The Effects of Physicians' Training and Personality on Test Ordering for Ambulatory Patients

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Abstract: We studied records of 351 hypertensive patients cared for by 30 internists in private office practice. We correlated the use of outpatient diagnostic tests with personal characteristics of the prescribing physicians. Doctors trained in medical schools with academic orientations used more tests than other physicians. Patterns of use were not strongly related to the number of years since medical school graduation, or physicians "intolerance of ambiguity" as measured by a standard psychological instrument. These findings suggest that certain types of training may predispose physicians to be high testers. (*Am J Public Health* 1984; 74:1271–1273.)

Because of the high costs of diagnostic services, many investigators have been interested in identifying characteristics of physicians who use a greater than average number of diagnostic tests. Knowledge of such characteristics would be useful in the design or implementation of interventions to modify physician behavior.

Unfortunately, most studies which have attempted to identify "high testers" have either not had a uniform case mix or have used atypical practice settings.[1–7] In this investigation, we have attempted to identify "high testers" by studying the behavior of private practice internists in their care of a narrowly defined case mix (uncomplicated hypertension), and by examining their behavior in relation to characteristics of their training and personality.

Methods

Data Collection

All physicians who had admission privileges at six selected community hospitals in the Boston area and who were board certified in internal medicine, but without subspecialty boards, were invited to participate in the study. Thirty-nine physicians met these criteria and 30 (77 per cent) agreed to participate. All of these doctors practiced full-time in private office, fee-for-service settings.

For each physician, we selected up to 15 patients from an on-site chart review. To standardize the case mix, we required that all patients have medical insurance, be older than 16 years of age, and have uncomplicated hypertension diagnosed before July 1, 1977. We abstracted patients' ambulatory records to obtain demographic and diagnostic data, number of office visits, and the numbers and types of all radiographic and laboratory tests performed between January 1, 1978 and December 31, 1979. Tests analyzed in this study include only those ordered by the patient's primary physician, a covering doctor, or a nurse practitioner associated with the primary physician.

Physician Characteristics

Several physician characteristics were analyzed:

Years since graduation from medical school—Information on year of graduation was obtained from published sources.[8,9]

Academic orientation of medical school—To characterize the academic nature of a physician's medical school, we used an index composed of the ratio of graduates involved in research or academic activities to all physicians graduated from 1960–67, and the ratio of specialists to general practitioners graduated during the same period.[4] We employed data[10] published in 1967 for these measures because they reflected conditions when the internists in our sample were in training.

Academic orientation of residency training—We used an index[4] composed of the following indicators of academic orientation: 1) degree of hospital *participation* in the teaching program of a medical school; 2) degree of *control* exerted by the medical school on the hospital; and 3) *orientation* of the affiliated medical school. Data on the status of individual hospitals were obtained from the *Directory of Approved Internships and Residencies 1969–70*.[11]

Intolerance of Ambiguity—We hypothesized that the tendency to perceive ambiguous situations as undesirable and structured situations as preferable might be indicative of a high-testing physician. To measure intolerance of ambiguity, we used a psychological instrument developed by Budner.[12] It was mailed to all study participants and 90 per cent completed it.

Data Analysis

We first considered each of the four training and personality characteristics separately and compared means for four related outcome measures of test-ordering behavior: the average number of tests per office visit (test/dov); the average testing charges per office visit (charges/dov); the average number of tests per patient per two years (tests/pt/2yrs); and the average testing charges per patient per two years (charges/pt/2yrs). In the calculations, a testing profile (e.g., SMA-20) was counted as a single test and charges were based on the 1981 Blue Shield customary reimbursement levels in Massachusetts. To control for demographic differences in the subjects treated by each physician, we used standard covariate adjustments[13] based on the average age and sex (percentage female) of each physician's panel. For simplicity of presentation, we assessed the effects of the training and personality characteristics by categorizing each characteristic at its median into either high or low, and compared the two groups.

