# A Comprehensive Microcomputer-Based Medical Records System With Sophisticated Preventive Services Features For The Family Physician

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***Abstract:*** ***Background:*** **Computer-based medical records systems improve the provision of preventive services in the offices of family physicians. Until recently, these systems were either not commercially available for use by practicing physicians or were very expensive.**

***Methods:*** **A commercially available, microcomputer-based medical records system is currently used at the Department of Family Medicine at the Medical University of South Carolina. This system is used as a fully electronic medical record and has 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 reference to relevant patient education resources.**

***Results and Conclusion:*** **The system described in this paper can be used by practicing physicians to improve their delivery of preventive services. (J Am Board Fam Pract 1993; 6:55-60.)**

The landmark 1989 report of the US Preventive Services Task Force[1] provided recommendations on 169 interventions for the prevention of 60 target conditions. Editorial opinion has been favorable,[2] and there is good physician agreement with the developed guidelines.[3] Dissemination of the task force guidelines into clinical practice is now the important agenda.

There is an extensive body of literature demonstrating the difficulty of disseminating guidelines for preventive services into clinical practice. Although physicians and patients report good adherence with recommendations for preventive services, actual measurements indicate otherwise, and a substantial proportion of persons in the United States, often those at greatest risk, fail to adhere to recommended services.[4-13]

Three recent reviews have summarized the literature on the reasons for divergence between published recommendations for preventive services and actual receipt of these services by patients.[14-16] Although issues beyond control of the individual physician, such as lack of reimbursement for certain preventive services, frequently are cited, several factors amenable to control by physicians are also prominent. These factors include overestimation of performance, lack of knowledge about published recommendations, and lack of time. Computerized medical record and reminder systems are effective in overcoming these barriers and have improved compliance with preventive services in several clinical settings.[17-24] Computer systems can incorporate and readily modify recommendations for numerous preventive services, track the provision of these services to individual patients, and remind both providers and patients about services that are due. The limitations of these systems have been that, until recently, they were developed for use in university settings and either were not commercially available for use by practicing physicians or were very expensive.

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These limitations came to our attention at the Department of Family Medicine at the Medical University of South Carolina in late 1989 when we were seeking to replace our aging, expensive-to-maintain, minicomputer system. Among our requirements for a new system were the following: (1) the system should be microcomputer-based for cost considerations, (2) the system should be available for purchase at a reasonable cost by our graduating residents for use in their future practices, (3) the system should function as a fully automated medical record in addition to fulfilling administrative needs, and (4) the system should possess a sophisticated preventive-service tracking and reminder system. A competitive bidding process was used to select the system that met our stated needs. This report describes the features of the system and how it is being used in our clinical practice to enhance the provision of preventive services.

## System Description

The software being used includes modules for medical records, medical transcription, and appointment scheduling.* Integrated billing software is also available, but it is not being used in our setting because billing is done by an outside agency.

The department system runs on a Novell Ethernet network, with two file-servers that have 33-Mhz 80386 microprocessors. Data are stored on mirrored 1.2-gigabyte external hard drives with an associated 2.5-gigabyte tape backup system for daily backup and archival storage. Sixty workstations are connected to the network, most have 80286 microprocessors, and some have 80386SX or 80386 microprocessors. Workstations are located throughout the department, with one in each examination room, at nursing stations, in administrative areas, and in many faculty and staff offices. Printers are accessible from any workstation on the network. Remote access to the network is available by modem for vendor support and for physicians taking calls outside the department.

Access to the system is limited by password protection at both the network and application software levels. Data security is provided through automatic nightly backup of all data to magnetic tape, with weekly off-site backup.

*Software is a product of Physician Micro Systems, Inc., 2033 Sixth Avenue, Seattle, WA 98121.

The medical records software includes, in electronic form, all the features typically contained in a paper record: problem lists, progress notes, vital signs, medical history, social history, family history, medication lists, immunizations, health maintenance, laboratory results, and sections for reports of ancillary studies. The software also includes sophisticated search and data export functions, useful for quality assurance, practice analysis, and research.

Data entry to the electronic medical record is accomplished in two ways: by direct keypunch and through automated batch loading. All physicians use direct keypunch to enter prescriptions, which are printed by the system. Nurses use direct keypunch for prescription renewal and entry of immunizations. Both physicians and nurses keypunch some preventive service information, as described below. The majority of data entry, however, is accomplished through automated loading of data. Progress notes are loaded daily from the associated medical transcription software. Laboratory data are loaded daily from an ASCII file sent by the hospital clinical laboratory. Other text data (e.g., consultation letters) from outside sources are entered using an optical scanner and character recognition software.

