



# Improving Efficiency in Performance of CT of the Chest, Abdomen, and Pelvis from Order Entry to Protocol at a Safety Net Hospital



Jay P. Agrawal, MD; Nalini Kanth, MD; Saba Gilani, MD; Susan DeCosta, LPN; Prachi Anand, MD; Dhyan Rajan, MD; Valeria Zilberman, DO; Sumreen Majeed, MD; Martha Radford, MD

## Purpose

Ordering the right radiological study for a clinical indication is essential to having the test performed in a timely fashion and improving CT throughput. Ordering incorrect tests slows the process since the ordering clinician must be contacted to discuss the indication in order to perform the appropriate exam. Additionally, appropriate laboratory data need to be obtained prior to intravenous contrast administration, which can lead to further delays. Incorrect tests also lead to unnecessary radiation exposure and unnecessary cost. Our purpose was to decrease CT turnaround time and improve throughput by reducing the number of incorrect orders by educating internal medicine residents on ACR appropriateness criteria for ordering computed tomography of the chest, abdomen, and pelvis.

## Methods

Baseline data was collected for one week (6/25/2011 to 7/1/2011) followed by one additional week post-intervention (2/6/2012 to 2/12/2012). The data collected included the total number of changed orders for CT examinations of the chest, abdomen, and pelvis with and without contrast; the total number of CT examinations performed; the timestamp of when a study was ready for protocol; and the timestamp of when a study had been protocolled. It is important to note that changed orders represent incorrect orders because every incorrect order must be changed to a correct order before a patient is scanned. The total number of changed orders was expressed as a percentage of the total number of CT examinations performed. The elapsed time between when a study was ready for protocol and when it had been protocolled was calculated for each case and subsequently used to formulate an average elapsed time. Only CT examinations performed on inpatients and outpatients were considered; CT examinations performed on ER patients were excluded because studies ordered by ER clinicians are not protocolled.

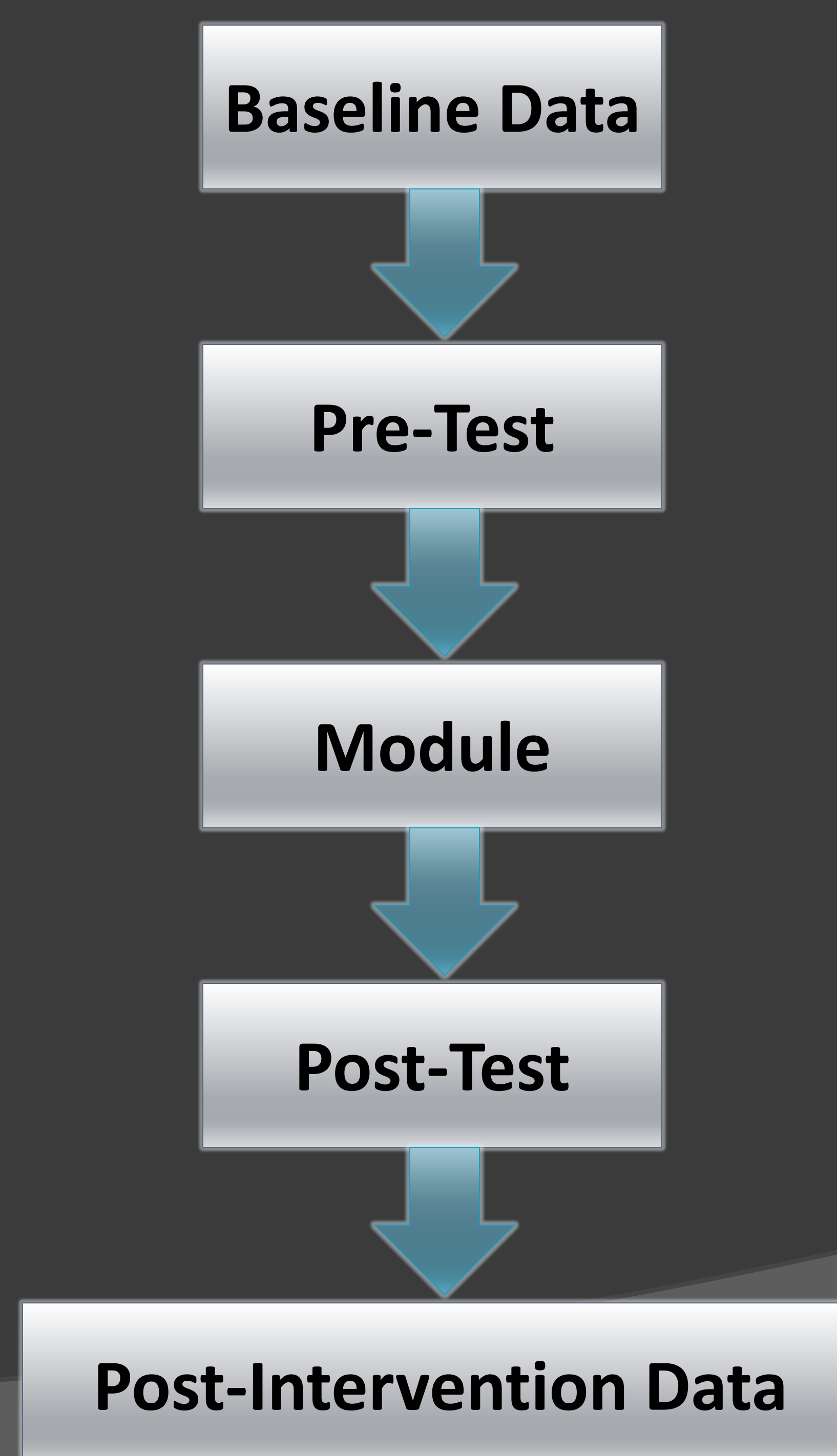
A pre-test on ACR appropriateness criteria for common indications of chest, abdomen, and pelvis CT was created and distributed to medical residents via software provided by New Innovations, Inc. The pre-test was followed by an educational PowerPoint module that described ACR appropriateness criteria for chest, abdomen, and pelvis CT along with a discussion on the appropriate indications for ordering CT examinations with or without contrast. A post-test using the same software as the pre-test was administered to medical residents after they had the opportunity to review the educational module.