In the second part of the analysis we used multiple regression to examine whether the effects shown in the first part of the analysis were independent of each other. We also included group size as a binary (large group (≥5 members) versus small group and solo practice) independent variable to eliminate possible confounding since results from our

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TABLE 1—Mean Utilization of Tests Corrected for Patient Age and Sex in Relation to Academic Orientation of Physician Training

Measures of Test Use	Academic Orientation of Physicians' Medical School			Academic Orientation of Physicians' Residency Training		
	More Academically Oriented	Less Academically Oriented	Difference ±95% Confidence Intervals	More Academically Oriented	Less Academically Oriented	Difference ±95% Confidence Intervals
Tests/dov	2.3	1.5	0.8 ± 0.7*	2.1	1.6	0.5 ± 0.7
Tests/pt/2 yrs.	9.9	7.7	2.2 ± 3.0	10.2	7.0	3.2 ± 2.8*
Charges/dov	45.6	27.0	18.6 ± 13.5*	40.9	29.8	11.1 ± 14.6
Charges/pt/2 yrs.	202	137	65 ± 66	199	132	67 ± 65*

*Differences significant at $p < .05$.

earlier research have shown that practice in a large group setting is associated with increased use of diagnostic tests.[14] In both parts of our analysis we used the physician (n = 30) as the unit of evaluation.

Results

The study population consisted of 351 patients with average age 58.0 ± 13.0; 62 per cent were female; 73 per cent were married.

Physician characteristics—Tables 1 and 2 display means for the four measures of test use comparing groups of physicians categorized for each characteristic into either high or low based on the median. The results indicate higher test usage for doctors trained in more academic medical schools and residencies. Doctors tolerant of ambiguity had a generally higher test ordering pattern. Years since medical school graduation exhibited no consistent trend.

In the multiple linear regression analysis, after adjusting for the academic orientation of residency training and the size of the group practice, academic orientation of medical school still exhibited a strong ($p < .05$) association with tests/dov and charges/dov.

Discussion

Our study supports the existing evidence that "non-medical" factors are related to test ordering. Academic orientation of the physician's medical school appears to be a predictor of test utilization. Experience, as measured by years since graduation, and personal intolerance of ambiguity did not appear to influence utilization substantially.

These findings suggest that academic environments which sponsor investigation and research may also inculcate clinical habits that make more intensive use of diagnostic services. Our data showed similar but statistically less stable trends for the effects of residency training.

Our data show no important effect for the personality characteristic we studied, intolerance of ambiguity. These negative findings could be because the particular personality variable we measured is not related to testing behavior, because the instrument we used (developed over 30 years ago) is outdated, or because our study size was too small.

Our results do suggest that academically oriented medical schools tend to produce high-testing physicians. It may be that trainees with a predisposition to use technical services self-select into particular types of schools for their education, but we speculate that these environments themselves, where role models are heavily involved in research and the use of technology for investigation, tend to develop physicians with clinical habits oriented toward the intensive use of diagnostic tests.

Our investigation was based on only 30 doctors in one specialty—internal medicine. If these results were replicated for other types of physicians and other diseases, it may be worthwhile to target such physicians for more intensive study and possibly for interventions to modify their behavior. Their utilization behavior has important implications that affect the cost and possibly the quality of medical care.

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TABLE 2—Mean Utilization of Tests Corrected for Patient Age and Sex in Relation to Time of Physician Training and Personality Characteristics

Measures of Test Use	Years Since Medical School Graduation			Tolerance of Ambiguity		
	1–20 Years	21–40 Years	Difference ±95% Confidence Intervals	Tolerant of Ambiguity	Intolerant of Amgibuity	Difference ±95% Confidence Intervals
Tests/dov	2.0	1.8	0.2 ± 0.5	2.2	1.5	0.7 ± 0.7
Tests/pt/2 yrs	9.1	8.3	0.8 ± 1.7	9.7	7.4	2.3 ± 3.2
Charges/dov	34.3	37.2	−2.9 ± 11.0	41.8	30.5	11.3 ± 16.0
Charges/pt/2 yrs	185	151	34 ± 50	183	147	36 ± 76

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ACKNOWLEDGMENTS

We are grateful to Howard Frazier, MD, and Jonathan A. Showstack, MPH, for helpful comments on an earlier draft of this manuscript.