The department currently maintains a parallel paper copy of the record (generated by the computer) but plans to abandon this practice in the next few months when electronic signature of progress notes will be available. The paper record is retrieved for only 10 to 15 percent of all patient visits, primarily for the use of prenatal flow sheets, pediatric growth curves, and review of old data that were not transferred to the new computer system (e.g., discharge summaries, electrocardiograms).

Because the paper copy of the record is not routinely provided, physicians and nurses quickly learned to use the medical records software. The formal training period for each physician and nurse was 2 hours of hands-on practice, with additional training as needed during the first few weeks of use. Physicians and nurses have generally been enthusiastic about the system and recognize the improved patient care it allows. Although no formal studies of patient acceptance of the system have been conducted, anecdotal response has been enthusiastic. Many patients, including some who work in fast-food restaurants, use computers daily in their lives and seem pleased that their physicians have followed suit.



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**Table 1. Basic Recommendations of US Preventive Services Task Force Included in Computerized Tracking.**

| Recommendation | Age Group (Years) | Interval |
|---|---|---|
| **Counseling** | | |
| Dental | All ages | Every 2 years, more frequently in young children |
| Diet | All ages | Every 2 years, more frequently in young children |
| Injury prevention | All ages | Every 2 years, more frequently in young children |
| Passive smoking | 0 - 6 | Every 3 months to age 2 years, then every year |
| Exercise | 3 and older | Every 1 to 2 years |
| Sexuality | 13 and older | Every 2 years |
| Substance abuse | 13 and older | Every 2 years |
| **Immunizations** | | |
| Diphtheria, pertussis, and tetanus | 0 - 6 | 2, 4, 6, 15 months; booster at age 4 years |
| Oral polio vaccine | 0 - 6 | 2, 4, 15 months; booster at age 4 years |
| *Haemophilus influenzae* Type B | 0 - 6 | 2, 4, 6, 15 months |
| Measles, mumps, and rubella | 0 - 4 | At 15 months and at age 4 years |
| Diphtheria and tetanus booster | 13 and older | Every 10 years |
| Pneumococcal | 65 - 75 | Once |
| Influenza | 65 and older | Every year |
| **Screening** | | |
| Height and weight | All ages | Every 2 years, more frequently in young children |
| Hemoglobin and hematocrit | 0 - 2 | Once at 1 year of age |
| Amblyopia and strabismus | 3 - 6 | Once |
| Blood pressure | 3 and older | Every 1-2 years |
| Urinalysis | 3 - 6, 65 and older | Age 3, every 2 years after age 65 years |
| Cholesterol | 19 - 75 | Every 4 years |
| Breast examination | 40 and older | Every year |
| Fecal occult blood | 40 and older | Every 2 years from 40 - 49 years, then every year |
| Hearing | 65 and older | Every 5 years |
| Visual acuity | 65 and older | Every 2 years |
| Glaucoma testing | 76 and older | Every 2 years |
| Transient ischemic attack symptoms | 76 and older | Every year |
| **Women only** | | |
| Papanicolaou smear | 19 - 75 | Every 2 years |
| Mammogram | 50 - 75 | Every year |
| Thyroid function test | 65 and older | Every 5 years |

The cost of the system was considerable. Hardware, software, data conversion, installation, and training cost approximately $250,000. Hardware and software maintenance (including software upgrades) costs an additional $2000 per month. A full-time operator maintains the network and supports the users. Costs would be considerably less for a typical group practice. The cost to equip a practice with workstations in eight examination rooms, at three nursing stations, and in four physician offices would be approximately $40,000. Monthly maintenance costs would be about $500, and there would be no need for a system operator. The software can also be used on a stand-alone system, with printed copy provided for a traditional paper chart. The cost of this type of system would be approximately $5000.

The costs of computerized medical records are compensated somewhat by decreased costs for medical records personnel, paper supplies, and space required for paper records. In addition, it is assumed that some value in improved medical care is possible with the use of the system, although this value has not been directly measured.

## Preventive Services Application

Currently, the department is using the system to track and provide reminders for 29 basic recommendations of the US Preventive Services Task Force.[1] These preventive services consist of screening, counseling, and immunizations (Table 1). The services are organized into 16 age-sex groups, which closely correspond to the age groups used by the task force.

