

Computerized Provider Order Entry (CPOE) as a Cause of Errors in Imaging Requests: *What a Difference a Space Makes*

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Problem

The type of CT study requested is frequently inappropriate for addressing the provided indication

Our most frequently encountered error is a CT abdomen-only request with an indication that requires a CT abdomen and pelvis

Impact

Due to billing requirements, clinician must change CT request to abdomen and pelvis before scan is performed

Getting clinicians to change requests wastes radiologist and clinician time

Waiting for changes delays patient care and increases costs

Outpatients may have to be rescheduled if insurance authorization was for CT abdomen-only

Initial Investigation

Radiologists contacting clinicians to get requests changed asked why a CT abdomen-only had been requested

Most clinicians thought they had requested a CT abdomen and pelvis

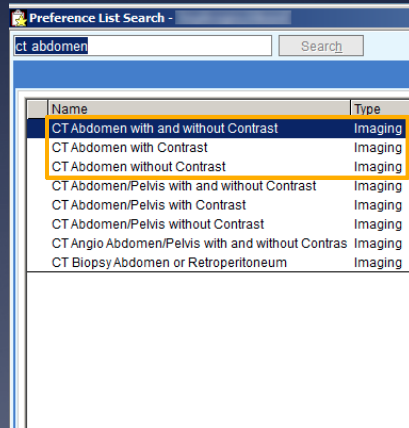
This suggests error in image request workflow rather than inadequate medical knowledge or reasoning

CPOE Investigation

Abdominal CT imaging is typically selected from a searchable preference list

Options all appear similar: Start with "CT Abdomen..." and end with "...Contrast"

The first three options in the CPOE were for CT abdomen-only based on alphabetical arrangement



The screenshot shows a window titled "Preference List Search" with a search input field containing "ct abdomen" and a "Search" button. Below the search bar is a table with two columns: "Name" and "Type". The table lists several CT scan options, with the first three highlighted in blue.

Name	Type
CT Abdomen with and without Contrast	Imaging
CT Abdomen with Contrast	Imaging
CT Abdomen without Contrast	Imaging
CT Abdomen/Pelvis with and without Contrast	Imaging
CT Abdomen/Pelvis with Contrast	Imaging
CT Abdomen/Pelvis without Contrast	Imaging
CT Anglo Abdomen/Pelvis with and without Contras	Imaging
CT Biopsy Abdomen or Retroperitoneum	Imaging

Potential Interventions

Clinician education

Pro: Directly addresses problem

Con: Requires large, ongoing outreach effort due to large, constantly changing population of clinicians and trainees in our hospital

Confirmation dialog for abdomen-only

Pro: Reaches all clinicians without outreach

Con: Meaningless alert for appropriate abdomen-only requests; contributes to alert fatigue

Unclear efficacy: Many clinicians click through confirmations without reconsidering due to time pressures and pre-existing alert fatigue

Potential Interventions

Change CPOE user interface to encourage selection of most-commonly appropriate study (CT abdomen/pelvis)

Pro: Does not require expensive outreach or involve obtrusive changes to imaging request workflow

Con: User interface of CPOE is largely fixed; minimal ability to make changes

Unclear efficacy: Limited scope of possible changes may not be sufficient to significantly impact error rate

Plan: Decreasing Incorrect Requests

Select modification of CPOE user interface as least intrusive, least resource intensive initial intervention

Hypothesis: Rearranging choices to put more frequently used CT abdomen/pelvis above CT abdomen-only will decrease erroneous abdominal CT requests

Do: Rearranging CT Choices

Name	Type	Doc
CT Abdomen with and without Contrast	Imaging	
CT Abdomen with Contrast	Imaging	
CT Abdomen without Contrast	Imaging	
CT Abdomen/Pelvis with and without Contrast	Imaging	
CT Abdomen/Pelvis with Contrast	Imaging	
CT Abdomen/Pelvis without Contrast	Imaging	
CT Angio Abdomen/Pelvis with and without Contr	Imaging	
CT Biopsy Abdomen or Retroperitoneum	Imaging	

