

Computerized Health Maintenance Tracking Systems: A Clinician's Guide To Necessary And Optional Features

A Report from the American Cancer Society Advisory Group on Preventive Health Care Reminder Systems: Paul S. Frame, MD, Senior Author

Background: To promote preventive health care by primary care physicians and the development of computerized health maintenance tracking systems, the American Cancer Society sponsored an expert advisory group to define necessary and desirable, but optional, features of computer-based health maintenance tracking software for use in primary care practice.

Methods: Systematic literature review and structured consensus development were followed by independent expert critique.

Results: Necessary input features include a comprehensive, practice-specific health maintenance protocol, multiple entry codes to indicate the current status of each procedure, and a mechanism for patient-specific exclusion or alteration of procedure frequency.

Necessary features of the information management system include a linkage to a demographic data system, optional tracking of all or selected patients, identification of each patient's primary provider, and the ability to provide either a paper or electronic interface for the provider.

Necessary outputs include provider reminders, patient reminders sent regularly regardless of visit status, and summary reports of provider and patient compliance.

Conclusions: Although the ideal computer-based health maintenance tracking system is still evolving, knowledge of these necessary and optional features can aid clinicians interested in buying or developing a system for their own practice. (J Am Board Fam Pract 1995; 8:221-9.)

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The provision of preventive care for all patients is an accepted component of primary care practice. Increasingly managed care organizations and third-party payers for medical care are requesting documentation that clinicians are offering appropriate preventive care to their patients. Evidence-based recommendations for preventive care of asymptomatic patients have been made by several authoritative groups.¹ In spite of these recommendations, physicians have been slow to incorporate routine health maintenance into their daily practice, and many patients do not receive routine preventive care.²⁻⁴

The many barriers to and strategies for implementing prevention in practice have been recently reviewed.⁵ This article focuses on one tool to facilitate clinical prevention, computerized health maintenance tracking.

Health maintenance tracking systems, whether paper based or computerized, should assist the clinician to accomplish three basic objectives: (1) tracking longitudinally a comprehen-

sive personalized health maintenance protocol, (2) providing periodic health maintenance status reminders for providers and patients, and (3) providing data and reports to allow quality assurance and reinforcement of provider and patient behavior.

Computerized health maintenance tracking simply means using computers to prompt providers or patients to do appropriate health maintenance procedures at regular specified intervals based on age, sex, or risk factors. Figure 1 shows an example of a patient health maintenance reminder letter that can be sent to all patients in the practice at regular intervals.

Computerized reminders to providers and patients have been discussed for more than a decade. McDonald, et al.⁶ first reported changes in physician behavior, including improvement in provision of preventive procedures, as a result of computerized prompting. Despite the intuitive appeal of computerized health maintenance tracking, however, only four systems for comprehensive tracking of adult health maintenance protocols have been described in the medical literature.⁷⁻¹² Prospective, randomized, controlled trials using these systems have shown that computerized health maintenance tracking is feasible and that it can improve provider and patient health maintenance.



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HEALTH MAINTENANCE STATUS REPORT

**LUELLA W
STATE RTE 70
DALTON, NY 14836**

**DOB: 09/01/45
Age: 49 Sex: F
Last Visit: 08/22/94**

**Head of Household: DAVID W
Office: Canaseraga**

**Phone: (716)476-5771
Reminder Status: MB**

Dear LUELLA W

09/94

Preventing illness and keeping our patients as healthy as possible is an important part of family medicine.

Our records indicate you had the following health maintenance procedures done on the dates indicated:

History of Tobacco Use	07/94
Blood Pressure	07/94
Serum Cholesterol	05/94
Weight	07/94
Tetanus-Diphtheria Immunization	07/92
History of Alcohol Use	07/94
Pap Smear	10/93
Physician Breast Exam	10/93

You are overdue for the following health maintenance procedures:

Injury Prevention

If you do not already have an appointment in the next 2 months, please call the Canaseraga office at (607) 545-8333 to schedule a health maintenance checkup. Show this letter to your physician at your next appointment.

