An Expert System for Performance-based Direct Delivery of Published Clinical Evidence

E. ANDREW BALAS, MD, PhD, ZONG RONG LI, MS, DONALD C. SPENCER, MD, FARAH JAFFREY, MSc, EDWARD BRENT, PhD, JOYCE A. MITCHELL, PhD

Abstract  Objective: To develop a system for clinical performance improvement through rule-based analysis of medical practice patterns and individualized distribution of published scientific evidence.

Methods: The Quality Feedback Expert System (QFES) was developed by applying a Level-5 expert system shell to generate clinical direct reports for performance improvement. The system comprises three data and knowledge bases: 1) a knowledge base of measurable clinical practice parameters; 2) a practice pattern database of provider-specific numbers of patients and clinical activities; and 3) a management rule base comprising “redline rules” that identify providers whose practice styles vary significantly. Clinical direct reports consist of a table of practice data highlighting individual utilization vs recommendation and selected pertinent statements from medical literature.

Results: The QFES supports integration of recommendations from several guidelines into a comprehensive and measurable quality improvement plan, analysis of actual practice patterns and comparison with accepted recommendations, and generation of a confidential individualized direct report to those who significantly deviate from clinical recommendations. The feasibility of the practice pattern analysis by the QFES was demonstrated in a sample of 182 urinary tract infection cases from a primary care clinic. In a set of clinical activities, four questions/procedures were associated with significant (p < 0.001) and unexplained variation.

Conclusion: The QFES provides a flexible tool for the implementation of clinical practice guidelines in diverse and changing clinical areas without the need for special program development. Preliminary studies indicate utility in the analysis of clinical practice variation and deviations. Using data obtained through a retrospective chart audit, the QFES was able to detect overutilization, and to identify nonrandom differences in practice patterns.


The limited and delayed impact of new scientific information on clinical practice patterns indicates an urgent need to find more effective information delivery methods. Wide variations in practice styles are signs of clinical uncertainty among care providers in making decisions. Physicians are inundated with clinical research findings, but have little means of abstracting and evaluating the practical value. Informing physicians about clinical practice patterns without comparing them with clinical practice recommendations offers only limited benefits. Peer-
comparing feedback report (profile) compares the performance of individual physicians with that of their colleagues. Several clinical trials have been conducted in an attempt to substantiate the effect of profiling, but many of them produced inconclusive results. A randomized clinical study measured the effect on colorectal cancer screening and showed nominal improvement. Another clinical trial evaluated the cost-savings effect of peer-comparison feedback but failed to document a significant change in the cost of prescribed drugs.

There are a variety of ways to define practice recommendations, but clinical practice guidelines are the most rapidly expanding sources of recommendations. Practice guidelines can be defined as syntheses of quality scientific evidence with expert opinion. Under different names, the publication of such consensus statements has been steadily growing. The Agency for Health Care Policy and Research uses the term "clinical practice guidelines." The American Diabetes Association calls its recommendations "standards of care." The American Medical Association publishes a directory of consensus statements on clinical practice recommendations and calls them "practice parameters."

In spite of the increasing number of published clinical practice recommendations, several studies have documented their limited effect on actual practice patterns. Apparently, there is a need for better understanding of the channels of communication within the medical profession, and the impact of information on clinical practice. Scientific journals, which are currently the dominant communication channels in medicine, represent the mass-media-type approach to the dissemination of clinical research results. To overcome the limitations of mass-media communication, direct mail is a frequently recommended alternative.

Direct mail is a personalized report tailored to the needs of the individual providing summarized messages from several sources. The intention of direct mail is to heighten awareness and encourage a beneficial response. Unlike mass media, direct mail enables the sender to get the attention of recipients through timely mailing. Through improved targeting, direct mail does seem to generate a higher response rate. Experts recommend that the most important benefits, endorsed by substantiating evidence, should be emphasized. Each direct mail should also call for an action the mailer wants the recipient to take. Of the commercial direct mail to physicians that is opened, 59.5% of the time it is opened by physicians themselves, and 25.7% of the time it is opened by staff members. The same study showed that among physicians who are exposed to a piece of direct mail, 91.6% read the piece. A national study indicated that direct mailing is the preferred source of health care information. An intervention study by Sadowsky and Kunzel demonstrated that the use of direct mailing for distributing recommendations by the American Heart Association was an effective intervention in improving scientific knowledge of clinicians.