This work has been supported by grants from the John A. Hartford Foundation, the National Library of Medicine [LM 04301-02], and the National Cancer Institute (CA-31247). Dr. Epstein is a Medical Foundation Fellow 1982–84.

Thermotolerant Non-fecal Source *Klebsiella pneumoniae*: Validity of the Fecal Coliform Test in Recreational Waters

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Abstract: Wisconsin pulp and paper mill processing plants were evaluated for fecal coliform and total Klebsiella (i.e., thermotolerant and thermointolerant) bacterial concentrations. Using the standard fecal coliform test, up to 90 per cent of non-fecal source thermotolerant *K. pneumoniae* was falsely identified as fecal source bacteria. Since there is a lack of specificity in the currently used standard for fecal coliform evaluation, a more reliable health risk assessment for fecal coliform bacteria is recommended. (*Am J Public Health* 1984; 74:1273–1275.)

Introduction

Fecal coliform bacteria are defined as gram negative, nonspore-forming facultatively anaerobic bacilli capable of fermenting lactose with acid and gas production at an incubating temperature of 44.5°C within 48 hours. The use of fecal coliform bacteria as indicators of fecal contamination and the subsequent human health hazards associated with their presence in recreational waters originated in the late 19th century after the isolation of these organisms from fecal wastes of warm-blooded animals.[1,2]

By definition, the densities of an indicator of fecal pollution should correlate consistently and specifically with health hazards associated with fecal contamination. This has not been the case with the current fecal coliform standard test, however. A number of recent studies have found high densities of fecal coliform bacteria (as measured by the current fecal coliform test) in waters not receiving human or animal wastes.[3–5] Our previous survey of fecal coliform and Klebsiella bacteria densities in pulp and paper mill processing waters, treated waters, and waters receiving effluent discharge has also shown elevated thermotolerant Klebsiella concentrations in the pulp and paper mill industry.[6] Thermotolerant Klebsiella bacteria from an industrial wastewater source of non-fecal origin consistently elevate the level of fecal coliform organisms as measured by the current fecal coliform standard test.

Methods

Water samples were obtained from pulp and paper mills located predominantly in the north central and northeastern regions of Wisconsin. The sampling points examined for bacterial densities included fresh water supplies, re-cycled water within mills, treated effluent wastewater, and waters receiving effluent wastes downstream from nine pulp and paper mills.

Samples were collected in sterile 250 ml screw cap bottles and stored at 4°C during transport to the laboratory. Samples containing residual chlorine were collected in sterile bottles containing the dechlorinating agent, sodium thiosulfate.* Bacteriologic examination was initiated within 24 hours of sample collection.

Determination of fecal coliform bacterial densities was made by the membrane filter technique. The membrane filter procedure calls for an enriched lactose medium that requires an incubation temperature of 44.5 ± 0.2°C for selectivity. The membrane-fecal coliform medium utilized for this test was prepared according to the media specifications in Standard Methods for the Examination of Water and Wastewater.[7]

All fecal coliform isolates (blue colonies on membrane-fecal coliform medium) were verified by subculturing isolated blue colonies to EC broth (elevated coliform) at 44.5°C for 24 ± two hours. Gas production in the fermentation tube within 24 hours or less was considered a positive reaction indicating fecal origin.

Klebsiella concentrations were determined by the membrane filter method developed by Dufour and Lupo.[8] Appropriate volumes of water samples were filtered with 0.45-μm Millipore HC membrane filters and incubated at 35°C for 48 hours on the specifically developed medium. All non-pink colonies were counted for the total *K. pneumoniae* concentration.**

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*Approximate concentration of 100 mg/l per sample bottle; enough to neutralize approximately 15 mg/l of residual chlorine.

**At 35°C both the thermointolerant and the thermotolerant strains of *K. pneumoniae* can be evaluated, i.e., total *K. pneumoniae* concentration.