The Geriatric Medication Algorithm:

A Pilot Study

PATRICIA FRANCESCA NEWTON, MD, WENDY LEVINSON, MD, DAVID MASLEN, MD

A geriatric medication algorithm designed to reduce inappropriate prescribing was tested in a resident outpatient clinic. The medications of patients over 65 years old taking more than three medications ($n = 41$) were compared pre- and post-algorithm using the paired t-test. Pre-algorithm, the average number of drugs was 5.8 per patient (SD 1.62). Fifteen medications (6.4%) were discontinued, seven were substituted for a less toxic medication, and five were added. Post-algorithm, the average number of drugs was 5.6 (SD 1.69), mean difference 0.3 (SD 0.67), $p < 0.025$. Drugs discontinued were more likely to be high risk compared with drugs used at baseline; drugs added were less likely to be high risk. In this pilot study, the authors conclude that the algorithm helps resident physicians reduce inappropriate prescribing. *Key words:* elderly; polypharmacy; algorithm; prescribing patterns.

J GEN INTERN MED 1994;9:164–167.

POLYPHARMACY in elderly patients has been associated with adverse drug reactions,[1, 2] reduced compliance,[3, 4] increased health care costs,[5] and increased hospital admission.[6, 7] While the extensive literature is generally discouraging,[8] three recent controlled randomized trials have shown that medication number and appropriateness can be modestly improved in the elderly. Two studies evaluated expert review of medications by a pharmacist[9] or physician,[10] followed by suggestions to the primary care provider. The third study involved extensive education in psychotropic medication in a nursing home setting.[11] While these studies are encouraging, they involve time-intensive and expensive interventions that are not generally available to the practicing physician. Unfortunately, less time-intensive interventions, such as requesting physicians to reduce medications[12] and providing drug lists,[13, 14] are generally ineffective.

In this study a geriatric medication evaluation algorithm designed to educate physicians in reducing inappropriate prescribing was developed and tested. The goal was to make this algorithm an effective and feasible tool in the primary care setting.

METHODS

The development of the algorithm was a several-step process. To understand the logic used by geriatric specialists, two certified geriatric internists discussed the medications of four elderly patients, and a board-certified internist recorded their implicit rules. Based on this information a pilot algorithm was developed and tested with five academic internists. These internists thought the algorithm required knowledge of high-risk drugs, dosing, and relative drug toxicities beyond the fund of knowledge of many internists. This information was added to the final algorithm (Figs. 1 and 2). A drug was considered high risk if it had been associated with exacerbating common problems in the elderly or causing excessive side effects.[11, 15–18]

The final algorithm was tested in the resident outpatient clinic of a community teaching hospital between March and June 1992. All the residents received a 45-minute lecture on pharmacokinetic changes, high-risk drugs, drug interactions, and the logic of choosing the most appropriate drug for an elderly patient. They were instructed in the use of the algorithm. The study was explained and they were encouraged to participate.

A research assistant reviewed all the clinic charts and placed the algorithm and an evaluation form inside the charts of all patients over 65 years old who were taking four or more chronic medications. Drugs intended for short-term usage were excluded. The nurse recorded the patient's age, gender, and orthostatic blood pressure. Based on the lecture, the residents knew to evaluate the medication regimen using the algorithm and then record present medications and dosages and changes in therapy, including medications discontinued, substituted, and added and dosages changed. They indicated the reason for the change on a checklist. Resident participation was voluntary.

Eligible patients were evaluated one time in a pre–post intervention design. The numbers of medications before and after the algorithm were compared by paired t-test. Medication appropriateness was evaluated by changes in the high-risk medications listed on the algorithm. The proportion of all drugs that were in the high-risk category was calculated at baseline. The observed proportion of high-risk drugs discontinued or added was compared with the expected or baseline proportion by chi-square analysis.

RESULTS

Eighteen residents had 47 patients eligible for the study. Forty-one patients (87%) had complete evaluations. The average age was 70.4 years; there were 15 men and 26 women. These 41 patients were taking a

Received from the Good Samaritan Hospital, Portland, Oregon.

Address correspondence and reprint requests to Dr. Newton; Good Samaritan Hospital and Medical Center, 1015 NW 22nd, R200, Portland, OR 97210.

total of 236 medications, with a mean of 5.8 (SD 1.62) per patient. During the study period, 15 medications (6.4%) were discontinued due to no indication (4), side effect (4), high risk (5), or drug regimen simplification (2). Seven medications (3%) were substituted with less toxic medications. Five medications (2.1%) were added for a new indication. Post-algorithm, the average number of drugs was 5.6 (SD 1.69) per patient. Paired t-test showed a mean difference of 0.3 (SD 0.67) ($p < 0.025$).