Figure 1. Example of a patient health maintenance reminder letter. Similar letters can be sent by the HTRAK¹¹ system to all patients in the practice on an annual basis. "MB" = month of birth.

nance compliance compared with usual care^{8,9} and compared with a manual flowchart-based health maintenance tracking system.¹² Nevertheless, few computerized tracking systems are currently available that are linked to demographic data bases and have commercial support. This situation will undoubtedly change with the evolution of electronic medical records and expanded clinical capabilities of medical billing systems.

The purpose of this article is to outline the necessary and optional features that clinicians should consider when purchasing or developing a computerized health maintenance tracking system. These features pertain both to electronic medical records or systems that are a clinical module of a billing or other demographic data system.

Methods

In 1993 the American Cancer Society convened an Advisory Group on Preventive Health Care Reminder Systems. The purposes of this group were, first, to review current knowledge about implementation of clinical preventive services in primary care practice and, second, to develop strategies for facilitating provision of preventive services by primary care providers. The focus was on strategies for implementation of a comprehensive preventive program without endorsing a specific preventive protocol and without being limited to cancer prevention. The American Cancer Society sponsored the group's activities but did not try to influence the process or recommendations.

The advisory group was divided into three subgroups to focus on (1) paper-based reminder systems, (2) computerized reminder systems, and (3) patient-retained systems. This report presents the recommendations of the subcommittee on computerized reminder systems.

A complete review of published material relevant to office systems for promoting preventive care had previously been done by one of the members (Larry Dickey) as part of the work for the National Coordinating Committee on Clinical Preventive Services. This review was supplemented by the members of the committee, many of whom had extensive research experience in the implementation of clinical preventive services.^{13,14}

The computer subcommittee created a list of features they considered desirable in a computer-

ized health maintenance tracking system. Initially the list was extensive but was progressively pared down to include those features expected to be feasible, cost-effective, and efficient. Whenever possible, these decisions were based on experience obtained from trials of existing systems. Rigorous scientific proof of the importance or necessity of individual features was not, however, available from the reviewed literature; therefore, these recommendations should be considered to be a consensus of expert opinion.

The subcommittee sent drafts of the proposed features to several outside experts for review and comment before finalizing the document.

Computerized tracking system features were designated as "necessary" or "optional." Necessary features were those features essential to achieve the basic objectives of health maintenance tracking, including (1) longitudinal tracking of a comprehensive health maintenance protocol, (2) providing periodic health maintenance status reminders for providers and patients, and (3) allowing quality assurance and reinforcement of provider and patient behavior. Only those features essential for effective functioning of the system were considered necessary.

Optional features were additional capabilities, such as being able to change the protocol automatically based on the patient's risk profile or being able to highlight tests that have been ordered but not yet completed. Many optional features are highly desirable but not absolutely essential. Optional features frequently require a more sophisticated system or additional data entry and therefore can increase the cost of health maintenance tracking.

Results

The recommended necessary and optional components of a computerized health maintenance tracking system are organized in three sections: inputs, information management system, and outputs (Figure 2). It is recognized that different types of systems will have different constraints. For example, displaying actual laboratory and test results is easier if the system is linked to an electronic medical record than if the system stands alone or is linked to a billing system. In the following section, codes are used to indicate whether the component is a necessary (N) or optional (O) feature.

