



Improving “Order-to-Scan Time” for Emergency Department Unenhanced CT Examinations Through Auto-Protocols & Expedited Clinical/Imaging Communication

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BACKGROUND

Reducing emergency department length-of-stay (ED LOS) has become increasingly important as our ED volume continues to rise by approximately 4% each year. In an effort to meet this goal, decreasing “order-to-scan time” has become a major quality improvement effort in our emergency radiology division.

THE PROBLEM

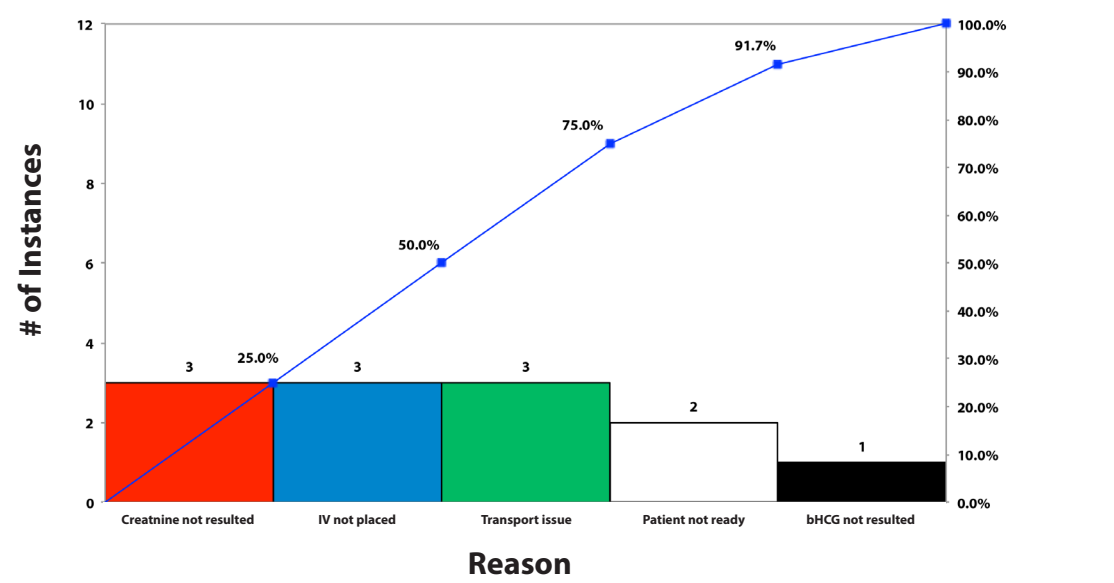
Baseline data included:

1	Surveys of technologists inquiring about reasons for CT exam delays.
2	Timestamps of “exam ordered” and “exam begun” which were extracted from the electronic medical record, subtracted from each other (OtB or “order-to-scan” time), and averaged daily.

A Pareto chart of survey responses showed that issues with patient readiness - including waiting for labs to result and for an IV to be placed – accounted for 75% of delays.

