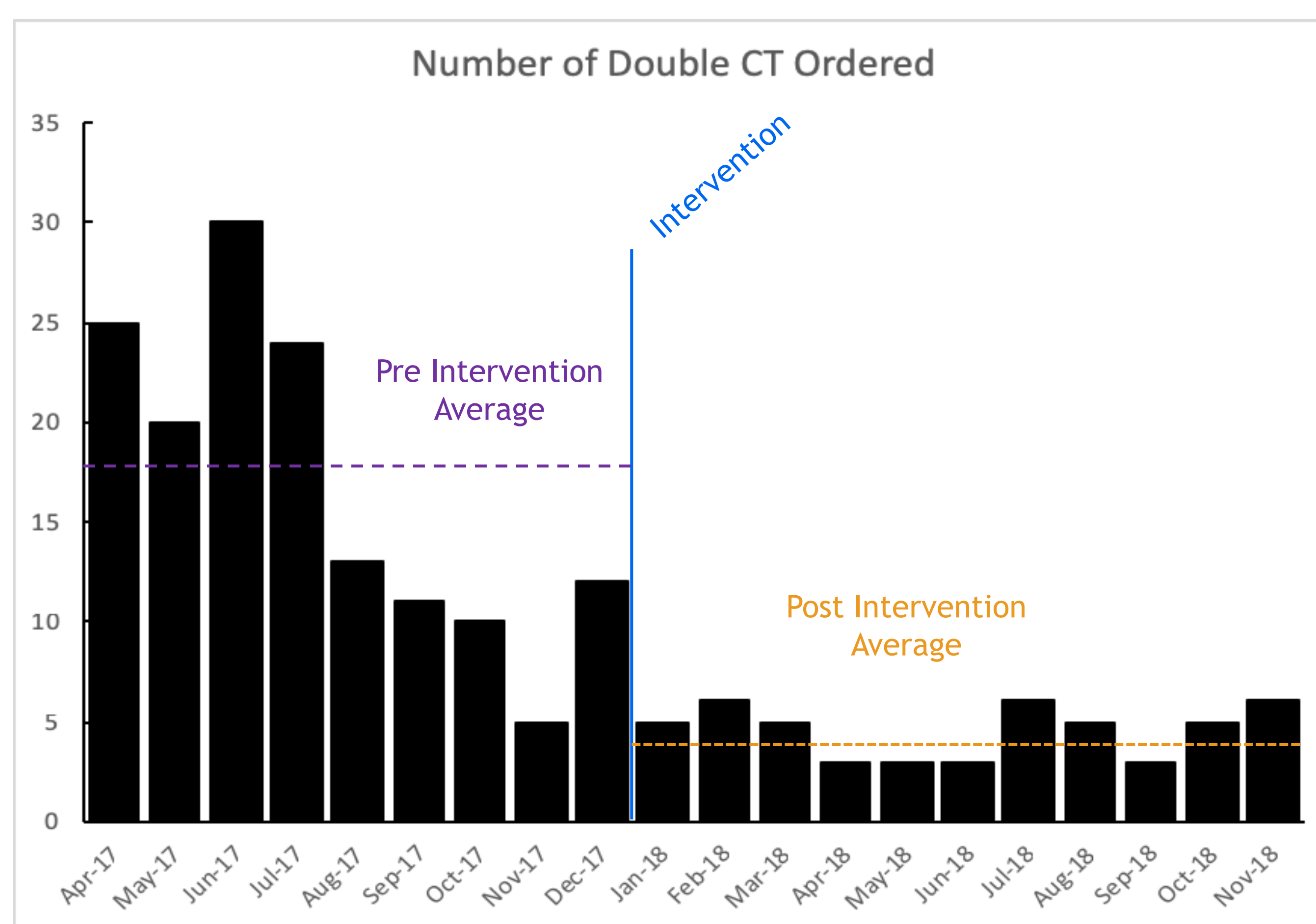


Figure 2. Number of double chest CTs ordered from 04/2017 to 11/2018. The blue line represents the time point when intervention measures were used to decrease the number of non-indicated double chest CTs. There was an overall decrease in the amount of double contrast chest CTs ordered from an average of 18 studies per month (purple) to an average of 4 studies per month (orange).

The amount of double CT studies ordered in ED and non-ED locations reduced after intervention by 84.6% (26 vs. 4) and 84% (25 vs. 4) respectively.