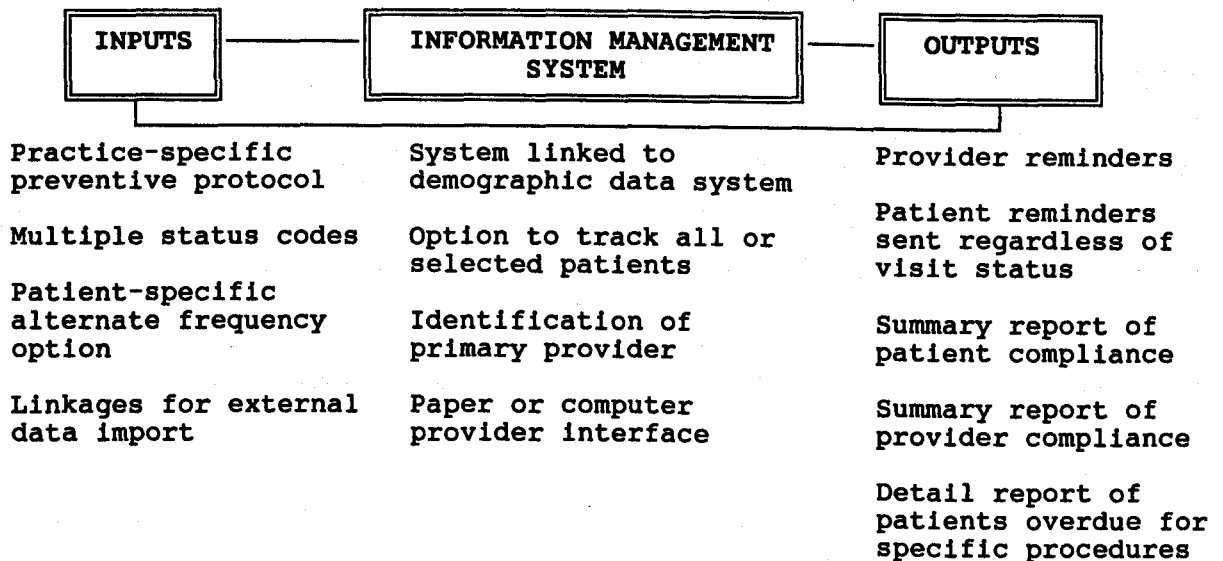


Figure 2. Overview of computer-based preventive reminder system, including summary of major necessary features.

Inputs

1. The system should allow tracking the full spectrum of effective preventive services, including primary and secondary preventive procedures and counseling interventions, for any age range (N).
 - A. The system should provide a format into which users can fit their own preventive care protocol or nationally recognized protocols (N). It might be desirable for the system to come initially loaded with a set of nationally recognized guidelines that the user could adopt or modify (O).
 - B. The basic procedure criteria are determined by patient age and sex (N).
 - C. Protocols based on risk factors other than age or sex, including diagnoses, or specific medication use are desirable (O).
 - D. Most procedures are indicated in multiples of yearly intervals; however, a few procedures (e.g., childhood immunizations) require the capability of tracking multiple procedures within a given year (N).
 - E. It must be possible for the practice to modify the preventive protocol or add new items easily without need for an outside consultant (N).
2. Multiple entry codes must be available to inform the provider of the patient's health maintenance status (N). A simple yes or no (procedure either done or not done) alternative is not sufficient to allow providers to understand the patients health maintenance status. Suggested status options include (1) test done and normal, (2) test done and abnormal, (3) test refused, (4) test not indicated, and (5) test done elsewhere.
 - A. The system must be efficient. Provider and clerical data entry time must be minimized, as should the process of creating provider and patient reminders (N).
 - B. It must be possible to record procedures done both at the current visit and at other dates (N).
 - C. The system should indicate that a test has been ordered but not yet completed (O). For some tests, the system should allow entering the actual test value (O). Entering actual test values is most easily accomplished if the system is part of an electronic record that directly imports laboratory test and radiograph data.
 - D. Tracking the follow-up of abnormal results is desirable (O). Such tracking requires that the system recognize abnormal values and the ability to enter additional data at the time of addressing the abnormal result.
3. There should be an alternate frequency option, which allows providers to change the frequency of doing specific procedures for individual patients (N).

- A. It should be possible to cancel all or specific procedures for individual patients (N).
- 4. External linkages for transferring data files of laboratory test and radiograph results and for remote data entry are desirable, especially if the system is part of an electronic medical record (O).

