The Effect Of Microcomputer-Generated Reminders On Influenza Vaccination Rates In A University-Based Family Practice Center

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Abstract: **Less than 20 percent of elderly and other high-risk persons targeted for annual influenza vaccination are immunized each year. In most busy practice settings, it is difficult for primary care physicians to identify every patient in need of preventive health interventions. The purpose of this study was to assess the effect of microcomputer-generated reminders on influenza vaccination rates in a university-based family practice center. The practice uses an interactive encounter form system from which updated clinical information is routinely entered into a cumulative database. During a 2-month period, 686 patients were identified in the database as eligible to receive influenza vaccine according to accepted criteria. Practice physicians (n = 32) were stratified by level of training and randomized to one of three groups, thereby receiving printed reminders on the encounter forms of all, none, or half of their eligible patients. Patients of physicians who always received reminders were more likely to receive influenza vaccine during the study period than patients of the never-reminded physicians (51 percent versus 30 percent, $P < 0.001$). Patients whose physicians received reminders for only half their patients had an intermediate likelihood of receiving a vaccination if a reminder was printed (38 percent) but were less likely than the patients of never-reminded physicians to receive the vaccine if no reminder was printed (20 percent, $P < 0.001$). This study suggests that physicians learn to depend on reminders for preventive health activities and that reminders are most effective when they are provided at every patient encounter. (J Am Board Fam Pract 1991; 4:19-26.)**

The Immunization Practices Advisory Committee (ACIP) recommends annual influenza vaccination for all elderly and other high-risk persons.[1] It is believed, however, that no more than 20 percent in these target groups are immunized each year.[2]

Several studies have reported that administrative and organizational changes can greatly improve immunization rates for high- and moderate-risk patients. Various strategies have been used to encourage immunization, including postcard[3] and telephone[4] reminders to patients, notices appended to patients' charts,[5] and computer-generated forms reminding physicians to immunize their high-risk patients.[6,7] Programs implemented at an administrative level have been, in general, more successful than educational efforts directed at patients or physicians.[2] A common feature of successful administrative programs created to increase vaccination rates is their systematic offering of influenza vaccine to groups of patients identified as moderate or high risk.

While administrative strategies can assist clinical decision making by office-based physicians, the limitations of these programs in effecting meaningful changes in immunization practices are also well documented. For example, identification of appropriate patients by chart audit at the time of each office visit is labor intensive and, therefore, too costly to sustain year after year. Strategies that mandate administering vaccine to all eligible patients aged 65 years and older fail to identify younger patients with chronic diseases who are at greatest risk for complications of influenza.[8] Reports of interventions of various types involving large patient populations have noted that immunization rates usually plateau at a level below the targeted 80 percent or more of the at-risk population necessary to limit epidemics,[1,2] a phenomenon referred to as the "ceiling effect." The reasons for the ceiling effect remain unclear.

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In most busy practice settings, primary care physicians are unable to process all the information necessary to identify every patient in need of preventive health interventions.[9] Computer systems can help in this area by retrieving salient information regarding the periodic health needs of patients. Computer-generated reminders have improved vaccination rates of patients in a university medical practice.[6] Computerized reminder systems require a practice database containing clinical and registration information that can be searched to identify patients eligible for preventive health screening measures.[10] The continuing decline in the price of computing power, brought on by the advent of microcomputers, makes systems capable of supporting such a reminder process accessible to increasing numbers of office practices.

The primary purpose of our study was to assess the impact of microcomputer-generated reminders on influenza vaccination rates in a university-based group practice. Our second purpose was to identify factors that might help to explain the ceiling effect so that appropriate interventions could be implemented to increase vaccination rates in subsequent years.