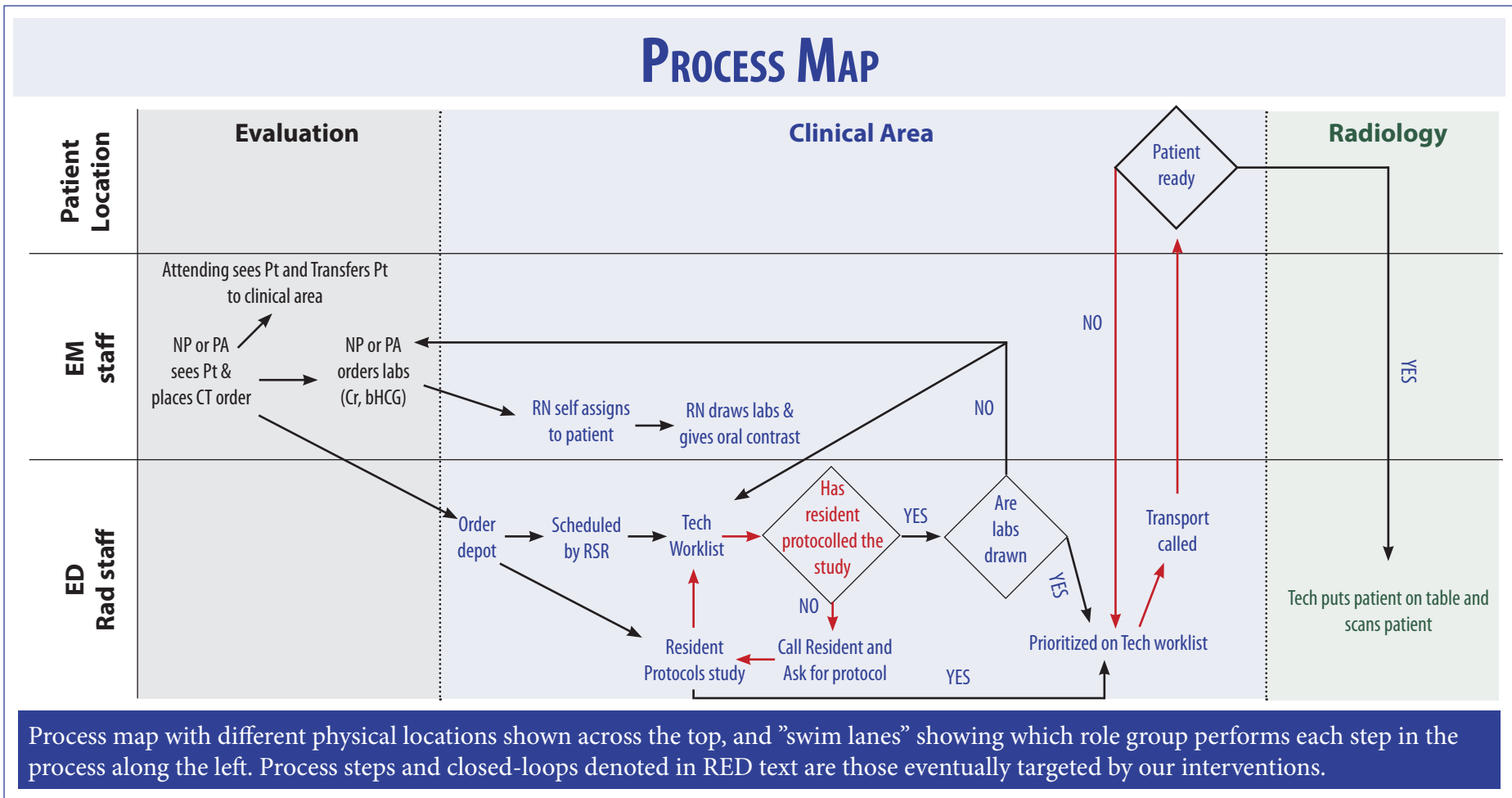
PARETO CHART OF CT TECHNOLOGIST SURVEY RESPONSES