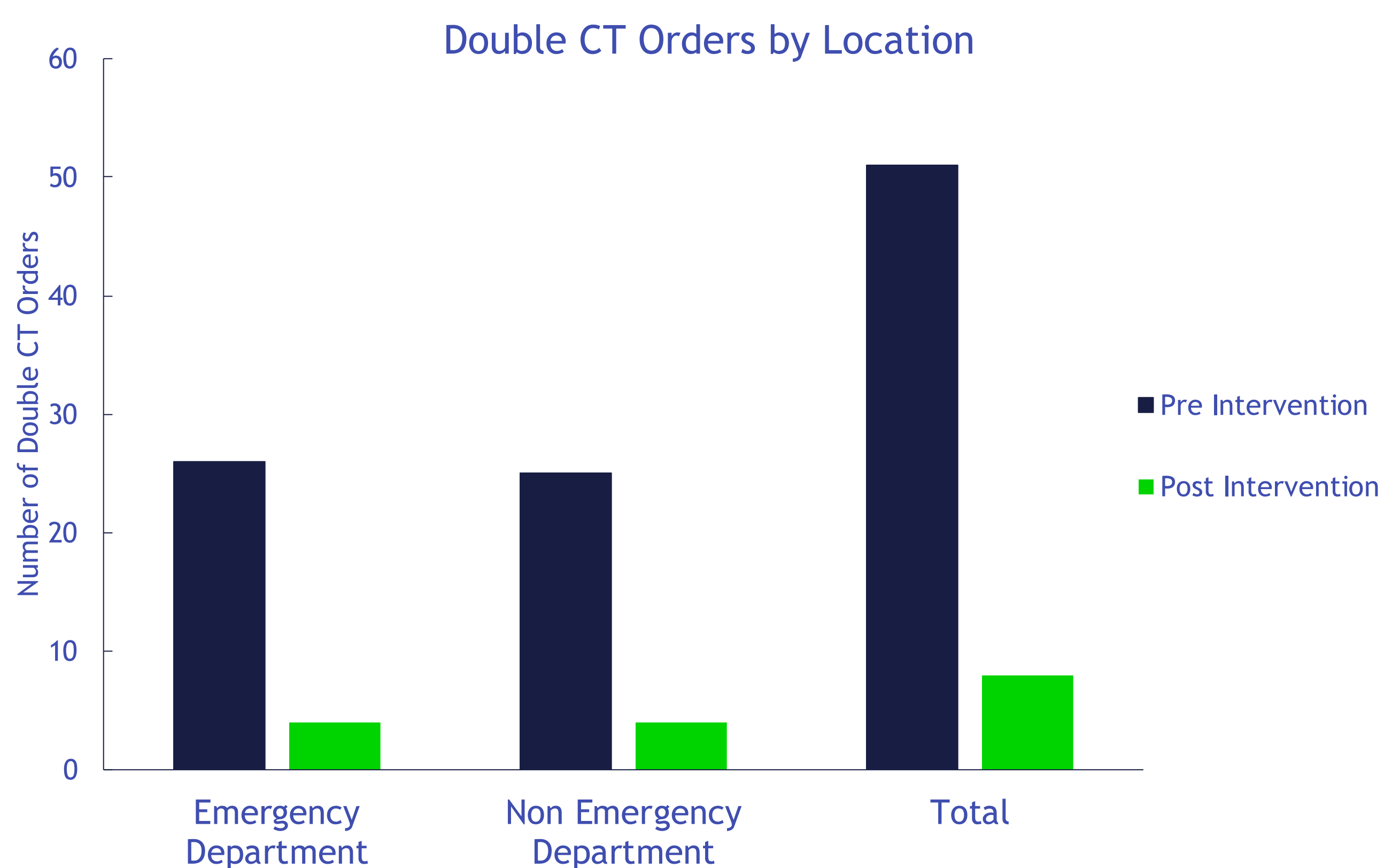


Figure 3. Number of double chest CT ordered by location in the Emergency Department and non-Emergency Department setting. There was an overall decrease in the amount of studies ordered in each location after implementation of intervention measures.

The amount of double chest CTs performed for a vascular and a non-vascular indication reduced by 77.8% (27 vs. 6) and 91.7% (24 vs 2) respectively.