The software provides the following preventive services features:

1. User specification of the preventive services to be tracked based on the patient's age and sex.



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**HEALTH MAINTENANCE TEMPLATE**

For ages 40 to 49 years. Sex: F (M/F)

| | Frequency | |
|---|---|---|
| Tetanus | Every 10/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Height and weight | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Blood pressure | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Breast examination | Every 01/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Cholesterol | Every 04/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Papanicolaou smear | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Fecal occult blood | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Diet counseling | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Exercise counseling | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Substance abuse counseling | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Sexual counseling | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Injury counseling | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |
| Dental counseling | Every 02/00 (yy/mm) or at ages: | _/_, _/_, _/_, _/_, _/_. |

**Figure 1. An example of a health maintenance template for 40- to 49-year-old women. The services and frequency can be customized by the user for an individual patient or for all patients.**

This specification is accomplished by completing easily constructed templates (Figure 1). Templates can be modified for individual patients.

2. Flexible means of data entry to update preventive services that are performed. In our center, data entry is accomplished in the following manner: Temperature, blood pressure, pulse rate, and respiratory rate data are updated by nurses at the time measurements are obtained. Immunization data are updated by nurses at the time they administer the immunizations. Laboratory data are updated automatically when a laboratory result is loaded into the computer. Data on screening services or counseling provided by physicians can be entered directly by the physician or through dictation and uploading from the medical transcription software.
3. Provider reminders in either paper or electronic form. In our center, provider reminders are available at the time of each patient visit through the chart summary screen (Figure 2). Providers who need additional information can access the health maintenance screen through a few keystrokes (Figure 3). Nurses respond to certain reminders (height, weight, and blood pressure). They also are encouraged to request physician authorization to provide other services, e.g., immunizations. Physicians respond to the prompts for counseling and most screening services.
4. Maintenance and citation of the US Preventive Services Task Force recommendation, as well as relevant patient education materials for each preventive service. Providers can access this information directly from the health maintenance screen. The educational materials are located in a filing cabinet near each examination room.
5. Patient reminder letters. Reminder letters can be generated by searching the system for patients deficient in one or all preventive serv-

CHART SUMMARY SUSAN MARTIN ID: 123456

Most Recent Problems:
08/09/91 Edema
08/09/91 Diabetes mellitus
08/09/91 Arthritis
07/15/91 Fever unknown origin
07/15/91 Diabetes mellitus
07/15/91 Dermatomyositis
07/10/91 Patient education
06/28/91 Medical examination

Major Problem List:
1. Medical examination
2. Arthritis
3. Diabetes mellitus
4. Cervical spine syndrome
5. Economic problem
6. Obesity
7. End of list

Allergies

Health Maintenance Needed:

Breast Examination Cholesterol Fecal Occult Blood
Exercise Counseling Sexual Counseling

**Figure 2. A chart summary for a hypothetical 42-year-old woman. Needed health maintenance services are prominently displayed.**



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**HEALTH MAINTENANCE**

Name: Martin, Susan ID: 123456 Age: 42 Sex: F

| | 06/28/91 | 03/20/91 | 02/22/91 | 07/06/90 | 07/25/87 |
|---|---|---|---|---|---|
| Tetanus | — | — | — | — | X |
| Height and weight | — | X | — | — | — |
| Blood pressure | — | — | X | — | — |
| **Breast examination** | — | — | — | — | — |
| **Cholesterol** | — | — | — | — | X |
| Papanicolaou smear | — | — | — | X | — |
| **Fecal occult blood** | — | — | — | — | — |
| Diet counseling | X | — | — | — | — |
| **Exercise counseling** | — | — | — | — | — |
| Substance abuse counseling | X | — | — | — | — |
| **Sexual counseling** | — | — | — | — | — |
| Injury counseling | X | — | — | — | — |
| Dental counseling | X | — | — | — | — |

Notes:

**Figure 3. The health maintenance section for the same hypothetical patient. Dates that preventive services were provided are indicated and needed services are highlighted.**

ices. In our center, patient reminder letters are sent annually, just before patients' birthdays. In our experience 5 to 10 percent of all patient visits are made in response to birthday letters.

## Discussion

The availability of a computer system such as the one described in this report comes at an opportune time. Agreement has been reached on the importance of preventive services and on a basic set of preventive services.[1] The usefulness of a preventive services tracking system that provides physician and patient reminders for deficient preventive services has been clearly demonstrated.[23] Many have now recognized the advantages of computerized medical record systems.[25,26] Indeed, the prestigious Institute of Medicine has recently recommended that a major initiative be undertaken to computerize medical records throughout the United States.[27] Finally, microcomputer hardware with capabilities unimaginable 10 years ago is available at a cost affordable for all physicians. Primary care physicians now have the opportunity to computerize their practices and improve their delivery of preventive services.

