

# Modification of Admission Diagnostic Test-Ordering by Residents

William L. Marcy, MD, Stephen T. Miller, MD, and Roger Vander Zwaag, PhD  
Memphis, Tennessee

Medical education may contribute to the non-selective use of technology for diagnostic testing because the value system employed in clinical education rewards the discovery of rare events.<sup>1</sup> Exposure to this value system occurs early and persists for most physicians. Medical students are introduced to patient care predominantly in teaching hospitals where patients have more diagnostic tests and greater costs of hospitalization than in community hospitals.<sup>2</sup> Residency training may encourage overuse of diagnostic tests because unnecessary tests may be ordered to allay clinical insecurity and to exclude improbable diagnoses.<sup>3,4</sup>

Educational interventions in test ordering behavior have been attempted but techniques for modifying this behavior may require additional educational costs<sup>5</sup> and may produce only short-lived changes.<sup>6</sup> Two multi-factorial interventions have been successful in controlling the use of laboratory tests in teaching hospitals, but the separate effects of many different strategies could not be identified.<sup>7,8</sup> A single effective and inexpensive strategy is still unknown. In this experimental study of one technique, attending physicians on an inpatient medicine service reviewed with residents the justifications for admission diagnostic tests during teaching rounds, and the impact of this review on the number of diagnostic tests ordered by residents was then observed.

## Method

During a 15-day control period, admission diagnoses and the number of admission tests ordered by each of 13 first year residents on seven inpa-

tient services were obtained from admission orders routinely sent to the pharmacy. The residents were unaware of these observations. Each diagnostic test was ordered and counted separately. Routinely performed admission screening tests were not included in the tabulations. At this hospital the routine tests were complete blood count, urinalysis, serum electrolytes, urea nitrogen, and glucose.

Two general medical services were randomly selected for the experimental interventions. These services contained 4 first year residents who became the experimental group. The control group consisted of 9 first year residents divided among 5 other services. On day 15, the two experimental attending physicians announced that a periodic review of admission diagnostic tests would become a part of the teaching activities of rounds. The attending physicians were not aware of the hypothesis being tested; however, they were aware that monitoring of diagnostic testing would occur. The next day the test orders of a recent admission were systematically read by the attending physician with a request for the rationale for each test, and a 15-day intervention period was begun. The chart review was repeated by the attending physicians approximately one week into the experimental period. Observation of all admission diagnoses and diagnostic tests continued for all seven medical services during the intervention period without the residents being aware of the surveillance. The data were analyzed using Student's *t* tests for unpaired and paired data.

## Results

During the pre-intervention period there was no significant difference in the mean number of admission diagnostic tests per patient between the

From the St. Francis Hospital Family Medicine Program, Department of Family Medicine, and the Department of Community Medicine, University of Tennessee Center for the Health Sciences, Memphis, Tennessee. At the time this paper was written, Dr. Marcy was a second year resident. Requests for reprints should be addressed to Dr. William L. Marcy, St. Francis Hospital Family Medicine Program, 6005 Park Avenue, Memphis, TN 38119.

control and experimental groups. The nine control residents ordered  $16.4 \pm 5.6$  SD diagnostic admission tests per patient (range 27.2 to 7.7 tests per patient by individual residents) for their 73 admissions. The four experimental residents ordered  $18.2 \pm 7.4$  SD tests per patient (range 27.7 to 9.6) for their 42 admissions.

During the intervention period, the control residents demonstrated an increase in the mean number of diagnostic tests per patient to  $21.2 \pm 3.9$  SD (range 26.7 to 16.0) for 59 admissions. This 4.8 tests per patient increase in test ordering by the control residents was statistically significant ( $P < 0.02$ ). During the intervention period, the experimental residents decreased the mean number of diagnostic tests per patient to  $16.6 \pm 2.3$  SD (range 18.7 to 13.6) for 37 admissions. This decrease of 1.6 tests per patient was not significant.

Comparison of the mean number of tests for the control and experimental groups during the intervention period demonstrated that the difference between the increased number of tests in the control group and the decreased number of tests in the experimental group was significant ( $P < 0.05$ ). This difference was also confirmed by the observation that three of four experimental residents had decreases in their test ordering from the pre-intervention period to the intervention period while seven of nine control residents had increases.

These differences were not produced by the case-mix of admissions. Admissions were rotated among the inpatient services, and admission diagnoses were classified by International Classification of Disease-9. There were no significant differences between the control and experimental groups for major diagnostic categories.

## Discussion

These results suggest an impact by the attending physician on controlling diagnostic test ordering of residents. Attending physicians traditionally ask for results of tests rather than explore what tests were or were not ordered. The teaching maneuver of the study was the consideration of the indications for diagnostic testing and the most effective and efficient methods of obtaining information. Therefore, both inappropriately low and excessive test ordering could be identified. The decrease in tests was an additional feature of this instructional technique.

These results are preliminary, and this technique requires further investigation. The duration of the study was short due to the rotation of housestaff, and the number of subjects was small. The logistics of data collection did not allow reliable determination of shifts in test ordering from admission to subsequent hospitalized days. If tests were only postponed and lengths of hospitalization increased, the review might increase costs. Also, if tests later substituted were more costly or hazardous to patients, the favorable results of the review might be questioned. However, this substitution did not occur on admission testing. The longer educational benefit to the residents was not assessed because of their monthly rotation at the end of the study period and their dispersment to different clinical experiences. Lasting change would require repetition and the participation of more faculty members.

Despite their limitations, the results are encouraging because of the receptiveness of the attending physicians to performing the review and the observed differences in admission test ordering between experimental and control groups. This review can be added with little marginal educational cost because the attending physician structure is already established. The incorporation of teaching concerning diagnostic test ordering and cost consciousness therefore appears to be a worthwhile component of attending physician teaching rounds and deserves further exploration as an educational intervention.

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