The dosages of eight medications (3.4%) were decreased due to side effect (4), high risk (1), or higher dose not necessary (3). Four medication dosages (1.7%) were increased. Of the 41 study patients, 16 (39%) had a medication discontinued or substituted and eight (19%) had a dosage decreased.

Forty-nine (21%) of the baseline 236 medications met the criteria for high-risk medications. Of the 22 drugs discontinued, nine (41%) were high risk compared with the baseline of 21% ($p < 0.001$). Of the drugs added, 8% were high risk compared with the baseline of 21% ($p < 0.001$). The high-risk drugs discontinued were ibuprofen, naproxen, temazepam, diphenhydramine, diazepam, chloral hydrate, clonidine, amitriptyline, and metoprolol.

DISCUSSION

This study reports the pilot testing of a geriatric medication evaluation algorithm. It suggests that this intervention has a modest but significant effect on polypharmacy in the elderly. Use of the algorithm also led to a reduction in the use of high-risk medications.

This modest reduction of polypharmacy is similar to the effects of more intensive interventions. A randomized controlled trial using expert physician review showed that eight medications (3.5%) were stopped and

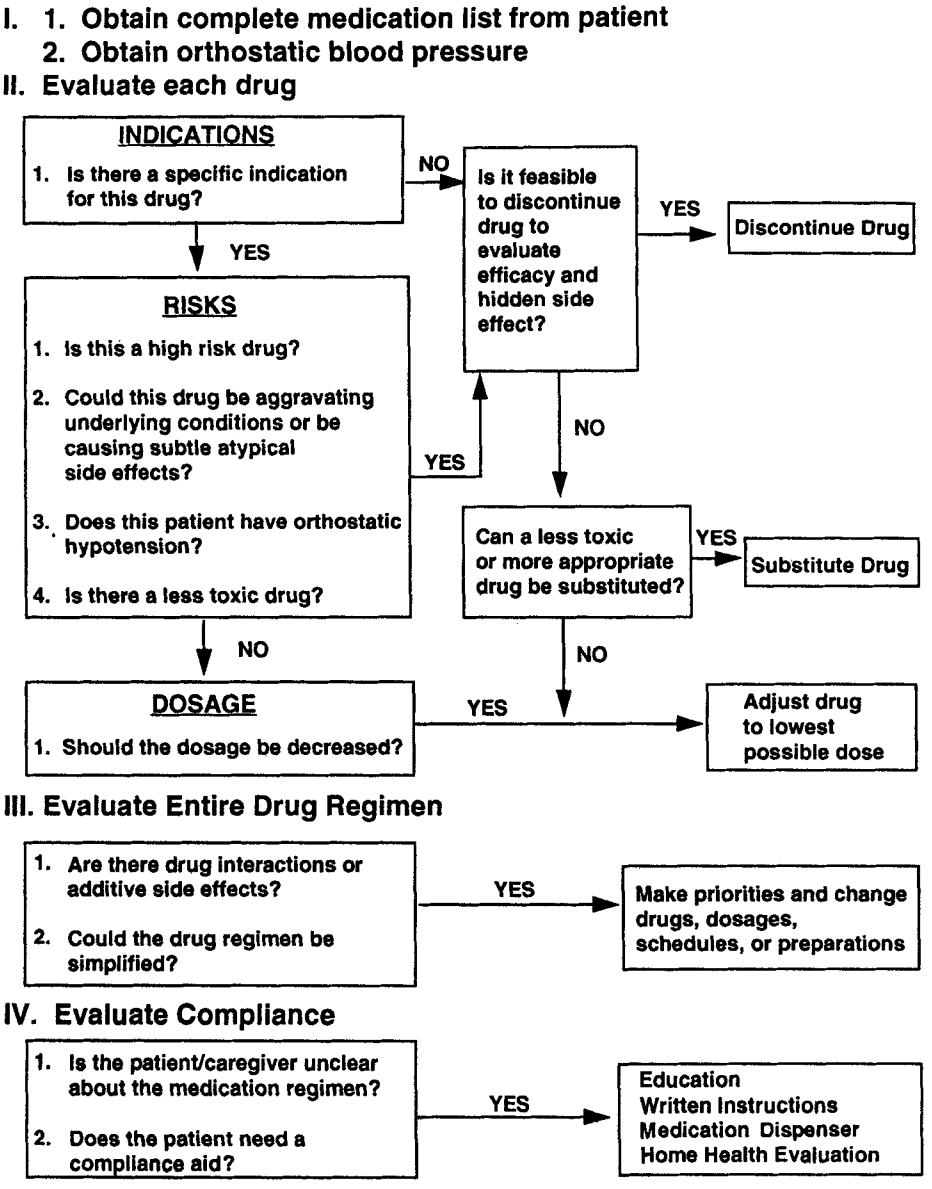

FIGURE 1. The geriatric medication evaluation algorithm.