The purpose of this project was to support clinical performance improvement through the application of the direct mail and performance improvement concepts. Presentations of specific measurable objectives and actual clinical practice data have the potential to control practice variations, reduce medical costs, and improve patient outcomes. The specific aims were to support the implementation of a wide range of clinical practice guidelines and improve patient care by informing physicians about clinical practice patterns and pertinent published recommendations. The objectives of this development and research project also included feasibility testing in a clinical area, i.e., analysis of primary care practice patterns in the management of urinary tract infections.

Quality Feedback Expert System

In this project, a direct clinical report was defined as a confidential summary of clinical practice data and pertinent statements from research reports. It is prepared for those practitioners whose practice data indicate substantial deviations from the guidelines. Figure 1 is a schematic representation of the entire performance improvement system, which transfers clinical practice data and pertinent evidence from the clinical literature to the individual providers. The Quality Feedback Expert System (QFES) development was based on a Level-5 expert system shell that provided a flexible toolkit (Information Builders, Inc. New York, NY).

Data and Knowledge Bases

Figure 2 is the main menu of the system, which also represents the key steps of defining, measuring, and disseminating clinical practice parameters. The system consists of various data and knowledge bases that can be revised and updated by the user as needed.

Quality Parameter Knowledge Base

This knowledge base stores a series of measurable clinical practice recommendations called parameters, with substantiating evidence for each recommenda-
Each parameter is defined by a brief description of the recommended clinical procedure (critical action), the condition making a population of patients eligible for the particular procedure, and a numeric target for the utilization rate of the procedure among eligible patients. Instead of focusing on issues of "accuracy" in clinical decision making, the quality parameters specify utilization targets that have been substantiated by documented benefits on outcome (health status) and also recommended by panels of experts.

As an example, Figure 3 shows the practice parameter for foot examinations, an important quality parameter for the management of diabetes. The screen displays a brief description of the parameter, procedure, condition, and target utilization as recommended by the American Diabetes Association. Evidence from pertinent literature, accessed by clicking on one of the boxes for the five categories of evidence, is displayed in a smaller window. This particular screen shows a direct quotation from the clinical practice guideline of the American Diabetes Association.

Clinical practice parameters can be identified through a systematic process. First, critical procedures are identified, which are recommended by clinical practice guidelines and have a demonstrated effect on the outcome of care. In other words, the overlap between the results of randomized controlled clinical trials and clinical practice guidelines is identified. Subsequently, descriptions of the identified critical pro-
cerebrospinal fluid (CSF) and the corresponding condition that makes the patient eligible for the procedure are abstracted. Afterwards, a target ratio (the recommended number of procedures divided by the number of eligible patients) of utilization is specified. The last step is the collection and abstraction of published evidence supporting the defined quality objective (e.g., meta-analysis or randomized controlled trial, clinical practice guideline, non-randomized clinical studies, cost-benefit analyses, epidemiologic studies).

**Practice Pattern Database**

This database stores data describing the utilization of specific clinical procedures in various groups of patients. The Practice Pattern Database provides information for the statistical analysis of patient care decisions by the participating physicians in the particular health care organization during the given period of time. The information enables the QFES to compare expected and actual procedure utilization rates for each physician and identify variations in clinical practice patterns. Ideally, performance improvement relies on the database of management information system (MIS), particularly computerized medical records. However, there is frequently a need to collect additional information from the patient charts.

In this database, practice information is organized into five fields: 1) name of physicians who participate in the quality improvement program; 2) patient groups categorized by the similar severities of their diseases; 3) number of patients in each patient group who were eligible for the particular clinical procedure; 4) name of the analyzed clinical procedures; and 5) number of clinical procedures administered or ordered by each physician for the particular group of patients.

