

RESEARCH LETTER

ONLINE FIRST

Reducing Radiology Use on an Inpatient Medical Service: Choosing Wisely

**D**iagnostic imaging costs and use are increasing rapidly without clear evidence of incremental benefit.<sup>1</sup> Approximately 20% to 50% of these tests fail to provide information that improves clinical care; more alarming, the prevalence of unnecessary radiation exposure or subsequent testing may generate patient harm.<sup>2-4</sup> Addressing these facts and the burgeoning costs associated with test overuse provides an opportunity to change physician behavior. Because cost consciousness and physician stewardship are not a standard curricular focus in medical education,<sup>5,6</sup> optimizing physicians' test ordering behavior can also align educational imperatives with a value-based initiative. Herein, we present the results of a quality-improvement intervention that evaluated the impact of providing cost, utilization, and radiation exposure data on radiology test ordering practices.

**Methods.** We implemented a 2-phase interrupted educational intervention on our inpatient medical service at the University of California, San Francisco (UCSF) Medical Center. Each intervention targeted a total of 48 house staff and 32 attending physicians. The first intervention (October–November 2011) provided cost and utilization data for commonly ordered radiographic tests, including national comparisons. After a 2-month intervention-free period (December 2011–January 2012) the second intervention (February–March 2012) provided radiation exposure data for the same radiographic tests to determine if one, both, or neither strategy would have an impact on physicians' ordering practices. Both interventions delivered targeted educational materials that were sent electronically and posted

in common ordering areas on the wards. In addition, we developed a "Radiology Utilization Facilitator's Guide" for attending physicians to use during teaching rounds. The guide served to engage the inpatient teams in an active learning and reflective exercise about our local radiology utilization data, the impact of unnecessary test ordering on cost (first intervention) and preventable radiation exposure (second intervention), and strategies to improve the appropriateness of test-ordering practices.

We assessed ordering practices for each intervention independently and compared them with a 12-month baseline period leading up to the first intervention. All x-ray film and computed tomographic scan orders were tracked before and after intervention, with intensive care unit-based orders excluded from the analysis. We then calculated the mean weekly number of tests ordered, adjusted by patient-days. We also estimated annual direct cost savings from each intervention by multiplying the percentage change in tests ordered by the total direct cost reported in 2011 based on national billing codes. Finally, we administered a brief house staff survey before and after each intervention to understand their attitudes about the impact of cost, utilization, and radiation exposure data on their own test ordering practices. For all data, we conducted 2-tailed statistical testing. This study was covered by a UCSF Human Research Protection Program waiver for quality improvement activities.

**Results.** The mean number of tests ordered per 100 patient-days was reduced by 19.8% during the first intervention and 9.5% during the second intervention, with statistical significance compared with the baseline period (**Table**). The greatest reductions in ordering were seen for chest radiography during the first intervention and for body computed tomography during the second. The estimated annual direct cost savings of these changes in ordering practices was \$108 285 and \$78 155, respectively, during each intervention.

House staff also reported increased knowledge and likelihood of changed test-ordering behavior. Com-

Table. X-Ray Film and CT Scan Orders Before and After Educational Interventions

	Baseline, No. <sup>a</sup>	No. <sup>a</sup> (% Change)		
		First Intervention	No Intervention	Second Intervention
X-ray chest <sup>c</sup>	32.4	23.2 (-28.4) <sup>b</sup>	30.7 (-5.1)	30.1 (-7.2)
X-ray body <sup>c</sup>	15.4	12.3 (-18.6) <sup>b</sup>	14.2 (-7.8)	12.9 (-16.1) <sup>b</sup>
CT body <sup>c</sup>	14.6	12.8 (-11.7) <sup>b</sup>	13.7 (-6.2) <sup>b</sup>	12.2 (-16.4) <sup>b</sup>
CT head <sup>c</sup>	5.7	6.3 (+10.7)	5.4 (-5.6)	6.4 (+11.6)
<b>Total</b>	<b>68.1</b>	<b>54.6</b> (-19.8) <sup>b</sup>	<b>64.0</b> (-6.0) <sup>b</sup>	<b>61.6</b> (-9.5) <sup>b</sup>

Abbreviation: CT, computed tomography.

<sup>a</sup>No. is the number of tests per 100 patient-days.

<sup>b</sup>P < .05.

<sup>c</sup>Uniform Billing codes: X-ray chest, 324; X-ray body, 320; CT body, 351; and CT head, 352.

pared with baseline, there was a 27.3% increase after the first intervention in response to the statement “I know the cost of radiology tests I order” (2.56 to 3.26 on a 1-5 Likert scale;  $P < .05$ ) and a 14.9% increase in response to the statement “I take the cost of radiology tests into consideration when ordering them” (3.28 to 3.74 on a 1-5 Likert scale;  $P < .05$ ). There were no statistically significant differences in house staff knowledge and attitudes with regard to radiation exposure during the second intervention.

**Comment.** Our interventions combined a targeted educational curriculum with the provision of local radiology utilization data to influence ordering practices. While both interventions led to reductions in test ordering, the cost and utilization focus had a greater impact on test ordering and resident-reported knowledge and practice. Increased national attention to cost consciousness, catalyzed most recently by the American Board of Internal Medicine’s *Choosing Wisely* campaign,<sup>7</sup> may have increased the impact of our interventions. Our findings demonstrate that in our current culture, interventions to improve the utilization of health care resources need not be high-cost themselves. Providing physicians with individualized audit and feedback reports on their resource utilization, clinical decision-support tools, and educational interventions such as ours offer ways reinforce an important message. Providing high-value care, rather than just high quality, is a priority of our health care delivery systems.<sup>8,9</sup>

Training institutions have the responsibility to shape the behavior of future health care providers. Trainees must learn to prioritize the stewardship of making the best decisions for our patients in a system with increasingly constrained resources. Having trainees view this as part of their education and supervising attending physicians view this as part of their role modeling is a necessary partnership for desired system change.

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