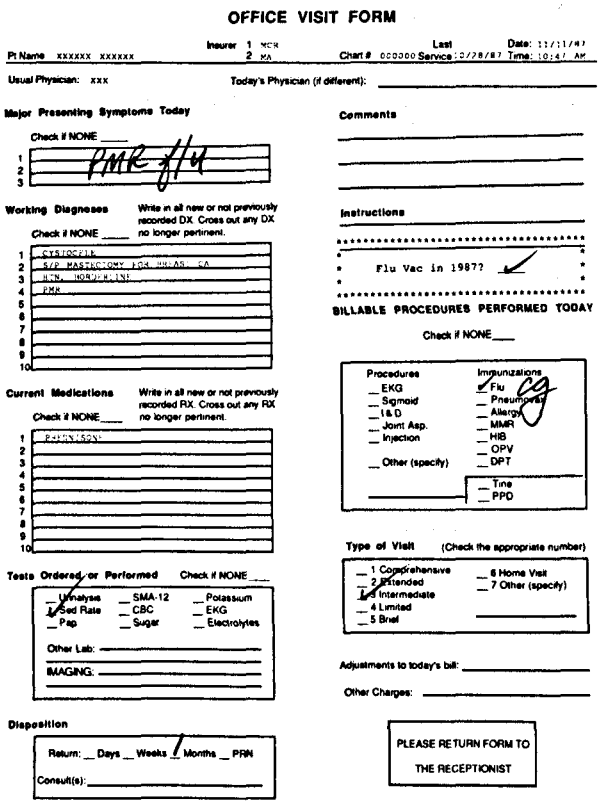
Methods

Study Site

This study was conducted in the Family Practice Center of the Department of Family Medicine at Thomas Jefferson University, Philadelphia, between October 1, 1987, and November 30, 1987. Twelve full-time faculty and 18 residents provide continuing primary care to approximately 9000 patients, who make more than 25,000 visits to the practice each year.

Patient Encounter Form System

In 1984, the practice developed and implemented a microcomputerized patient registration system linked to a clinical encounter form system.[11] In 1986, these components were coupled with a billing information system. An encounter form (Figure 1), generated for each visit when a patient arrives at the receptionist's desk, is attached to the front of the patient chart; it includes space for information regarding presenting symptoms, current diagnoses and medications, and tests and procedures ordered. All sections of the form are blank when patients are seen for the first time.


OFFICE VISIT FORM

Insurer 1 MCR
2 MA

Pt Name xxxxxx xxxxxx

Last

Date: 11/11/87

Chart # 000000 Service: 10/28/87 Time: 10:47 AM

Usual Physician: xxx

Today's Physician (if different):

Major Presenting Symptoms Today

Check if NONE

1 PMR f/u
2
3

Comments

Working Diagnoses

Write in all new or not previously recorded DX. Cross out any DX no longer pertinent.

Check if NONE

1 CYSTOCELE
2 S/P MASTECTOMY FOR BREAST CA
3 HTN, NON-INSULIN
4 PMR
5
6
7
8
9
10

Instructions

Flu Vac in 1988?

BILLABLE PROCEDURES PERFORMED TODAY

Check if NONE

Procedures
- EKG
- Sigmoid
- I & D
- Joint Asp.
- Injection
- Other (specify)

Immunizations
- Flu CG
- Pneumovax
- Allergy
- MMR
- HIB
- OPV
- DPT
- Other (specify)
- Tine
- PPD

Current Medications

Write in all new or not previously recorded RX. Cross out any RX no longer pertinent.

Check if NONE

1 PREMARIN
2
3
4
5
6
7
8
9
10

Type of Visit (Check the appropriate number)
- 1 Comprehensive
- 2 Extended
- 3 Intermediate
- 4 Limited
- 5 Brief
- 6 Home Visit
- 7 Other (specify)

Tests Ordered or Performed Check if NONE

- Urinalysis
- Sed Rate
- Pap
- SMA-12
- CBC
- Sugar
- Potassium
- EKG
- Electrolytes

Other Lab:

IMAGING:

Adjustments to today's bill:

Other Charges:

Disposition

Return: Days Weeks 1 Months PRN

Consult(s):

PLEASE RETURN FORM TO THE RECEPTIONIST

Figure 1. A sample encounter form showing the preprinted diagnoses and medications and a reminder in the "Instructions" field. Entry of the charge for the vaccine would result in the removal of the reminder for any subsequent visits.