Reasons for time delay between exam ordered and performed Survey n = 12

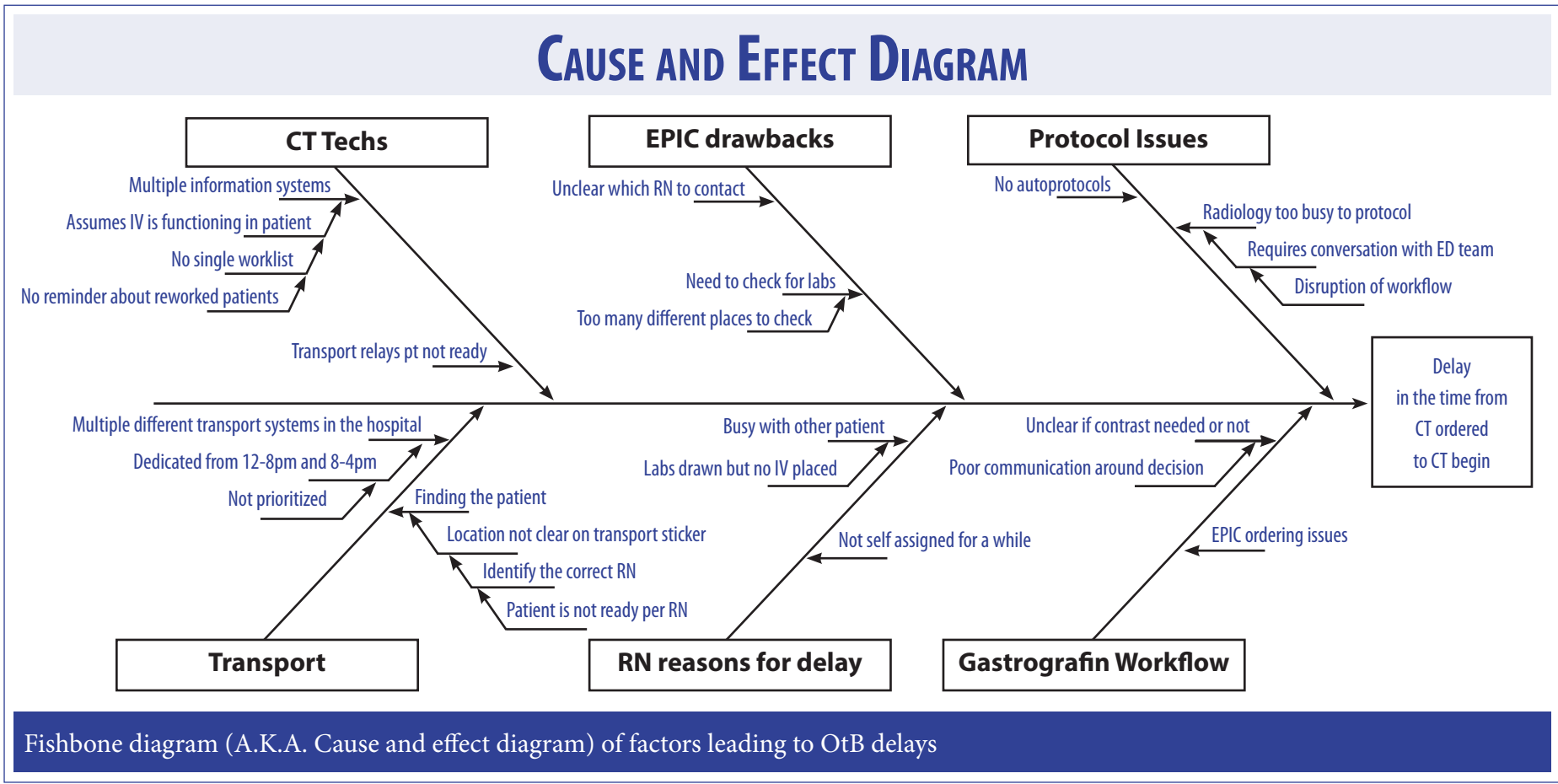


Statistical process control (SPC) charts of baseline average daily OtB performance showed that it took an average of 90 minutes for non-contrast enhanced C-spine CTs and non-contrast, stone protocol Abdomen/Pelvis CTs to be performed after the exams were ordered.

Our multidisciplinary focus group included ED radiology staff and trainees, CT technologists and managers, ED physician staff and trainees, ED nurses, and Radiology information technology staff. Our team created a process map and fishbone diagram to better understand factors contributing to delays.



Process map with different physical locations shown across the top, and “swim lanes” showing which role group performs each step in the process along the left. Process steps and closed-loops denoted in RED text are those eventually targeted by our interventions.