Name	Type	Doc
CT Abdomen /Pelvis with and without Contrast	Imaging	
CT Abdomen /Pelvis with Contrast	Imaging	
CT Abdomen /Pelvis without Contrast	Imaging	
CT Abdomen with and without Contrast	Imaging	
CT Abdomen with Contrast	Imaging	
CT Abdomen without Contrast	Imaging	
CT Angio Abdomen/Pelvis with and without Contra	Imaging	
CT Biopsy Abdomen or Retroperitoneum	Imaging	

Adding a space before the / in Abdomen/Pelvis causes "CT Abdomen /Pelvis" to sort to the top of the list

Study: Identifying Errors

All CT abdomen and CT abdomen/pelvis requests for 180 days before and after intervention were exported from our RIS (IDXrad) to a SQL database (SQLite).

SQL queries identified incorrectly requested abdomen/pelvis studies:
completed abdomen/pelvis studies
changed from abdomen-only or
performed within 2 days of a canceled
abdomen-only request.

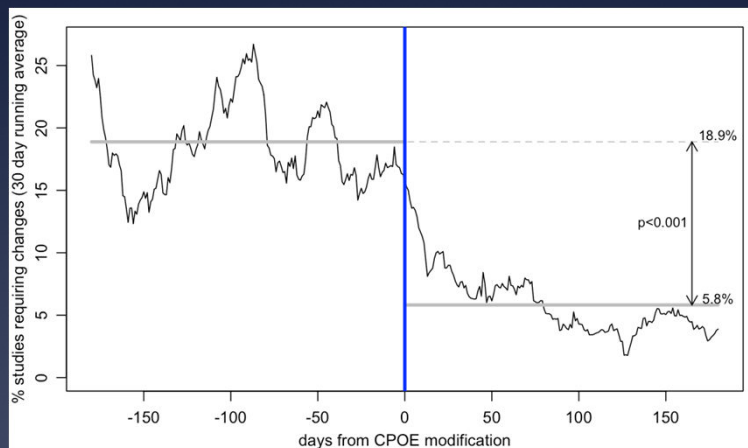
Study: Analyzing Error Rates

30 day running average proportions of incorrectly requested CT abdomen/pelvis studies calculated using R

Error rates before and after intervention plotted and compared using χ -squared test

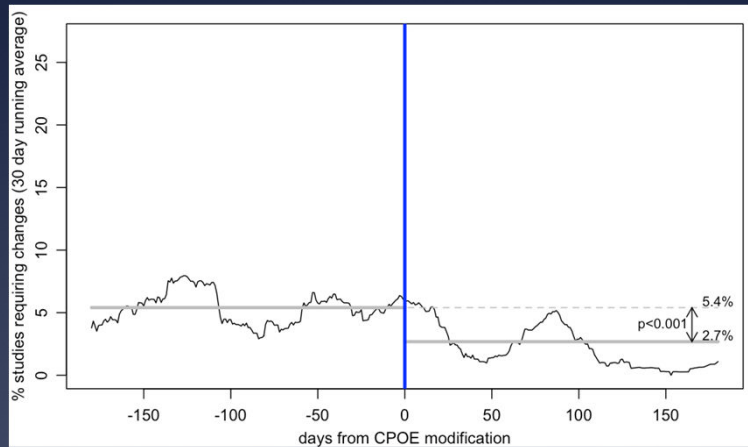
Inpatients, outpatients and ED patients analyzed separately

Study: Inpatient Results



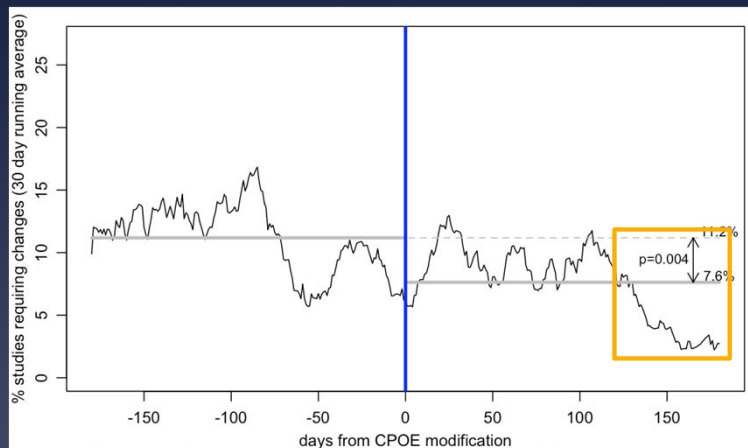
70% reduction in incorrectly requested inpatient studies with sharp decline seen immediately following intervention