For subsequent visits, the diagnoses and medications from the previous visit are preprinted on the form; physicians need only update these items by writing in appropriate changes. Updated information from the encounter form is entered into the database by the office receptionist. The completion rate for the encounter form is greater than 98 percent.[10] The reliability of information recorded on the encounter form, as determined by random audits, compares favorably with the information contained elsewhere in the clinical record and contains fewer invalid diagnoses and medications than the handwritten problems list or medication sheet contained in the chart.[11] Completed forms are stored in archives separate from the clinical record by the billing office.

Identification of Eligible Patients

The encounter form system can be programmed according to physician-authored rules to identify patients eligible for recommended preventive health interventions.[10] For this study, the moder-

ate- and high-risk criteria defined by the Centers for Disease Control[1] were adapted for the database search. Patients were considered eligible if they were 65 years or older at the beginning of the intervention or if they had any of the following clinical diagnoses listed in the database: diabetes mellitus, renal failure, anemia, congestive heart failure, asthma, or chronic obstructive pulmonary disease. New patients were not considered eligible for this study because no clinical information existed in the database.

Experimental Intervention

All physicians in the practice were stratified based on level of training and randomly assigned to one of three groups via a computerized randomization program. The three physician groups were: (1) always reminded, i.e., reminders were printed for all eligible patients; (2) sometimes reminded, i.e., reminders were printed for half the eligible patients (randomly assigned at the patient level); and (3) never reminded, i.e., no reminders were printed for eligible patients. Reminders identifying patients as eligible for the vaccine were printed on the encounter form according to the assigned group of the patient's primary physician.

These reminders were provided for appropriate patients at every visit during the study period until the physician responded by ordering the vaccine. Influenza vaccines are, according to office routine, given by nurses and recorded on the encounter form as a billable procedure. When the billing record showed the procedure had been performed, the computer program removed the reminder message from the encounter form.

Patients assigned to a specific primary care physician occasionally see a different physician in the office, e.g., during an acute illness, if their own physician is not available. The experimental intervention was designed so that physician assignment overruled patient assignment. Thus, a physician who was randomized to the never- reminded group did not see a reminder for an eligible patient under any circumstances.

Data Analysis

Data were analyzed on a microcomputer using the SYSTAT statistical package.[12] Vaccination rates were determined for each physician and for the eligible patient population according to the assignment of each patient's primary physician. Patients of physicians who received reminders for only half their encounters were divided into two groups (reminders printed and no reminders printed). Analyses were run both including and excluding patients of one physician outlier (randomized to the never-reminded group and described in detail later). Patients who saw physicians in more than one randomization group during the two study months were excluded from the analyses, as were those who received the influenza vaccine in September (before the study period). Those who received the vaccine in December were not excluded and were considered, for analysis purposes, not to have received a vaccination.

Patient characteristics (age, sex, race, type of insurance, number of visits made, and risk-factor–level) and physician characteristics (sex, resident versus attending physician or fellow, and residency training in family medicine versus other) were tabulated from information in the database. To evaluate the effectiveness of the reminders, the number of vaccinations within the physician randomization groups was compared using the chi-square test. Appropriate tests were run separately for each subgroup (patient and patient's physician characteristics) mentioned above. In addition, multiple logistic regression analyses were conducted. In one model, the dependent variable was whether a vaccination was given and the independent variables included physician randomization group, risk level (moderate versus high), age (less than or greater than 65 years), number of visits made, and specialty training (family medicine versus other). Other models included the patient's sex, race, and insurance type and the physician's sex and training level.

Results

A total of 2493 patients were identified in the accumulated database (any recorded visit to the practice since 1984) as fulfilling one or more of the adapted CDC risk criteria for complications of influenza; 1442 made at least one visit in the 1987 calendar year, and 864 of these "active" patients made one or more visits during the 2-month study period. Of these, 168 were excluded from the analysis (51 received the vaccine before the study began; 93 saw multiple providers during the study; and 24 made drop-in visits

Table 1. Characteristics of the Influenza Vaccine Reminder Study Population (n = 686).