Fishbone diagram (A.K.A. Cause and effect diagram) of factors leading to OtB delays

THE INTERVENTION

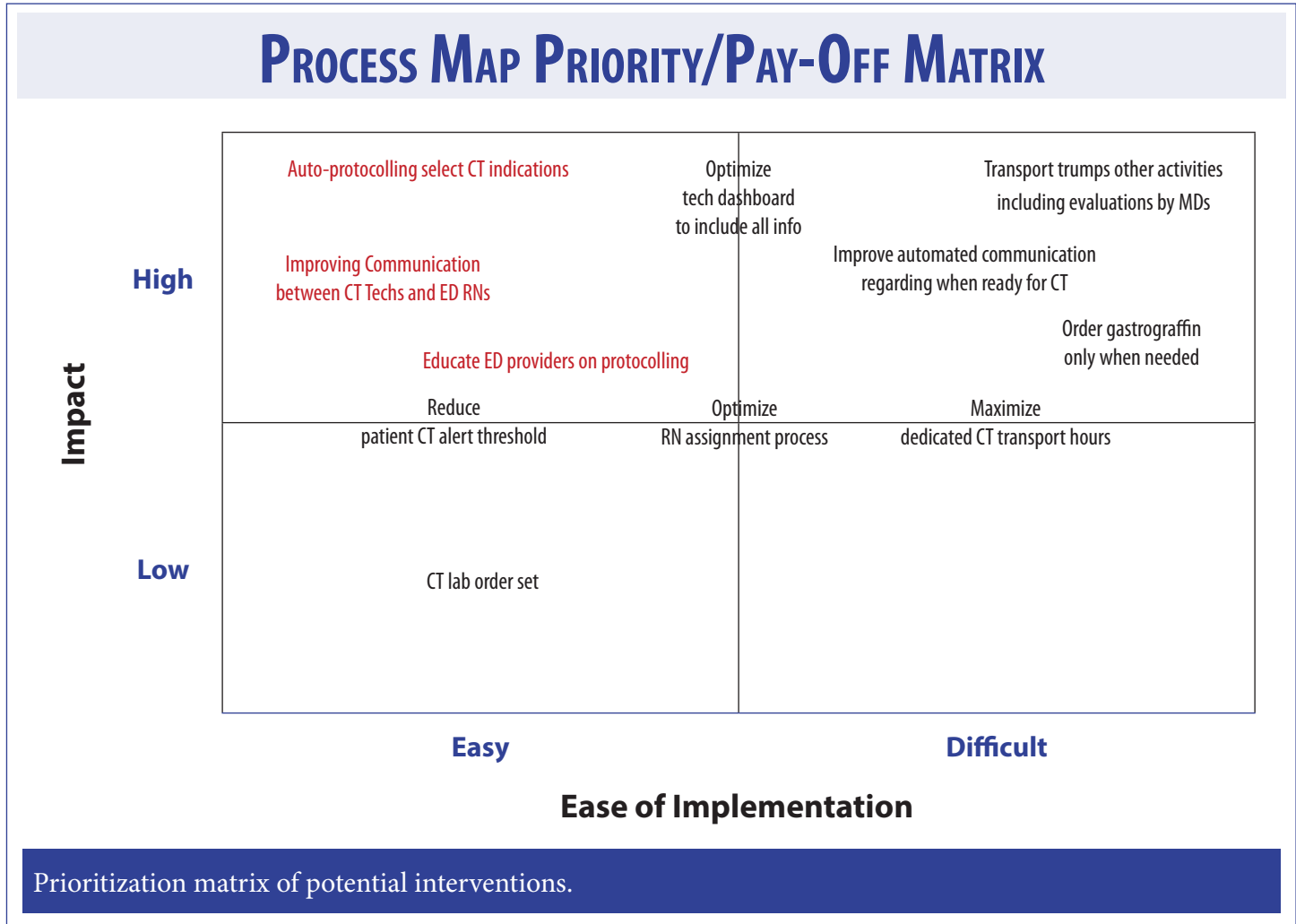
Our team brainstormed potential solutions and created a prioritization matrix to classify interventions by ease of implementation and potential impact. By vote, the team decided to focus our PDSA cycles on the interventions in red.