## Results

A total of 136 patients were analyzed. There were 52 baseline and 84 post-intervention cases. The total number of changed orders at baseline was 26 while the total number of changed orders post-intervention was 7. The percentage of changed orders decreased from 50% at baseline to 8.3% post-intervention, an 83.4% improvement. The average elapsed time between when a study was ready for protocol and when it had been protocolled decreased from 7.49 hours at baseline to 2.39 hours post-intervention, a 68.1% improvement. The average percentage of correct answers was 61% on the pre-test and 59.1% on the post-test, a 3.1% change.

The percentage of changed orders showed a significant improvement from baseline to post-intervention. This could be attributed to the educational module because it encouraged medical residents to contact radiology residents prior to ordering a radiological study if unsure of the correct study to order. Another possibility could be that the baseline time period included relatively newer medical residents who had less exposure to the knowledge required to make a correct order entry. The average elapsed time also showed marked improvement from baseline to post-intervention. This can be attributed to less incorrect studies being ordered leading to fewer callbacks from radiologists to ordering clinicians.

The average percentage of correct answers did not significantly change between the pre-test and post-test. A possible explanation could be that more medical residents participated in the post-test, including those who were unaware that an educational module was available for review.



	Baseline 6/25/2011 – 7/1/2011	Post-Intervention 2/6/2012 – 2/12/2012
Inpatients & Outpatients Scanned	52	84
Changed orders	26 (50%)	7 (8.3%)
Average Elapsed Time Between Ready for Protocol & Protocolled (hours)	7.49	2.39

	Pre-Test 12/11/2011 – 12/23/2011	Post-Test 1/2/2012 – 1/20/2012
Average % Answers Correct	61%	59.1%

## Conclusion

Our project showed that educating ordering clinicians on ACR appropriateness criteria leads to significant reductions in the number of incorrect studies ordered, improves CT turnaround time, and increases CT throughput. Collecting baseline data allowed us to develop an educational module that not only covered relevant ACR appropriateness criteria but also targeted the most frequent incorrectly ordered studies. By working with the internal medicine department, we were able to distribute the pre-test, educational module, and post-test to medical residents via online software. For future PDSA (Plan-Do-Study-Act) cycles, the internal medicine department has expressed interest in continuing to educate current and incoming residents through our educational module with the goal of decreasing the number of incorrectly ordered studies.

## Take Home Points

- ✓ Educating ordering clinicians is key to improving efficiency
- ✓ The ACR Appropriateness Criteria is readily accessible and is an excellent resource
- ✓ An interdisciplinary approach is essential to understanding the workflow process and promoting change