Information Management System

- 1. The system should run under a commonly used operating system in a language or format for which programming and support are widely available (N).
- 2. The system should be linked to or capable of exchanging data with the practice billing or other demographic data systems. It could also be part of a more complete electronic medical record (N).
 - A. A stand-alone system is less desirable. At a minimum, a stand-alone system needs to be able to receive demographic data by electronic transfer from a preexisting source.
- 3. It must be possible to set up the system so that health maintenance is tracked for all patients or for only enrolled patients (N). If all patients are tracked, the computer includes them unless specifically excluded by the provider. Tracking only enrolled patients means the computer excludes patients unless specifically included (enrolled) by the provider.
 - A. Tracking all patients is the preferred option for most primary care practices; however, the provider will have to cancel health maintenance tracking for inappropriate patients (e.g., out-of-town visitors, terminally ill patients, patients who have died, or patients seen while covering for another clinical practice).
 - B. Practices tracking only enrolled patients will have fewer problems with inappropriate patient reminders but will risk not reaching infrequently seen patients.
 - C. The system should be capable of readily selecting active (seen within a defined time period) patients (O).
- 4. It should be possible to identify the patient's primary provider, a necessary feature for feedback and quality assurance activities (N).

- A. Methods of identifying the primary provider in order of preference include (1) external assignment, (2) the provider who has seen the patient for the majority of visits, or (3) the provider with the most recent patient contact.
- 5. Interface with providers can either be on paper, by computer screen (N), or both. Few practices will have an entirely paperless system.
- 6. Support and system maintenance services must be available (N).
 - A. It must be possible periodically to delete or archive older or unneeded data (N).
 - B. Appropriate security is needed to protect patient confidentiality and system integrity (N).
 - C. Written instructions describing the installation and operation of the system must be available (N).
 - D. An archival function is desirable to document generation of provider and patient reminders and patient correspondence (O).
- 7. The system should have been tested in actual primary care practice situations. It should be possible to observe the system in operation (O).
 - A. Data should be available describing the costs of installation and operation of the system (N).

Outputs

- 1. A provider reminder should be generated that includes a history of procedures done, when procedures are next due, and the procedure status (normal, abnormal, done elsewhere, etc.) (N).
 - A. It is ideal for this reminder to be generated at each patient visit. If computer printouts are not generated for each visit, reminders can be placed on the chart at predetermined intervals (e.g., annually).
 - B. It should be possible to produce an ad hoc provider reminder for a specific patient at times other than a patient encounter (N).
- 2. Patient reminders should be sent to all patients in the system regardless of appointment status (N).

- A. Patients reminders should inform the patient about overdue procedures (N). A listing of procedures previously done would be desirable (O). Patient reminders should include instructions for contacting the practice if health maintenance is due (N).
 - B. Notification of actual procedure results might be desirable but requires additional data entry or direct importing of external data (O).
 - C. Additional patient reminders should be obtainable on an ad hoc basis or at the time of patient visits (O).
3. The following reports should be available for provider feedback, quality assurance, and patient follow-up:
- A. A summary report should show patient compliance, by procedure, with the health maintenance protocol. This report should include compliance of all patients enrolled in the system by provider or office or both for each procedure (N). It tells the practice what percentage of the practice population is overdue for each specific procedure.
 - B. A summary report should show provider compliance by procedure, similar to 3A, except only patients currently active are included (N). Thus, it includes only patients actually seen by the provider.
 - C. A detail report listing all patients overdue for a particular procedure by provider or office should include the patient's address and telephone number to allow easy follow-up (N).
 - D. A detail report should list patients with a currently abnormal procedure. This report is applicable only if the system has provisions for follow-up and tracking of abnormal results (O).

Features of Available Health Maintenance Tracking Systems

Table 1 describes features of several health maintenance tracking systems that have recently been described in the literature.^{8,10,11} These tracking systems are not the only systems for tracking health maintenance but were chosen because (1) they have been tested in the primary care setting and the results have been published in the lit-

erature, and (2) they are currently available to physicians and researchers interested in computerized health maintenance tracking.