The Plan-Do-Study-Act (PDSA) methodology was employed and two interventions were executed:

- 1)The implementation of auto-protocol algorithms for the two exam types in question, along with educational presentations to ED PA/NPs, physician staff, and trainees to instruct them how to place exam orders (see example algorithm below). This automation removed an unnecessary manual step in our process map, as identified by our multidisciplinary team.

Orderable:	CT Cervical Spine
Inclusion Criteria:	History of “trauma” or “fall,” IV contrast “should not be used” or “per radiologist discretion”
Exclusion Criteria:	History of “abscess, fever, pharyngitis, tumor, surgery,” IV contrast “should be used”

- 2)The launch of a text-communication system and design of a standardized communication workflow between CT RTs and ED RNs regarding patient readiness for transport, addressing the most common causes for delays as identified by our baseline data survey.



Prioritization matrix of potential interventions.

RESULTS

The SPC charts show that our interventions resulted in an immediate, significant decrease in OtB time from 92 minutes to 67 minutes for unenhanced C-spine CT examinations ($p=0.05$), and from 90 minutes to 74 minutes for unenhanced stone protocol abdomen/pelvis CT examinations ($p=0.05$). We also observed decreases in variation in system performance, as evidenced by narrowing of the 3-sigma control limits.

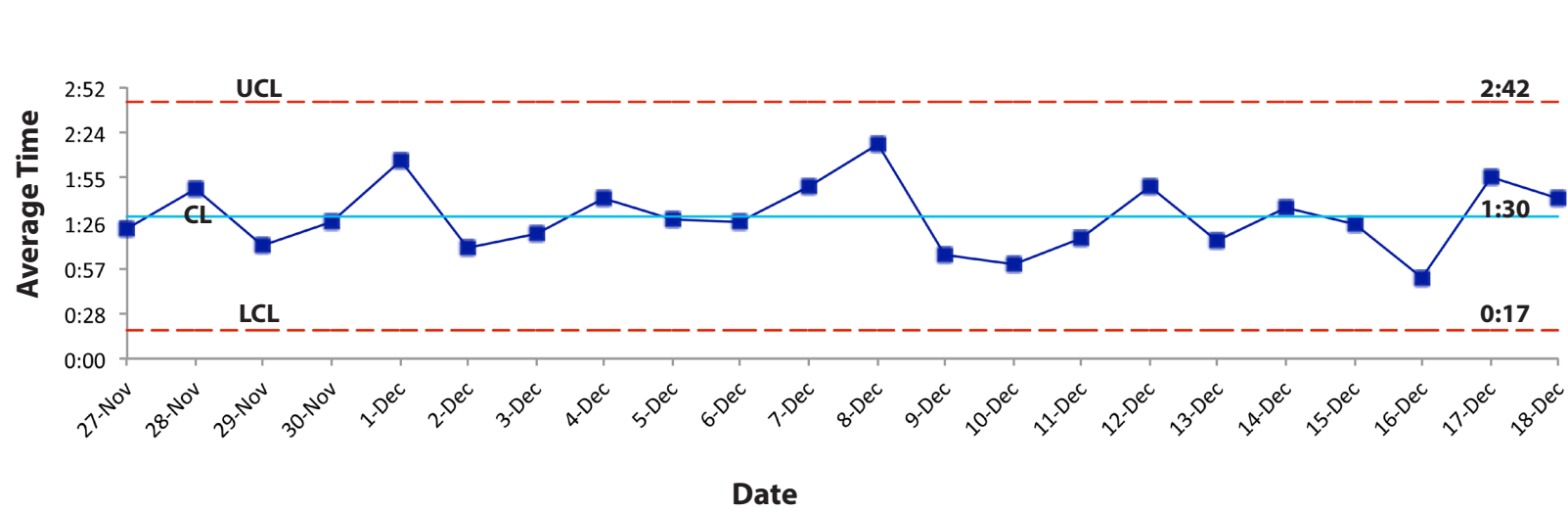
Updated data analysis has shown that these improvements have been sustained over time. As of 10/1/2017, 91% of C-spine exams and 72% of I-Stone exams are being captured by the autoprotocol algorithms. Average OtB times are 66 minutes and 73 minutes for C-spine CT exams and I-Stone CT exams, respectively.

