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

John Mongan, MD, PhD* (john.mongan@ucsf.edu)
Aaron Neinstein, MD†
Christopher Jovais* 
Spencer Behr, MD*

*UC San Francisco, Dept. of Radiology and Biomedical Imaging
†UC San Francisco, Dept. of Medicine, Division of Endocrinology

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.

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**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

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 χ²-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.