## References


1. Guide to clinical preventive services. An assessment of the effectiveness of 169 interventions. Report of the US Preventive Services Task Force. Baltimore: Williams & Wilkins; 1989.
2. Spitzer WO, Mann KV. The public's health is too important to be left to public health workers. A commentary on Guide to Preventive Services. Ann Intern Med 1989; 111:932-42.
3. Goodspeed R, Corvo P, Martel T. US Preventive Services Task Force guide to clinical preventive services: opinions of primary care physicians. Clin Res 1990; 38:728A.
4. Chao A, Paganini-Hill A, Ross RK, Henderson BE. Use of preventive services by the elderly. Prev Med 1987; 16:710-22.
5. Stephens T, Schoenborn CA. Adult health practices in the United States and Canada. Vital and Health Statistics, Series 5, No. 3. Washington, DC: Government Printing Office, 1988. (DHHS Publication No. (PHS) 88-1479.)
6. Provisional estimates from the National Health Interview Survey Supplement on Cancer Control — United States, January-March 1987. MMWR 1988; 37:417-20, 425.
7. Hayward RA, Shapiro MF, Freeman HE, Corey CR. Who gets screened for cervical and breast cancer? Results from a new national survey. Arch Intern Med 1988; 148:1177-81.
8. Woolhandler S, Himmelstein DU. Reverse targeting of preventive care due to lack of health insurance. JAMA 1988; 259:2872-4.
9. Summary of the Second National Community Forum on Adult Immunization. MMWR 1987; 36: 677-80.
10. Berner JS, Frame PS, Dickinson JC. Ten years of screening for cancer in a family practice. J Fam Pract 1987; 24:249-52.




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11. 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.
12. Anda RF, Sienko DG, Remington PL, Gentry EM, Marks JS. Screening mammography for women 50 years of age and older: practices and trends, 1987. Am J Prev Med 1990; 6:123-9.
13. Screening mammography. Results of the NCI Breast Council Screening Consortium and National Health Interview Survey Studies: a missed clinical opportunity? JAMA 1990; 264:54-8.
14. Nutting PA. Health promotion in primary medical care: problems and potential. Prev Med 1986; 15: 537-48.
15. Becker MH, Janz NK. Practicing health promotion: the doctor's dilemma. Ann Intern Med 1990; 113:419-22.
16. McPhee SJ, Bird JA. Implementation of cancer prevention guidelines in clinical practice. J Gen Intern Med 1990; 5(Suppl):116-22.
17. 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.
18. Tierney WM, Hui SL, McDonald CJ. Delayed feedback of physician performance versus immediate reminders to perform preventive care. Events on physician compliance. Med Care 1986; 24:659-66.
19. Tape TG, Givner N, Wigton RS, Seelig CB, Patil K, Campbell JR. Process in ambulatory care: a controlled clinical trial of computerized records. In: Greenes RA. Proceedings on the 12th Annual Symposium on Computer Applications in Medical Care (SCAMC), Los Alamitos, CA: Institute of Electrical and Electronic Engineers Computer Society Press, 1988: 749-52.
20. McPhee SJ, Bird JA, Jenkins CN, Fordham D. Promoting cancer screening. A randomized, controlled trial of three interventions. Arch Intern Med 1989; 149:1866-72.
21. Turner BJ, Day SC, Borenstein B. A controlled trial to improve delivery of preventive care: physician or patient reminders? J Gen Intern Med 1989; 4:403-9.
22. 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.
23. 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.
24. McPhee SJ, Bird JA, Fordham D, Rodnick JE, Osborn EH. Prompting cancer prevention activities by primary care physicians. Results of a randomized, controlled trial. JAMA 1991; 266:538-44.
25. Korpman RA, Lincoln TL. The computer-stored medical record. For whom? [editorial]. JAMA 1988; 259:3454-6.
26. Spann SJ. Should the complete medical record be computerized in family practice? An affirmative view. J Fam Pract 1990; 30:457-60.
27. Dick RS, Steen EB, editors. The computer-based patient record: an essential technology for health care. Report of a study by a committee of the Institute of Medicine. Washington, DC: National Academy Press, 1991.



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