Patient Characteristics	n*	%
Age (years)		
0–19	6	1
20–64	197	29
65–74	292	42
75+	172	25
Race		
Black	389	56
White	225	32
Other	53	8
Sex		
Men	160	23
Women	505	74
Primary Insurer		
Medicare-medical assistance	567	83
Private	53	8
None	47	7
Visits made during study period		
1	386	56
2	183	27
3+	98	14
Risk level (CDC)		
Moderate	495	72
High	172	25
Risk Factor†		
Age 65+ years	464	68
Diabetes mellitus	249	36
Chronic renal failure	3	<1
Anemia	30	4
Congestive heart failure	68	10
Asthma	71	10
Chronic obstructive pulmonary disease	48	7

*Numbers in individual categories may not add up to total n because of incomplete data.
†Many patients had multiple risk factors.

only), leaving 686 patients who met the eligibility criteria for inclusion in the study population (Table 1).

Nearly 70 percent of the patients were aged 65 years or older. The racial breakdown of the study population was similar to that of the practice as a whole. Three-quarters were women, an expected finding given the preponderance of elderly patients in the study group. Eighty-three percent identified Medicare or Medical Assistance as their primary insurance source. Based on the adapted risk criteria, almost one-fourth were classified as high risk because of medical diagnoses, including congestive heart failure and obstructive pulmonary disease of all types. More than one-half the eligible patients made only one visit during the study period. Ten percent had received the influenza vaccine in the previous year according to the database.

A total of 334 vaccinations were given to eligible patients in October and November. Fifty-one other patients who met CDC criteria for annual influenza vaccination received the vaccine in September but were excluded from the analysis as described above. An additional 11 patients received vaccinations in December but, according to the study definitions, were not counted. In total, 396 vaccinations were given to patients identified as moderate or high risk. According to computer-generated billing data, 585 vaccinations were given in the office in 1987 of which 68 percent were to moderate- or high-risk patients.

The effect of the reminders on the immunization practices of individual physicians was examined (Figure 2). All but one of the sometimes-reminded physicians had a higher immunization rate when reminders were printed than when no reminders were provided. One physician in the never-reminded group gave influenza vaccine to 75 percent of his eligible patients during the study. Our chart audit, completed after randomization for the 1987 study had already occurred, showed that this physician had vaccinated 61 percent of his eligible patients in 1986, while no other physician had immunized as many as 30 percent. This physician's patients (n = 61) were excluded from subsequent analyses (except as mentioned below).

Fifty-one percent of the patients whose primary physician always received reminders were

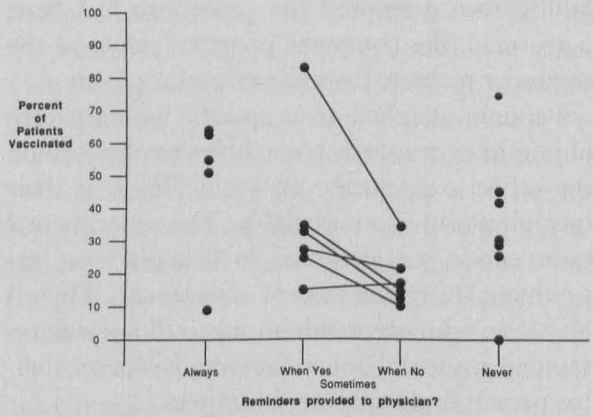


Figure 2. Effect of reminders on immunization rates of individual physicians (includes data only for physicians who saw 15 or more eligible patients during the study period). Shaded position represents the physician whose patients were excluded from subsequent analyses (see text).

Table 2. Characteristics Associated with Response to Computer-Generated Reminders. Percent (Number) of Patients Who Received Influenza Vaccine.