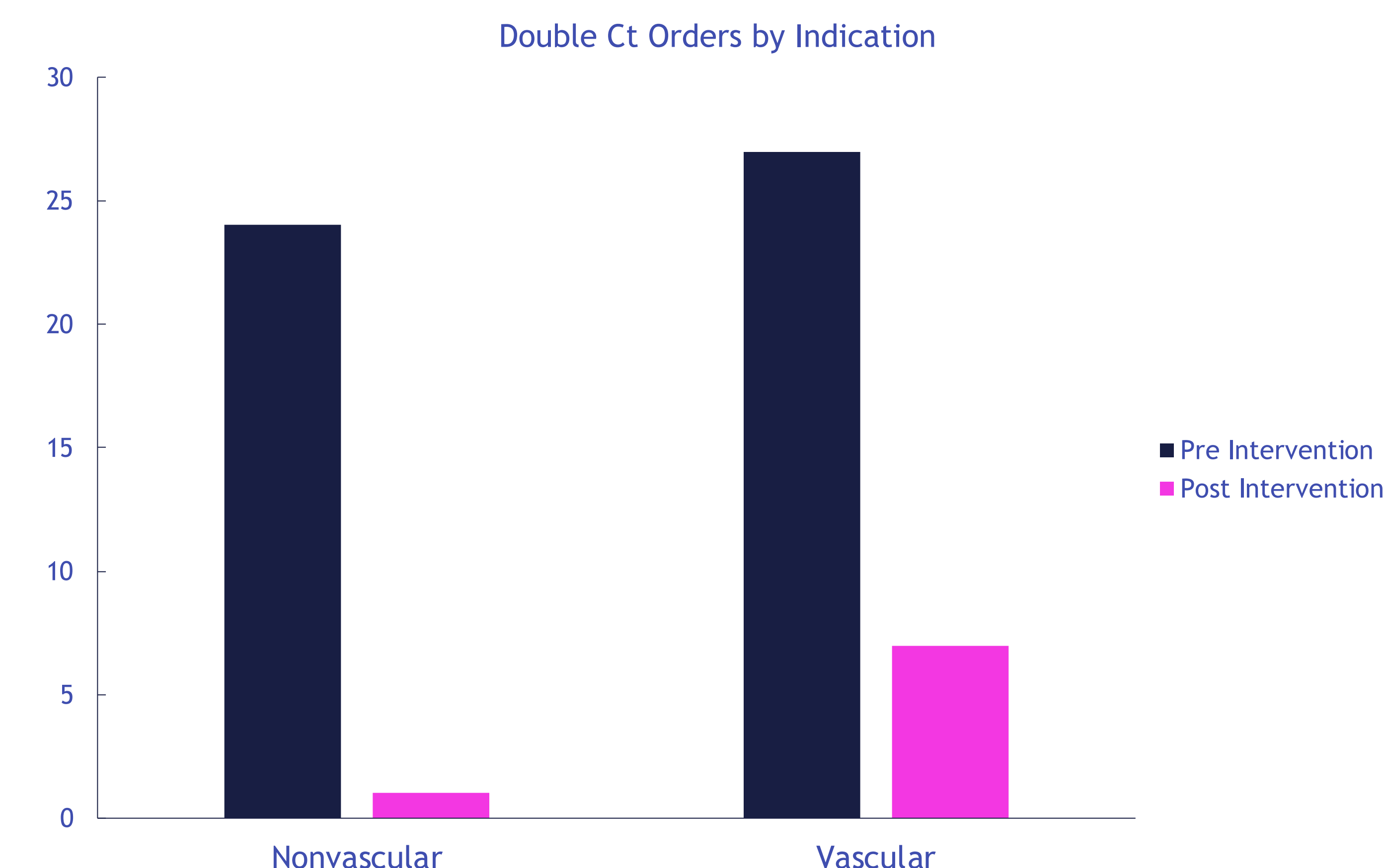


Figure 4. Number of double chest CTs ordered for a vascular or non-vascular indication. There was an overall decrease in the number of double chest CT orders for vascular and non-vascular indications after implementation of interventions.

Among the double CT exams, the exams performed without a specific pre-scan protocol and specific double CT prescriptions fell by 85% (20 vs 3) and 71.4% (7 vs 2) respectively. Erroneous labeling of a CTA as a double CT reduced by 85.7% (28 vs 4). Discordance between the procedure and billing reduced by 96.6% (29 vs 1).

Conclusion

We identified and, in a targeted fashion, reduced the total number of double chest CT studies and erroneous orders at Thomas Jefferson University Hospital demonstrating that our interventions were successful. We improved exam protocol prescriptions and improved our accurate reporting, for billing purposes, in radiology reports.

Using the experience gained from this project, we hope to expand this process to the other CMS quality measures for hospital grading in medical imaging, including double abdomen CT studies and double brain and sinus CT studies, so that we may deliver safer and more cost-efficient care for our patients.

References

- Berrington de González A, Mahesh M, Kim K, et al. Projected Cancer Risks From Computed Tomographic Scans Performed in the United States in 2007. *Arch Intern Med.* 2009;169(22):2071-2077. doi:10.1001/archinternmed.2009.440
- The Official U.S. Government Site for Medicare- Thomas Jefferson University Hospital, accessed 10 May 2019, <<https://www.medicare.gov/hospitalcompare/>>