**Management Rule Base**

The management rules base consists of specific redline rules to identify those physicians who should be targeted by a direct clinical report. Figure 4 is the corresponding screen of adjustable redline rules. The user can select an appropriate rule that can identify significant deviation based on: 1) a given utilization percentage; 2) standard deviation from a group average; 3) highest or lowest rank among the providers; 4) an absolute number of procedures in an analyzed period; or 5) number of procedures above or below expectation. The numeric threshold values can also be adjusted by the user. Having chosen a specific utilization rule, the user can select “Calculate” to display the number of physicians who would be identified by the selected rule criteria. If the user

---

**Figure 3** The screen for editing clinical quality parameters. Clicking on a selected evidence opens a smaller window for entry and modification. QFES = Quality Feedback Expert System; RCT = randomized controlled trial.
selects "Approve," the system puts a mark to the name of those physicians who meet the specified criteria and will be targeted by a direct report.

**Quality Improvement Cycle**

The QFES supports each major step of the classic quality improvement cycle and the user of the expert system is guided through a sequence of screens. The left side of the main menu displays the suggested sequence of steps toward quality improvement (Fig. 2).

**Quality Improvement Plan**

The first step is to generate a quality improvement plan for the particular health organization. The Practice Parameters knowledge base is the resource of parameters that can be selected and copied into the quality improvement plan by the user of the system. Copy, Edit, and Remove buttons are on display enabling the user to adjust and modify the plan as needed. The specified quality improvement plan can be printed in an abbreviated format to assist the collection of necessary practice data. In addition, each parameter can be printed in full with the complete list of supportive scientific evidence.

**Collection of Practice Data**

The next step is to obtain the necessary input data for the comparison of recommended targets and actual utilization of procedures by individual physicians. In this step, the user can identify the source data file and examine the list of participating physicians and frequency of procedures for each patient group. If needed, practice data can be added or corrected. A key step of the collection of practice data is the Adjust function. Pressing the Adjust button ensures that the system keeps in the quality improvement plan only those parameters which are supported by actual practice data.

To secure adequate data input and efficient use of reports, the QFES project went beyond software development and also included a redesign of the surrounding processes. Based on the specification of the quality parameter, collection of practice data requires 1) identification of patients having the particular medical condition and 2) counting of the number of procedures in that particular patient group. While computerized database searches should be preferred, manual chart reviews are often unavoidable. In some cases, computerized searches can be used as initial screening and subsequently supplemented with manual searches. For example, a computerized search can identify diabetic patients and a subsequent manual search can identify those who did not have eye examinations during the previous year. The information needs are greatly simplified when several recommendations apply to the same group of patients (e.g., adult diabetic patients).

**Group Analysis of Practice Data**

The supported analyses include ranking providers based on utilization measures and identification of those providers who need to receive a direct clinical report. There are two steps in the group analysis of practice data. The group analysis display includes two tables of data for the first step of group analysis. The first table provides an overall statistical analysis for all participating providers within the specified organization (target utilization, average utilization in the physician group, standard deviation). The second table shows utilization measures of individual physicians, ranked in descending order. There are two types of utilization measures: one expresses actual utilization, e.g., number of procedures; the other expresses an expectation or the discrepancy between expected and actual utilization rates. Expected utilization estimates what other physicians would do with the patients of the analyzed physician.

The use of the following nine utilization measures is supported by the QFES: raw number of procedures (number of procedures ordered or administered by a selected provider); adjusted number of procedures (expected number of procedures based on the case-mix of the selected providers and assuming the average practice pattern of the entire provider group); relative number of procedures (difference between raw and adjusted numbers); raw utilization (raw number of procedures/number of eligible cases); adjusted utilization (adjusted number of procedures/number of eligible cases); relative utilization (difference between raw and adjusted utilization rates); raw expenditure (raw number of procedures multiplied by the cost of the procedure); adjusted expenditure (adjusted number of procedures multiplied by the cost of the procedure); and relative expenditure (difference between raw and adjusted expenditures).