HTRAK was developed at Tri-County Family Medicine, a rural New York family practice under a grant from the Agency for Health Care Policy and Research.¹¹ As currently available, it is a stand-alone system designed to be linked to the practice billing system. A 2-year prospective, randomized, controlled trial compared the computerized tracking system linked to the practice billing system with a manual flowchart-based tracking system.

Overall provider compliance with the health maintenance protocol increased 16 percentage points in the computerized group and 6 percentage points in the control group. The computerized group had significantly higher provider compliance than the control group for 8 of 11 individual procedures. The computerized tracking system was acceptable to providers and patients and cost \$0.78 per patient per year to operate.¹²

Check-Up was developed as a cancer prevention system at the University of California at San Francisco under a grant from the National Cancer Institute. It has been updated and is now available from the American Cancer Society. McPhee et al.⁸ described implementation of this system in 20 primary care practices in California. The computer system was a stand-alone system that required separate demographic and health maintenance data entry. A provider reminder was generated at each patient visit along with patient reminder for the provider to give to the patient. After a 1-year intervention period compliance increased for 9 of 11 cancer prevention interventions.

Practice Partner is a commercially available electronic medical record sold by Physician Microsystems, Inc., of Seattle, Washington. The system is an electronic medical record with sophisticated health maintenance tracking and reminder features. These features track the provision of preventive services, provide physician reminders at the time of patient visits, permit generation of mailed patient reminders, and provide on-screen reference to relevant patient education resources. Practice Partner Patient Records is currently used at the family medicine residency program at the Medical University of South Carolina.¹⁰ Earlier study of five preventive

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Table 1. Features of Available Computerized Tracking Systems.

Necessary and Optional Components	HTRAK*	Check-Up†	Practice Partner‡
Inputs§			
1. System allows tracking the full spectrum of preventive services for any age range (N)	Yes	Yes	Yes
1A. System provides a template into which end users can fit their own preventive protocol or use nationally recognized protocols (N)	Yes, up to 20 procedures	Yes	Yes, up to 13 per patient
1B. Criteria based on age and sex (N)	Yes	Yes	Yes
1C. Criteria available based on risk factors (O)	No	Smoking only	No
1D. Procedures tracked in multiples of yearly or monthly intervals (N)	Yes	Yes	Yes
1E. Practice able to modify global criteria easily (N)	Yes, one screen	Yes	Yes, one screen by age group
2. Multiple status codes (N)	Yes	No	No
2A. Efficient data entry and output (N)	Yes	Yes	Yes
2B. Ability to update previously recorded information (N)	Yes	Yes	Yes
2C. "Test ordered — result pending" feature (O)	No	No	No
2D. Ability to track abnormal results (O)	Code but not track	Code but not track	Code but not track
3. Ability to change the frequency of doing selected procedures for specific patients (N)	Yes	Yes	Yes
3A. Ability to cancel all or specific procedures for individual patients (N)	Yes	Yes	Yes
4. Ability to import laboratory or radiograph data (O)	No	No	Yes
Information Management System			
1. Commonly used operating system (N)	DOS, FOXPRO	DOS, MAC FOXPRO	DOS UNIX
2. System linkage capability (N)	Stand-alone, linked with additional programming	Stand-alone, can import demographic data	Part of electronic record
3. Reminders sent to all patients or only enrolled patients (N)	All patients	Enrolled	All patients
3C. Ability to identify active patients (O)	No	No	Yes
4. Method of identifying the primary provider (N)	Provider at last visit	Assigned by the practice	Assigned by the practice
5. Provider interface: paper, online, or both (N)	Paper	Paper	Both
6. System support available (N)	No	No	Yes
6A. Ability to delete older data (N)	Yes	Yes	Yes
6B. Security systems to protect confidentiality and system integrity (N)	No	No	Yes
6C. Written instructions for installation and operation of health maintenance tracking (N)	Yes	Yes	Yes
6D. System documents generation of reminders (O)	No	No	No
7. Data available that system works (O)	2-year randomized-controlled trial, published	1-year randomized-controlled trial, published	Ongoing audits unpublished
7A. Data available on costs of operation (N)	Yes	Yes, for similar system	No
Outputs			
1A. Generates provider reminder: regular interval, each visit (N)	Annually	Each visit	Each visit
1B. Generates ad hoc provider reminder (N)	No	Yes	Yes
2. Patient reminders sent regardless of visit status (N)	Yes	No	Yes
2A. Patient reminder lists overdue procedures (N)	Yes	Yes	Yes
2B. Patient reminder includes test results (O)	No	No	No
2C. Ability to generate ad hoc patient reminders (O)	No	Yes	Yes via mail merge

