HMO INNOVATIONS

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Computer-Prompted Diabetes Care

Objectives/Goals

Diabetes mellitus is one of the most common chronic diseases. It affects 3% to 5% of the population (1), and its prevalence is increasing in parallel with the mean body mass index in industrialized societies (2). Treatment of the chronic complications of diabetes (especially atherosclerosis) places a tremendous financial burden on health care systems. A recent study (3) showed that in 1992, diabetic patients constituted 4.5% of the U. S. population but accounted for 14.6% of total health care expenditures. In the modern era of diabetes care, we have a plethora of diabetes management tools as well as the ability to diagnose and modify the course of chronic complications. Improvement in outcomes and cost savings will therefore depend on enhancing physicians' abilities to deliver effective diabetes care.

Computer-Prompted Diabetes Care (CPDC) is a multifaceted software program designed to allow the physicians of the Maccabi Health Care Services (a 1,200,000-member Israeli health service network that combines features of both HMOs and IPAs) to deliver comprehensive and exacting diabetes care through the use of real-time, on-screen, situation-specific messages.

Program Details

The Maccabi system is extensively computerized and includes all laboratory testing and prescription data; imaging studies will be added in the near future. Ninety-five percent of all primary and consulting physicians in the Maccabi Health Fund have replaced paper patient charts with Clicks, a user-friendly computerized medical record database developed locally in Israel by Roshtov Software Industries, Ltd. The CPDC software overlays the basic Clicks medical record. This software functions by screening discrete text and data within each patient chart and comparing them with standards of care that are based on the recommendations of the St. Vincent's Declaration Diabetes Care Initiative of the World Health Organization and International Diabetes Foundation, which are nearly identical to the American Diabetes Association recommendations. On-screen prompts appear during the patient's visit only if physician practice behavior or patient metabolic outcomes differ from the recommended standards. Prompts continue to appear at subsequent visits until the software confirms that the deficiency generating the prompt has been corrected. All CPDC on-screen physician alerts are supported by concise and easily accessible help files.

To activate the various prompts and warnings within the CPDC software, diabetic patients in a clinic population must be identified and an internal diabetes registry must be constructed and continuously updated. This is done by screening the internal Clicks data of each patient who is not known as diabetic for diabetes-related diagnoses, diabetes-specific drugs prescribed, or high fasting glucose levels. When such data are found, the physician is asked to confirm or refute the diagnosis of diabetes.

Effective recall ensures that requisite laboratory testing and clinic visits are prompted at appropriate intervals. When patients with diabetes have clinic visits, the software searches the Clicks chart and generates referral forms for testing only if specific tests are overdue. Tests and their specified frequencies are outlined in Table 1. In addition, a list of identified diabetic patients who have not visited the clinic with-

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in the past 6 months prints automatically every 2 months at the end of the physician's workday.

To pursue continuous quality improvement, treatment outcomes must be monitored rigorously. At each clinic visit, the CPDC software searches the Clicks chart of recognized diabetic patients and generates appropriate prompts and warnings only if specific physical examination or laboratory results lie outside the target range. Variables and outlier values are listed in Table 2. After warnings are triggered, they appear at every patient visit until new physical examination or laboratory data that lie within the target zone are logged into Clicks. All of the software's prompts and warnings are linked to easily accessible help files that explain the prompt or warning and, when relevant, offer suggestions for improvement.

Another review function is the prompting for referral to a diabetes specialty clinic of patients who have type 1 diabetes mellitus; type 2 diabetes mellitus that requires insulin therapy; or hemoglobin A_{1c} levels, serum lipid levels, or blood pressure readings that remain outside the target range for longer than 12 months. In addition, a broad range of diabetes-specific standardized queries is included in the CPDC software package.

TABLE 1

Routine Diabetes Follow-up Tests Triggered by the Computer-Prompted Diabetes Care Software

TEST	FREQUENCY
Blood pressure measurement	Every 4 months
Hemoglobin A_{1C} level measurement	Every 6 months
Serum lipid profile	Yearly
Urine microalbumin–creatinine ratio measurement	Yearly
Serum creatinine clearance measurement	Yearly
Electrocardiography	Yearly
Ophthalmologic examination	Yearly
Comprehensive foot examination (with specific examination template)	Yearly

TABLE 2

Computer-Prompted Diabetes Care Review Variables, Outlier Values, and Prompts or Warnings*

VARIABLE	OUTLIER VALUE	PROMPT OR WARNING
Blood pressure, systolic	> 150 mm Hg	Hi BP, Hi Risk ASHD!![†]
Blood pressure, diastolic	> 85 mm Hg	Hi BP, Hi Risk ASHD!![†]
HgbA$_{1C}$ values	> 8%	Poor Diabetes Control!!
Total cholesterol levels	> 220 mg/dL	Dyslipidemia, Hi Risk ASHD!![†]
Triglyceride levels	> 200 mg/dL	Dyslipidemia, Hi Risk ASHD!![†]
High-density lipoprotein cholesterol levels	< 35 mg/dL	Dyslipidemia, Hi Risk ASHD!![†]
Low-density lipoprotein cholesterol levels	> 130 mg/dL	Dyslipidemia, Hi Risk ASHD!![†]
Urine microalbumin–creatinine ratio	> 0.03	Please Order 24 Hour Urine Microalbumin + Urine Culture
24-hour urine microalbumin levels	> 30 mg	Diabetic Nephropathy!! Consider ACE Inhibitor
Comprehensive foot examination	Abnormal pulse Abnormal sensation Deformity or wound	High Risk DM Foot!!

*ACE = angiotensin-converting enzyme; ASHD = arteriosclerotic heart disease; BP = blood pressure; DM = diabetes mellitus; Hgb = hemoglobin.
[†]Consider prescribing low-dose aspirin.

At present, the CPDC software is undergoing final stages of revision on the basis of the recommendations of a pilot group of physicians. During 1998, CPDC will be formally evaluated in a randomized, controlled trial of approximately 2000 patients and will be installed systemwide if it is found to be an effective and acceptable tool for enhancing the quality of diabetes care.

Costs

The CPDC software was developed relatively inexpensively by the Maccabi Health Care Services Medical Computing Group. The major cost of using the software involves ensuring that performance of periodic diagnostic testing meets recommended standards. Diminished long-term incidence of the chronic complications of diabetes will ideally reduce costs and far outweigh program costs. The software's true net financial impact will take several years to discern.

Evaluation

The CPDC software's impact on diabetes care during the 2-year randomized, controlled trial will be gauged by monitoring the following variables:

- Frequency of performance of recommended testing (Table 1)

- Laboratory values (Table 2)

- Hospitalizations, emergency department visits, and cardiac procedures

- Total systemwide health care expenditures per patient

- Patient satisfaction with care (evaluated by questionnaire)

- Primary physician level of comfort with treating diabetes (evaluated by questionnaire).

Recommendations to Others

Although it is logical to assume that highly specific real-time prompts should improve the quality of primary care, it is unknown whether an extensive system of on-screen messages will be acceptable to busy practicing physicians. Because the CPDC software is designed to reward compliant physicians for improved care by no longer displaying irrelevant on-screen prompts, acceptability may be higher. The number of prompts is initially high and potentially annoying; however, continued use of the software should bring most patients' laboratory measures into the desired range and keep real-time interruptions to a minimum. Although the CPDC software is customized to the Clicks platform, similar adaptations could be made to a variety of electronic medical records systems.

References

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