RISK ASSESSMENT

HIGH RISK DRUGS

NSAIDs	Antidepressants
Benzodiazepines	Anticholinergics
Neuroleptics	Warfarin
Central Acting Antihypertensives	Steroids
Drugs Causing Orthostatic Hypotension	Barbiturate Sedative Hypnotics

DRUGS WITH LESS TOXIC ALTERNATIVES: SUBSTITUTE LESS TOXIC DRUG

Nifedipine	Amitriptyline, Imipramine
Propranolol	Clonidine, Methyldopa, Prazosin
Chlorpropamide	Meperidine, Pentazocine, Methadone
Diazepam, Chlordiazepoxide, Flurazepam	

FIGURE 2. The drug information that accompanies the algorithm. NSAIDs = nonsteroidal anti-inflammatory drugs.

DRUGS REQUIRING DOSAGE REDUCTION

ANTIBIOTICS	PSYCHOACTIVE	CARDIAC	MISCELLANEOUS
Fluoroquinolones	Benzodiazepines	Digoxin	H_2 blockers
	Tricyclic Antidepressants	Lidocaine	Phenytoin
	Fluoxetine	Procainamide	Theophylline
	Neuroleptics	Quinidine	Warfarin
	Lithium	β-blockers	Quinine
	Narcotics	Nitrates	

eight (3.5%) were substituted.[10] These numbers are strikingly similar to the percentages of medications stopped (6.4%) and substituted (3%) in this study. While this algorithm may produce only modest changes in polypharmacy, even small changes in high-risk drugs associated with falls, confusion, and incontinence could potentially enhance the care of the elderly. Reduction in these expensive and functionally incapacitating adverse reactions through improved prescribing would be likely to enhance geriatric care.

It is debatable whether interventions using physician time are efficient. However, medication monitoring is the responsibility of the physician and is traditionally part of the outpatient visit. An algorithm may serve to educate, remind, and focus the approach of a physician. Previous studies have shown that physician education reinforced by educational materials, systematic reminders, and specific protocols is effective in influencing prescribing behavior.[8,12,19] The fact that 87% of the evaluations in this study were voluntarily completed suggests that this intervention was not perceived as a burden and was plausible in a resident clinic.

There are several limitations to this pilot study. Feasibility and physician time were not directly studied. The trial was not controlled and other factors in the study, such as subtle changes in supervision, the reminder to evaluate drugs, and asking the resident to make a medication list, could conceivably have influenced the outcome. Because patient outcomes were not measured, predictions of potential overall effect of this algorithm are conjecture.

We conclude from this pilot study that this algorithm has the potential of educating and focusing physicians to improve medication prescribing for their elderly patients. The degree of voluntary compliance suggests feasibility in the office setting. Controlled trials aimed at documenting the effect, feasibility, and outcomes of this algorithm should be considered.

REFERENCES

1. Ouslander JC. Drug therapy in the elderly. Ann Intern Med. 1981;95:711–22.
2. Smith JW, Seidl LG, Cluff LE. Studies on the epidemiology of adverse drug reactions. BMJ. 1969;1:536–9.
3. Eraker SA, Kirscht JP, Becker MH. Understanding and improving patient compliance. Ann Intern Med. 1984;100:258–68.
4. Darnell JC, Murray MD, Martz BL, et al. Medication use by ambulatory elderly: an in-home survey. J Am Geriatr Soc. 1986;34:1–4.
5. Strandberg LR, Gary WD, Mathieson D, Rawlings J, Clark BG. Effect of comprehensive pharmaceutical services on drug-use in long-term care facilities. Am J Hosp Pharm. 1980;37:92–4.
6. Col N, Fanale JE, Kronholm P. The role of medication noncompliance and adverse drug reactions in hospitalizations of the elderly. Arch Intern Med. 1990;150:841–5.
7. Bero LA, Lipton HL, Bird JA. Characterization of geriatric drug-related hospital readmissions. Med Care. 1991;29:989–1003.