CONCLUSION

Using classic process improvement tools and interventions focused on automation, standardization, and communication, we decreased the exam ordered-to-scan time for unenhanced cervical spine CT examinations and unenhanced stone protocol abdomen/pelvis CT examinations for non-acute trauma patients in our emergency department.

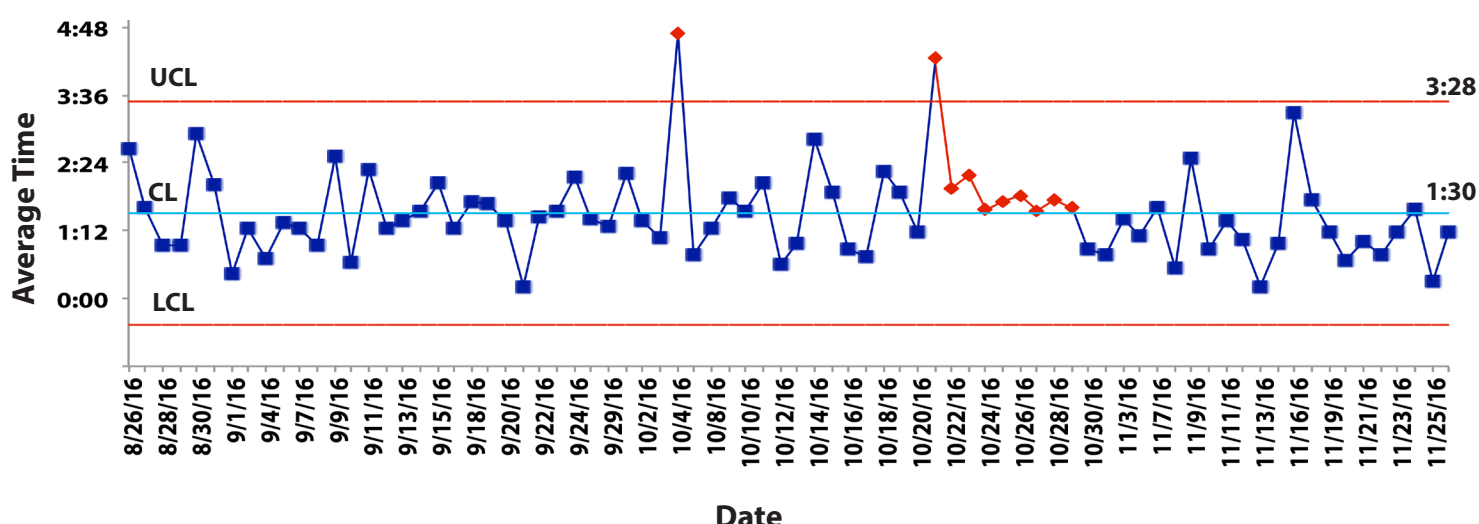
SPC XmR CHARTS BASELINE

C-Spine time ordered to CT begun n=22 days, 171 examinations



Statistical process control chart showing baseline OtB times for C-Spine CTs.

