

## Patient Reminders Improve Rates of Drug Monitoring

Feldstein AC, Smith DH, Perrin N, et al. Improved therapeutic monitoring with several interventions: a randomized trial. *Arch Intern Med* 2006;166:1848–54.

### Study Overview

**Objective.** To determine the effectiveness of 3 interventions designed to improve laboratory monitoring for 10 commonly prescribed medications.

**Design.** Cluster-randomized trial.

**Setting and participants.** Patients were recruited from 15 primary care clinics within a not-for-profit health maintenance organization (HMO) using a single electronic medical record (EMR). Patients were eligible if they were aged > 18 years, were enrolled in the HMO for  $\geq 12$  months, had prescription drug benefits, had a working telephone number, had received a new prescription for 1 of the study medications from their primary care provider (PCP); and had not had the recommended laboratory monitoring within 5 days of medication initiation. Patients were excluded if they were under hospice or nursing home care, were receiving care outside the HMO, or were non-English speakers.

**Intervention.** Primary care clinics were randomized to usual care or 1 of 3 interventions: (1) an EMR intervention that included an electronic message directed at the patient's PCP recommending appropriate drug-specific laboratory monitoring and referencing supportive literature; (2) an automated voice message (AVM) intervention that included a recorded personalized telephone message, which informed the patient directly of the recommended therapeutic monitoring tests and advised the patient to have the testing performed; and (3) a pharmacy team outreach intervention, which consisted of a telephone call and reminder letter from the pharmacy department advising the patient to seek laboratory testing. All intervention reminders were given at baseline and at 9 to 10 days for initial nonresponders.

**Main outcome measures.** The primary outcome was the completion of all recommended baseline laboratory monitoring parameters associated with the initiation of 1 of 10 study medications. The study medications and corresponding laboratory monitoring recommendations were as follows: (1) angiotensin-converting enzyme inhibitor or angiotensin receptor blocker and serum creatinine and serum potassium; (2) allopurinol and serum creatinine;

(3) carbamazepine and serum alanine aminotransferase (ALT) or aspartate aminotransferase (AST), complete blood count, and serum sodium; (4) any diuretic and serum creatinine and serum potassium; (5) metformin and serum creatinine; (6) phenytoin and serum ALT or AST, and complete blood count; (7) pioglitazone and serum ALT or AST; (8) potassium and serum creatinine and serum potassium; (9) any statin medication and serum ALT or AST; and (10) terbinafine and serum creatinine and serum ALT or AST.

**Main results.** Of 293 invited PCPs, 200 had an eligible patient base and agreed to participate. A total of 1075 patients were eligible; 961 were randomized to 1 of the 4 study arms. Baseline practice, provider, and patient characteristics were similar among groups. At day 9, there was a statistically significant difference in adherence to laboratory monitoring, with 14.3% of the usual care group, 31.1% of the EMR group, 43.8% of the AVM group, and 70.5% of the pharmacy team group having complete compliance with laboratory monitoring parameters ( $P < 0.001$ ). This pattern remained at day 25, with 22.4% of the usual care group, 48.5% of the EMR group, 66.3% of the AVM group, and 82% of the pharmacy team group having completed all laboratory monitoring parameters ( $P < 0.001$ ). Using Cox proportional hazards models, individuals allocated to the EMR arm were 2.5 times more likely to have completed all indicated laboratory monitoring parameters when compared with the usual care group (95% confidence interval [CI], 1.8–3.5). Compared with the usual care group, patients allocated to the AVM arm and the pharmacy teams were 4.1 and 6.7 times more likely to have undergone all the recommended laboratory tests (95% CI, 3.0–5.6 and 95% CI, 4.9–9.0, respectively).

**Conclusion.** Electronic provider reminders, patient-directed automated telephone reminders, and pharmacy-led telephone reminders to patients all increased therapeutic monitoring rates for 10 different newly prescribed medications. Interventions that involved patients directly appeared to be the more effective than provider-directed reminders.

### Commentary

Medication errors and adverse drug events are a common threat to patient safety [1]. Not only are these events associ-

ated with significant mortality and morbidity, they are also very costly to the health care system. One study suggested that adverse drug events can cost a large teaching hospital as much as \$5.6 million per year [2]. Interventions designed to reduce medication errors may reduce not only patient injuries but also health care costs. Unfortunately, some proven interventions (eg, computerized provider order entry) can be costly to implement, and considerable debate exists as to whether these systems might be cost-effective [3]. Research is desperately needed to identify lower-cost interventions that might enhance patient safety.

A common type of medical error is the error of omission, which occurs when a medically indicated test or procedure is not performed in a timely manner. Failure to monitor for medication toxicities is an error of omission that can frequently result in patient injuries. Feldstein et al examined 3 interventions designed to improve therapeutic monitoring for certain medications. All 3 interventions appeared to be more effective than the usual mode of care. Particularly intriguing is the finding that interventions that involved direct patient contact, such as AVMs or pharmacist calls, had a greater impact on testing rates than provider-directed reminders. Although the greatest effect size was found in the

pharmacy team intervention, almost two thirds of patients allocated to the AVM group were completely up-to-date with therapeutic monitoring parameters 1 month after the intervention. AVMs have the added advantage of being relatively inexpensive to implement and can be used in practices without EMRs.

### Applications for Clinical Practice

Reminders appear to increase therapeutic monitoring for several medications. Reminders directed specifically at patients, such as AVMs, may be more effective than physician-directed messages and may be cost-effective.

—Review by Harvey J. Murff, MD, MPH

### References

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3. Kuperman GJ, Gibson RF. Computer physician order entry: benefits, costs, and issues. *Ann Intern Med* 2003;139:31–9.

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