8. Soumerai SB, McLaughlin TJ, Avorn J. Improving drug prescribing in primary care: a critical analysis of the experimental literature. Milbank Q. 1989;67:268–316.
9. Lipton HL, Bero LA, Bird JA, McPhee SJ. The impact of clinical pharmacists' consultations on physicians' geriatric drug prescribing. Med Care. 1992;30:646–55.
10. Kroenke K, Pinholt EM. Reducing polypharmacy in the elderly: a controlled trial of physician feedback. J Am Geriatr Soc. 1990;38: 31–6.
11. Avorn J, Soumerai SB, Everitt DE, et al. A randomized trial of a program to reduce the use of psychoactive drugs in nursing homes. N Engl J Med. 1992;327:168–73.
12. Avorn J, Soumerai SB. Improving drug-therapy decisions through educational outreach; a randomized controlled trial of academically based "detailing." N Engl J Med. 1983;308:1457–63.
13. Johnson RE, Campbell WH, Azevedo D, Christensen DB. Studying the impact of patient drug profiles in an HMO. Med Care. 1976;14:799–807.
14. Hershey CO, Porter DK, Breslau D, Cohen DI. Influence of simple computerized feedback on prescription changes in an ambulatory clinic: a randomized clinical trial. Med Care. 1986;24:472–81.
15. Colt HG, Shapiro AP. Drug-induced illness as a cause for admission to a community hospital. J Am Geriatric Soc. 1989;37:323–6.
16. Larson EB, Kukull WA, Buchner D, Reifler BV. Adverse drug reactions associated with global cognitive impairment in elderly persons. Ann Intern Med. 1987;107:169–73.
17. Montamat SC, Cusack BJ, Vestal RE. Management of drug therapy in the elderly. N Engl J Med. 1989;321:303–9.
18. Ray WA, Griffin MR, Schaffner W, Baugh DK, Melton LJ. Psychotropic drug use and the risk of hip fracture. N Engl J Med. 1987;316:363–9.
19. McDonald CJ. Protocol-based computer reminders, the quality of care and the non-perfectability of man. N Engl J Med. 1976;295: 1351–5.

Methods of Preparing for the Certifying Examination in Internal Medicine and Their Efficacy

SUSAN C. DAY, MD, LOUIS J. GROSSO, MEd, JOHN J. NORCINI, PhD

Candidates for the 1991 Certifying Examination were asked how they prepared for the examination. There were 2,780 respondents (32% of the eligible candidates). The responding candidates used a mean of 5.2 study methods and gave higher educational value ratings to methods used most frequently. Regression analyses showed no independent contribution of study method or effort to explaining the variance in score for first-time takers, and a 2% contribution for repeat takers. Program director ratings were the most important predictors of score for first-time takers and previous examination score for repeat takers. Intensive study is likely to produce at most a small improvement in performance. *Key words*: certification; evaluation; written examination; self-assessment.

J GEN INTERN MED 1994;9:167–169.

CANDIDATES preparing for the Certifying Examination in internal medicine often wonder about how best to study. Research on other standardized tests has demonstrated that while small improvements can be achieved with a variety of coaching interventions, prior educational experience and other demographic factors have a greater effect on performance than does test preparation method.[1–5] Previous studies of factors predictive of performance on the Certifying Examination have shown the importance of performance on other examinations, as well as features of medical school and residency training.[6–9]

This study collected information about which methods of preparation are used by candidates for certification in internal medicine and examined the relationship of study method and effort to examination performance.

METHODS

Candidates for the 1991 Certifying Examination in internal medicine were surveyed two and one-half weeks prior to the test date to determine which commonly recommended strategies they used to study, the extent to which they used each method, and each method's perceived educational value. Candidates were also asked when they had begun to study and how many hours per week (outside of conferences or lectures) they had spent preparing. For each candidate, a study methods score was derived by summing the scores for all methods and dividing by the total number of methods. A study effort score was computed by multiplying the code for hours per week spent preparing by the code for how long ago preparation had begun.

Background information about training program, prior attempts to pass the examination, program director ratings of clinical competence, current activities, and score on the non-core component of the Certifying Examination were available for all subjects. Correlations between background variables, study methods and effort scores, and examination performance were calculated. Multiple regression analyses were conducted to determine the relative contributions of study methods and effort in predicting examination performance.

Received from the American Board of Internal Medicine, Philadelphia, Pennsylvania.

This work was supported by the American Board of Internal Medicine but does not necessarily reflect its views or opinions.

Address correspondence and reprints to Dr. Day: American Board of Internal Medicine, 3624 Market Street, Philadelphia, PA 19104-2675.