Figure 4 demonstrates the second critical step of group analysis, i.e., the rule-based screening of practice patterns. The "redline rules" represent a list of criteria that can be used in the detection of significant discrepancies between recommendations and practice patterns. Like all practice pattern analyses, the application of redline rules depends on the accuracy of available patient care documentation. However, the example of annual diabetic eye examinations can illustrate that not only missing procedures but also undocumented procedures are quality concerns.
Specification of Redline Rules

<table>
<thead>
<tr>
<th>Parameter: FOOT EXAMINATION</th>
<th>Target: From 80 To 100</th>
</tr>
</thead>
</table>

Redline Values:
- Calculate
- From the analyzed group of 22 providers will receive reports based on this rule.
- Approve
- Main Menu

Feedback letter needs to be generated for providers with a utilization:
- Lower than 80 percent
- Higher than 100 percent
- Below the group average by 1 standard deviation
- Above the group average by 1 standard deviation
- Ranking among the top 10 providers
- Ranking among the lowest 10 providers
- Generating 10 or more procedures in the analyzed period
- Generating 10 or fewer procedures in the analyzed period
- Resulting in at least 5 procedures above expectation
- Resulting in at least 5 procedures below expectation

Figure 4 Redline rules for the identification of outlier performance.

Generation of Direct Clinical Reports

The final step is the generation of confidential direct clinical reports to individual physicians (Fig. 5). The reports are combinations of numeric (tabular) and textual information. These reports inform care providers about those clinical procedures that showed utilization deviating from the established recommendations. Each direct clinical report consists of a table of practice data and quotations from pertinent publications. The table compares utilization rates of provider groups, the utilization rate of the particular provider, and the recommended range. Quotations selected from the scientific literature substantiate the outcomes and significance of the recommended clinical procedure. Direct quotes from five categories of scientific evidence can be shown to support the recommended utilization rates: 1) a randomized controlled clinical trial or meta-analysis; 2) a clinical practice guideline; 3) a non-randomized study; 4) a cost-effectiveness study; and 5) an epidemiologic study documenting the magnitude of the problem. Figure 5 shows a personalized direct report of the clinical utilization rates of annual eye examinations for diabetic retinopathy (the names have been falsified). The presented performance measure of diabetic eye examination is also a Health Plan Employer Data and Information Set (HEDIS) indicator.

Example of Practice Pattern Analysis

Urinary tract infection (UTI) frequently manifests as readily apparent clinical symptoms but is often difficult to treat. Anecdotal evidence indicates significant practice variation in both the diagnosis and treatment of these infections. The treatment of UTIs accounts for more than seven million physician visits annually. Various forms of a UTI may be detected on the basis of the presenting symptoms, signs, urine culture, and urinalysis findings. The episodes are often recurrent, indicating not only a quality concern but also a financial concern because of the costs associated with different practice styles. There needs to be a better understanding and management of variations in primary care with commonly occurring clinical problems, such as UTIs. A clinical study was conducted to analyze the feasibility of the practice pattern analysis method used by the QFES and to evaluate variations in the treatment of urinary tract infections.

The site of the study was the Callaway Physicians, a nonprofit family practice center providing fee-for-service care in Fulton, Missouri. At the time of the study, 12 resident physicians and four faculty physicians of the University of Missouri-Columbia Department of Family and Community Medicine were
practicing at the office. The annual patient encounters for the office were 16,057 visits. The facility uses the computer program COSTAR (COMputer STored Ambulatory Record, a registered trademark of the Massachusetts General Hospital) to document outpatient visits.

The sample of the study consisted of patients who were diagnosed as having cystitis, pyelonephritis, or a UTI during a six-month period. The diagnoses of the patients were identified by using the COSTAR database. A retrospective chart review was performed by using a baseline form for each new UTI episode, and an encounter form for each subsequent contact with the physician's office by visit or telephone regarding the UTI. Table 1 provides an overview of the patient sample and characteristics of the physicians treating these patients. The site of the first visit, when the patient was first identified as having one of the three diagnoses, was determined for each patient. The physicians' notes and laboratory tests were used to answer questions regarding the

XXX Health Plan Confidential Information

Dr. James

DIRECT REPORT ON CLINICAL RECOMMENDATIONS

The following report is a summary of research evidence related to the comparison of your practice patterns with established recommendations. Practice data were analyzed from the period 12/12/90 to 12/31/91.