	Physician Reminded?				
		Sometimes			
	Always Group	When Yes	When No	Never Group	P^*
All Patients	51% (137/271)	38% (27/72)	20% (15/74)	30% (65/218)	<0.001
Patient factors					
Age					
0–64 years	41	38	6	22	0.001
65–74 years	48	43	33	31	NS
75+ years	61	13	38	38	0.005
Risk level†					
Moderate	49	35	21	30	<0.001
High	55	45	19	28	0.002
Visits					
1	47	30	16	28	<0.001
2	59	43	29	25	<0.001
3+	45	55	14	42	NS
Training level of primary physician					
Resident	36	26	16	26	NS
Attending-fellow	56	64	28	32	<0.001

*Chi-square test, for patients represented in each row, comparing physicians with presence of influenza vaccine; NS = not significant.
†Adapted from CDC recommendations (see text).

given the vaccine compared with 30 percent of the patients whose physician never received reminders (40 percent, counting the patients of the one physician outlier). For patients whose regular physicians received reminders for only half of their patients, the results showed that when reminders were printed, the patient's likelihood of receiving the vaccine was intermediate (38 percent) between that of patients of the always-reminded (51 percent) and never-reminded (30 percent) physicians. When no reminders were provided, the patients were less likely (20 percent) than were the patients of the never-reminded physicians to receive a vaccination.

The effects of the reminders for patients grouped according to various characteristics are presented in Table 2. In bivariate analyses, the reminders increased the likelihood of the following patients receiving the vaccine: (1) women, (2) those younger than 65 years or older than 75 years, (3) those with moderate- and high-risk levels, (4) persons who made one or two visits during the study, and (5) patients of attending physicians or fellows.

Patients who received vaccinations in 1986 were no more likely than others to get the influenza vaccine during the study year (44 percent versus 38 percent). Also, type of insurance had no measurable association with the likelihood of receiving the vaccine. This finding may be due to the small number of patients without insurance or insurance other than Medicare or Medical Assistance.

In regression analyses, the patient characteristics that were significantly related to receiving a vaccination were age greater than 65 years, number of visits, and randomization to the always-reminded physician group. Patients who made two office visits were most likely to receive a flu shot. The effect of the reminders was diminished when the number of visits during the study was three or more. When the level of training of the patient's primary physician was included in a regression model, patients of attending physicians and fellows were more likely to receive a vaccination than were patients of residents.

The information recorded on the encounter form was validated by reviewing the charts of 10 percent of the eligible patients who made visits during October and November. The results of this audit are presented in Figure 3. Only two-thirds of the vaccinations were recorded both in the chart and on the encounter form. More than one-fourth were documented only on the encounter form, which seems to be a more reliable record of information regarding office procedures based on this and previous validations.[10]

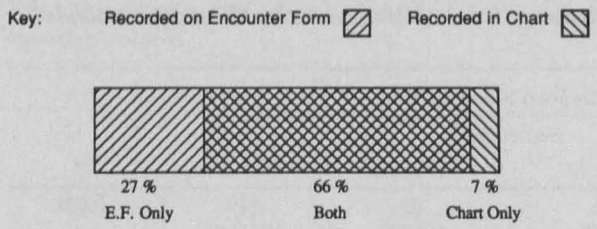


Figure 3. Influenza vaccine documentation.

In an attempt to explain the nonresponse to reminders for influenza vaccine in apparently clinically appropriate situations, the charts of patients (n = 134) of physicians in the always-reminded group who did not receive a vaccination according to the encounter form database were reviewed. These data are presented in Table 3. This second chart audit showed that one-quarter nonimmunized patients refused the vaccine. Fifteen percent actually received the vaccine in the patient office or at a different site but did not have the information recorded on the encounter form during the study period. Less than 2 percent of the patients were inappropriately identified by the program as eligible for the vaccine. No information to explain why the vaccine was not given could be gleaned from the chart for nearly half the patients.

Discussion

Administrative interventions can greatly improve immunization rates for moderate- and high-risk patients. In well-designed programs, vaccination rates of 50 to 70 percent have been achieved among high-risk patients.[2] In our study, microcomputer-generated reminders to physicians resulted in a similar increase in the number of patients immunized against influenza. The appropriate identification of moderate- and high-risk patients also may have improved the specificity of the immunization practices of the office physicians. Nationwide, only 40 percent of the influenza vaccine used each year is reportedly given to patients defined as moderate or high risk by CDC criteria.[2] During the year of this study, nearly 70 percent of the vaccine was administered to moderate- and high-risk patients.