continued

Table 1. Continued.

Necessary and Optional Components	HTRAK*	Check-Up†	Practice Partner‡
3A. Creates summary report of patient compliance (N)	Yes	Yes	Not directly
3B. Summary reports of provider compliance (N) (compliance of patients actually seen)	No	No	No
3C. Detail reports listing patients overdue for a specific test (N)	Yes	Yes	Via query function
3D. Detail report listing patients with an abnormal result (O)	No	No	Via query function

*Information about HTRAK is available from Paul S. Frame, MD, Tri-County Family Medicine Box 112, Cohocton, NY 14826.

†Information about Check-Up is available from Don Fordham, MPH, University of California San Francisco School of Medicine Division of General Internal Medicine 44 Montgomery Street, Suite 850 San Francisco, CA 94104.

‡Information about Practice Partner is available from Physician Micro Systems Inc. 2033 Sixth Ave, Suite 707 Seattle, WA 98121.

§Row numbers in the table correspond to Results section.

services at this institution on a previous computerized patient record system found that patient compliance with recommended preventive services improved with the use of a computerized reminder system.⁹ Patient compliance with four of the five procedures studied improved in the computer-based intervention groups compared with the control group, with the greatest improvement shown in the group receiving both patient and provider reminders.

Discussion

Providing appropriate preventive care to one's patients is good medicine. Aside from this idealistic reason for organizing the practice to provide preventive care is the practical reality that accountability for defined populations and documenting outcome and process measures are being increasingly required by health maintenance organizations, government, and the payers for health care. Computers can be valuable aids to clinicians attempting to achieve these goals.

We have defined necessary and optional features needed for effective, efficient computerized health maintenance tracking in primary care practice. Clinicians can use this information when purchasing or developing their own systems. It is important to remember, however, that this is a consensus opinion about a subject that is rapidly changing. Technology and research will undoubtedly lead to new innovations and thoughts about what constitutes basic and optimal health maintenance tracking.

It is also important for clinicians to remember what computers can and cannot do to increase and improve preventive care in medical practices.

Computers can (1) prompt providers to do health maintenance, (2) keep track of what has been done in the past and what needs to be done in the future, (3) tell providers which patients are overdue for procedures, (4) create reminder letters for patients, and (5) create summary reports of performance for feedback and quality assurance.

Computers are not a panacea. They cannot (1) define the practice preventive protocol, (2) force providers to respond to prompts, (3) enter the appropriate data, (4) mail reminders to patients, (5) force patients to respond to reminders, and (6) make the practice initiate a system of ongoing performance review and quality assurance. The computer is a tool that can be a valuable part of an office preventive care system but will not create, by itself, a preventive care system.

Few data are available on the costs of operating computer-based health maintenance tracking systems. One study,¹² in a fee-for-service practice reported a cost of \$0.78 per patient per year to operate the system. This cost included clerical time, system maintenance, and mailing of annual patient reminder letters. This cost seems reasonable, but when multiplied by thousands of patients can amount to a considerable practice expense. A prepaid care setting would have substantially higher costs, because each procedure done is an additional cost. Other studies have not reported formal cost analyses.