Study: Outpatient Results



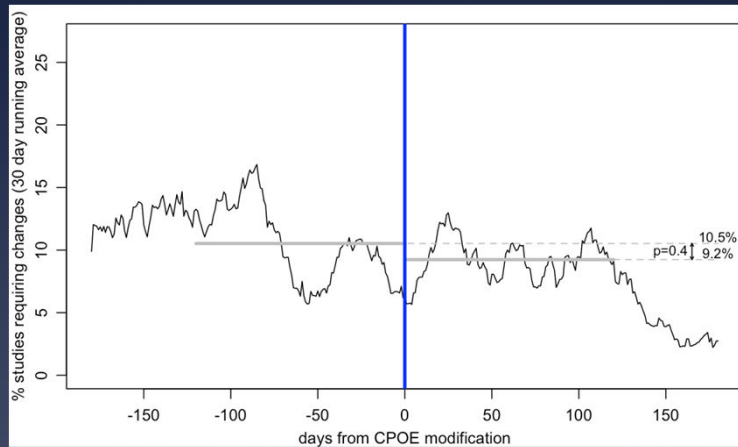
50% reduction in incorrectly requested outpatient studies, which had a lower pre-intervention error rate

Study: ED Results



Apparent reduction in error rate driven entirely by decline beginning 120 days after intervention

Study: ED Results



Repeat analysis with a 120 day window around intervention shows no significant change in error rate – intervention had no effect on imaging requests from the ED

Act: Investigation of ED Results

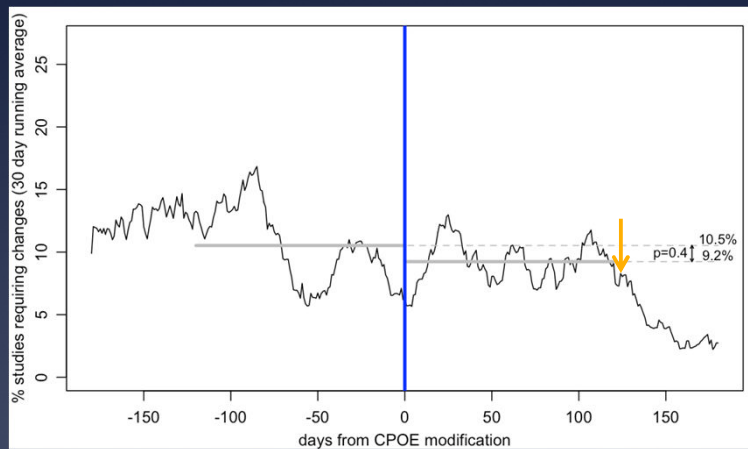
Further investigation into ineffectiveness of intervention in ED:

ED imaging request preference list was inadvertently omitted from updates

Additionally, imaging requests from ED more frequently come from check-box order sets rather than from searchable preference list

ED independently modified their order sets to reduce image request errors approximately 120 days following our intervention

Act: ED Intervention



Timing of ED change to order set options corresponds to observed decline in error rates approximately 120 days following our intervention

Results Summary

Placing “CT Abdomen /Pelvis” at the top of the list of abdominal CT options reduced errors in these requests:

- 70% in inpatients

- 50% in outpatients

ED patients served as a serendipitous control population and had no significant change in error rate for 120 days following intervention

Lessons learned: Errors in Imaging Requests

Workflow and user interface design choices strongly influence error rates

Fully understanding the process through which clinicians request imaging is essential to reducing errors

Systemic changes that facilitate correct requests may rapidly and cost-effectively reduce errors

Lessons learned: CPOE

CPOE is not a cure-all for medical errors

Users are very sensitive to the arrangement of options; small changes have dramatic effects on error rate

Putting more common choices first can be more effective than alphabetical arrangement