Table 3. Reasons Why the Influenza Vaccine Was Not Given When Reminders Were Provided.*

Reason	Percent of Charts†
Patient refused vaccine	25
Received vaccine elsewhere	2
Received vaccine during 9/87	3
Received vaccine during 12/87	5
Received vaccine 10/87–11/87	5
Inappropriate diagnosis/logic	2
MD comment re no vaccine	2
Illness at visit(s)	6
Other	3
Unknown	48

*Data from chart audit of patients (n = 134) from the "always reminded" group but for whom the encounter form showed that no vaccination was given.
†Numbers do not add up to 100 due to rounding.

Fedson reported that physicians are more likely to order influenza vaccine for older patients,[13] and in this study, as well, patients aged more than 65 years had a greater likelihood of receiving the vaccine. Two additional factors, the number of visits made and the level of training of the physician, were also independent predictors that an appropriate patient would be given a vaccination. Not surprisingly, the reminders had a greater impact when these factors were also present. If a patient made a return visit during the study, there was a second opportunity for the physician to notice and respond to a reminder, and patients making two visits benefitted most from the intervention. It may be that patients who made three or more visits in 2 months were sicker and required more acute medical attention, thereby leaving less time for preventive health needs during each office visit, although this was not investigated. The patients of the attending staff and fellows also benefited significantly from the reminders. In our office, these patients are seen by a student before being seen by their regular physician. In contrast, resident physicians see their patients alone with less active attending supervision. Having two providers (a student and a physician) review the encounter form at the time of each visit may have increased attention to the reminders.

Our study suggests that reminders to physicians are most effective when they are provided for every appropriate patient encounter. Physicians who received reminders for only randomly selected patient encounters may have become dependent on the computer-generated reminders. When these physicians did not receive a reminder, they were less likely than the never-reminded group to provide vaccinations to eligible patients. Physicians who receive reminders about

preventive health needs of patients may be less attentive when the reminders are not present to stimulate their decision making.

We found that only a small number of patients received vaccinations at other medical sites, although this information may have been underreported. A partial explanation why influenza vaccination rates have not reached the targeted 80 percent level[2] may be that physicians do not reliably document what transpires during medical visits. In our study, the billing portion of the encounter form was used to determine the practice immunization rates. An audit of all potential sources of vaccination documentation including the office progress notes and the patient chart folder showed that, although the encounter form was the most sensitive single source of information, an additional 15 percent of patients in fact received the vaccine but were not counted in the encounter form tally. Therefore, the actual vaccination rate was higher than reported.

We did not identify reasons other than patient refusal for the influenza vaccine not being given in clinically appropriate situations. It is possible that physicians either failed to notice the reminder and therefore did not offer the vaccine or that the patient refused and no notation was made in the record. Further research is needed to explain the "ceiling effect" observed in this and other studies.

A limitation of this approach to increasing influenza vaccination rates is that, as the intervention was directed at physicians, only those patients who made a visit during the study period could benefit. In the practice database, which included information from all patient visits during the previous 4 years, nearly 2500 patients were identified as meeting criteria to receive the influenza vaccine. However only 58 percent (n = 1442) had made one or more visits in the 12 months prior to the study, and this number may be a more accurate estimate of the "active" patient pool. Other university-based practices have noted similar rates of ongoing care among patients seen at least once.[14] In our study, 60 percent of the active population eligible for the influenza vaccine made a scheduled visit in the 2-month pre-influenza season even without a formal program to encourage these patients to seek immunization. We did not attempt to determine if any of the remaining patients had received vaccinations at community health centers or elsewhere.