Existing computerized billing systems can sometimes be modified to facilitate prevention without the need for new software. For example, nonbillable services (e.g., mammograms) can be entered into billing fields for tracking and recall. This setup allows using query functions to deter-

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mine eligible patients who have not received the service. It is also possible to have the computer generate a list, or create mailing labels, of patients who have not been seen by the practice within a defined period of time. These patients can then be prompted to come in for a health maintenance check-up.

The most important necessary feature for an effective preventive care system is provider and staff motivation. If the human motivation is present, computers can be valuable tools for achieving the goal of offering optimal preventive care to all patients. No single ideal commercial computerized health maintenance tracking system is currently available. This situation is rapidly changing, however, as medical software vendors are beginning to offer quality assurance or patient surveillance modules that can do health maintenance tracking as part of medical billing or electronic record systems.

Many medical software systems are currently available. Naturally some are better than others and, as always, the buyer should beware. It is hoped this article will be a useful guide to clinicians, informing them of features to look for in health maintenance tracking systems. Informed clinicians will be better able to decide which systems will be efficient, cost-effective tools for tracking preventive care.

References

1. Hayward RA, Steinberg EP, Ford DE, Roizen MF, Roach KW. Preventive care guidelines 1991. *Ann Intern Med* 1991; 114:758-83.
2. McPhee SJ, Richard RJ, Solkowitz SN. Performance of cancer screening in a university general internal medicine practice: comparison with the 1980 American Cancer Society Guidelines. *J Gen Intern Med* 1986; 1:275-81.
3. Lurie N, Manning WG, Peterson C, Goldberg GA, Phelps CA, Lillard L. Preventive care: do we practice what we preach? *Am J Public Health* 1987; 77:801-4.
4. Ornstein SM, Garr DR, Jenkins RG, Rust PF, Zemp L, Arnon A. Compliance with five health promotion recommendations in a university-based family practice. *J Fam Pract* 1989; 29:163-8.
5. Frame PS. Health maintenance in clinical practice: strategies and barriers. *Am Fam Physician* 1992; 45:1192-200.
6. McDonald CJ, Hui SL, Smith DM, Tierney WM, Cohen SJ, Weinberger M, et al. Reminders to physicians from an introspective computer medical record. A two-year randomized trial. *Ann Intern Med* 1984; 100:130-8.
7. Harris RP, O'Malley MS, Fletcher SW, Knight BP. Prompting physicians for preventive procedures: a five-year study of manual and computer reminders. *Am J Prev Med* 1990; 6:145-52.
8. McPhee SJ, Bird JA, Fordham D, Rodnick JE, Osborn EH. Promoting cancer prevention activities by primary care physicians. Results of a randomized, controlled trial. *JAMA* 1991; 266:538-44.
9. Ornstein SM, Garr DR, Jenkins RG, Rust PF, Arnon A. Computer-generated physician and patient reminders. Tools to improve population adherence to selected preventive services. *J Fam Pract* 1991; 32:82-90.
10. Ornstein SM, Garr DR, Jenkins RG. A comprehensive microcomputer-based medical records system with sophisticated preventive services features for the family physician. *J Am Board Fam Pract* 1993; 6:55-60.
11. Frame PS, Zimmer JG, Werth PL, Martens WB. Description of a computerized health maintenance tracking system for primary care practice. *Am J Prev Med* 1991; 7:311-8.
12. Frame PS, Zimmer JG, Werth PL, Hall JW, Eberly SW. Computer-based vs manual health maintenance tracking: a controlled trial. *Arch Fam Med* 1994; 3:581-8.
13. McPhee SJ, Detmer WM. Office-based interventions to improve delivery of cancer prevention services by primary care physicians. *Cancer* 1993; 72 (3 Suppl):1100-12.
14. Harris R, Leininger L. Preventive care in rural primary care practice. *Cancer* 1993; 72 (3 Suppl):1113-8.