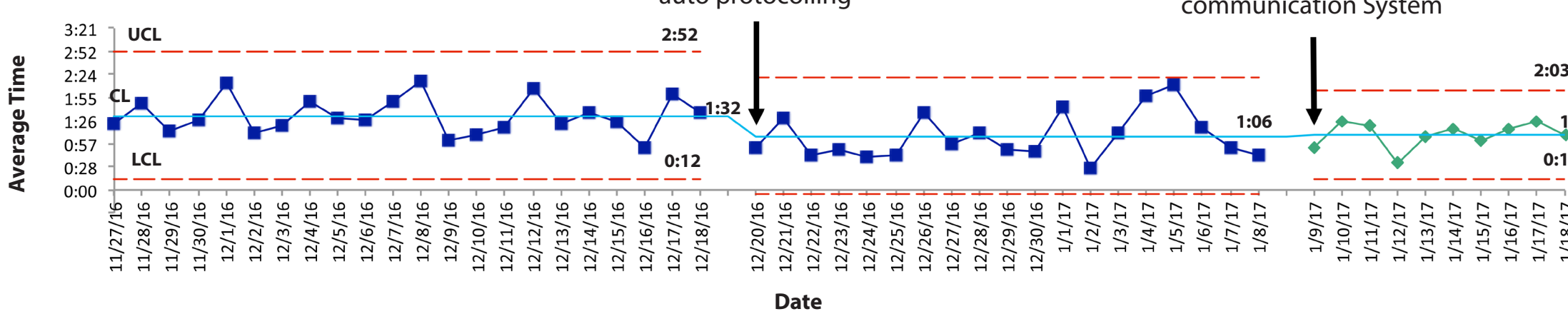
I-Stone time ordered to CT begun n=78 days, 161 examinations



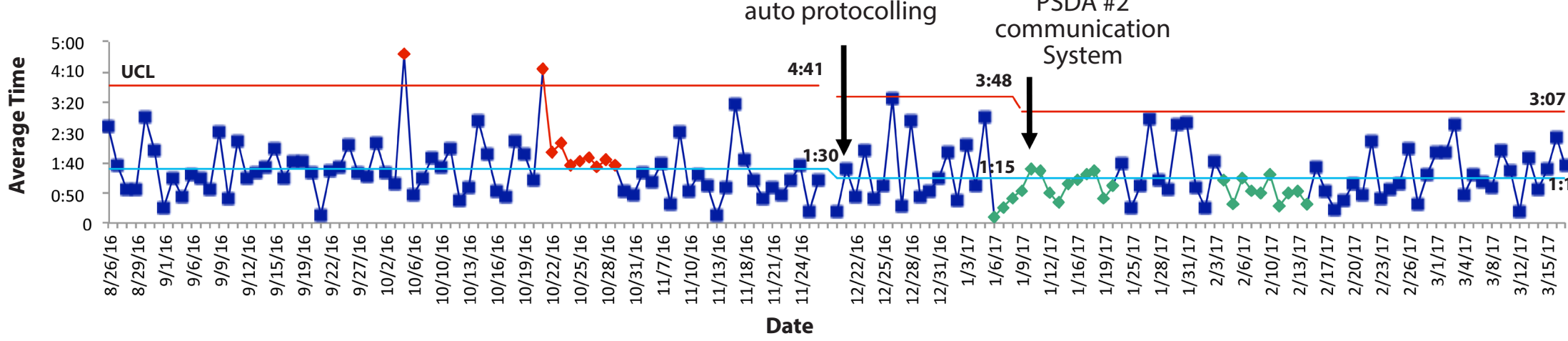
Statistical process control chart showing baseline OtB times for I-Stone CTs.

SPC XmR CHARTS POST INTERVENTION

C-Spine time ordered to CT begun n=276 patients, 53 days



I-Stone time ordered to CT Begun n=330 patients, 204 days



Statistical process control chart showing OtB times for C-Spine CTs and I- Stone CTs, with arrows denoting the dates of our auto-protocol intervention (PDSA #1) and communication system intervention (PDSA #2). Center lines and 3-sigma control limits were re-calculated after each PDSA cycle.