Postcard or letter reminders and telephone calls to patients have not been as effective at increasing vaccination rates as office-based reminder systems.[4,15] Community-based mass media reminders may increase awareness of the risks of influenza among susceptible patients and broaden the group of patients who would make office visits and therefore benefit from physician-directed reminders.[16] Unfortunately, previous studies have suggested that up to 40 percent of eligible patients simply do not want the influenza vaccine.[17] Other strategies need to be developed to encourage skeptical patients to schedule office visits and discuss their concerns with a physician. Face-to-face counseling may influence a patient's decision to accept the influenza vaccine. Patients who would otherwise not request one may change their minds if this is recommended by a physician.[18]

A microcomputerized medical information system can rapidly and inexpensively identify patients in need of vaccinations or other preventive health activities. The cost of a system necessary to support preventive care reminders could be excessive for a practice without computers or a database. However, many practices are increasingly turning to computer systems to generate bills to patients and third-party insurers who usually request appropriate clinical diagnoses to justify any billing charges. The maintenance of such a billing system already requires the timely entry of selected clinical data from each visit. An important feature of any administrative program designed to improve influenza vaccination rates is the required year-to-year maintenance.[2] The program used in this study, which identifies patients from registration and clinical information routinely entered into the practice database, can be reinstated each year with few start up costs.

References

1. Prevention and control of influenza. MMWR 1987; 36:373-80, 385-7.
2. Fedson DS. Influenza prevention and control. Past practices and future prospects. Am J Med 1987; 82:42-7.
3. Larson EB, Bergman J, Heidrich F, Alvin BL, Schneeweiss R. Do postcard reminders improve influenza vaccination compliance? A prospective trial

of different postcard "cues." Med Care 1982; 20:639-48.
4. Brimberry R. Vaccination of high-risk patients for influenza. A comparison of telephone and mail reminder methods. J Fam Pract 1988; 26: 397-400.
5. Cohen DI, Littenberg B, Wetzel C, Neuhauser D. Improving physician compliance with preventive medicine guidelines. Med Care 1982; 20:1040-5.
6. McDonald CJ, Hui SL, Smith DM, et al. Reminders to physicians from an introspective computer medical record. A two-year randomized trial. Ann Intern Med 1984; 100:130-8.
7. Klachko DM, Wright DL, Gardner DW. Effect of a microcomputer-based registry on adult immunizations. J Fam Pract 1989; 29:169-72.
8. Margolis KL, Lofgren RP, Korn JE. Organizational strategies to improve influenza vaccine delivery: a standing order in a general medicine clinic. Arch Intern Med 1988; 148:2205-7.
9. McDonald CJ. Protocol-based computer reminders, the quality of care and the non-perfectability of man. N Engl J Med 1976; 295:1351-5.
10. Chambers CV, Balaban DJ, Carlson BL, Ungemack JA, Grasberger DM. Microcomputer-generated reminders. Improving the compliance of primary care physicians with mammography screening guidelines. J Fam Pract 1989; 29:273-80.
11. Innes FT, Goldfarb NI, Balaban DJ. Development of a family medicine clinical encounter database system. Proceedings of the Eighth Annual Symposium on Computer Applications in Medical Care. Baltimore, MD, 1985.
12. Wilkinson L. SYSTAT: the system for statistics. Evanston, IL: SYSTAT, Inc., 1986.
13. Fedson DS. Influenza and pneumococcal immunization strategies for physicians. Chest 1987; 91:436-43.
14. Brook RH, Fink A, Kosecoff J, et al. Educating physicians and treating patients in the ambulatory setting. Where are we going and how will we know when we arrive? Ann Intern Med 1987; 107:392-8.
15. Tucker JB, DeSimone JP. Patient response to mail cues recommending influenza vaccine. Fam Med 1987; 19:209-12.
16. Buchner DM, Larson EB, White RF. Influenza vaccination in community elderly. A controlled trial of postcard reminders. J Am Geriatr Soc 1987; 35:755-60.
17. Frank JW, Henderson M, McMurray L. Influenza vaccination in the elderly: 1. Determinants of acceptance. Can Med Assoc J 1985; 132:371-5.
18. Ratner ER, Fedson DS. Influenza and pneumococcal immunization in medical clinics, 1978-1980. Arch Intern Med 1983; 143:2066-9.