Annual Diabetic Eye Exam:

<table>
<thead>
<tr>
<th>Utilization (%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>80-100%</td>
</tr>
<tr>
<td>Group Average</td>
<td>68 +/- 12%</td>
</tr>
<tr>
<td>Your Practice</td>
<td>22%</td>
</tr>
</tbody>
</table>

Published evidence substantiating the practice recommendation

A. Randomized controlled clinical trial

"In this randomized clinical trial,...,754 eyes that had macular edema and mild to moderate diabetic retinopathy were randomly assigned to focal argon laser photoocoagulation, while 1,490 such eyes were randomly assigned to deferral of photoocoagulation...Eyes assigned to immediate photoocoagulation were about half as likely to lose 15 or more letters on the Early Treatment Diabetic Retinopathy Study eye chart compared with eyes assigned to deferral of photoocoagulation: 5% vs 8% at one year, 7% vs 16% at two years, and 12% vs 24% at three years.....A loss of 15 letters is equivalent to a three-line visual acuity decrease on this chart or a doubling of the initial visual angle (e.g., 20/20 to 20/40 or 20/100 to 20/200)."


B. Recommendation by a panel of experts

"Comprehensive dilated eye and visual examinations should be performed annually by an eye doctor for all patients age 12 and over who have had diabetes for 5 years, all patients over the age of 30, and any patient with visual symptoms and/or abnormalities...Established diabetic......"
details of the physical examination, diagnostic testing, treatments, and referrals.

The chart review was conducted by two research assistants who received a few hours of training (data items, filing system) and initial feedback on inconsistencies and missing data. Following the training period, the computer generated a list of eligible encounters, which was used to retrieve charts for review. Between 5 to 10 minutes per chart were needed to identify the data used in this study. After entering the required practice data in the necessary spreadsheet file, the QFES analyses and production of reports required less than an hour for a group of 30 providers.

Deviation from expectations is an important issue in managing clinical practice patterns, and QFES supports such provider-specific analyses, which assume the existence of “gold standards.” In cases of sufficient sample size, deviation of actual utilization from expected utilization can be tested through comparison of the two corresponding probabilities (e.g., Fisher’s exact test). In the analyses of this study, patient data of the UTI practice pattern database were clustered into severity groups based on the grouping of the clinical practice recommendations for the management of UTI. Of the 22 providers, seven physicians examined five or more UTI patients. Table 2 shows the difference between actual and expected utilization rates for selected providers and selected procedures. A negative result indicated clinical utilization below expectation, whereas positive values indicated excessive procedure utilization. Based on these calculations, three physicians showed substantially less frequent use of questions for nausea, dysuria, vaginal discharge, and body temperature. One provider had only nominal differences between the actual and expected numbers of procedures performed.

Variation in utilization, another important quality concern, can be recognized without having a gold standard, and the QFES provides data for such group-based evaluations. In this study, the statistical analysis focused on variations of utilization to detect significant (nonrandom) differences within each group of physicians, and also between groups (residents and attending physicians). In the group-based analysis of this study, chi-square test was used to test the homogeneity of utilization rates. Each clinical activity, procedure, or question was evaluated in a separate chi-square test of homogeneity and, therefore, the usual $p = 0.05$ level of significance was reduced.

<table>
<thead>
<tr>
<th>Questions</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea/vomiting</td>
<td>2</td>
<td>-5</td>
<td>3</td>
<td>-4</td>
<td>2</td>
<td>-7</td>
<td>3</td>
</tr>
<tr>
<td>Incontinence</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>-2</td>
<td>-1</td>
<td>-3</td>
<td>1</td>
</tr>
<tr>
<td>Burning (dysuria)</td>
<td>1</td>
<td>-2</td>
<td>1</td>
<td>-2</td>
<td>2</td>
<td>-6</td>
<td>1</td>
</tr>
<tr>
<td>Blood in urine (hematuria)</td>
<td>-1</td>
<td>-4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>-3</td>
<td>3</td>
</tr>
<tr>
<td>Pregnant</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>0</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>Vaginal discharge</td>
<td>1</td>
<td>-2</td>
<td>1</td>
<td>-4</td>
<td>-1</td>
<td>-2</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actions</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature taken</td>
<td>0</td>
<td>-3</td>
<td>2</td>
<td>-4</td>
<td>1</td>
<td>-6</td>
<td>3</td>
</tr>
<tr>
<td>Urinalysis</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-5</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Urine culture</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>-3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>0</td>
<td>-2</td>
<td>1</td>
<td>-1</td>
<td>0</td>
<td>-2</td>
<td>1</td>
</tr>
</tbody>
</table>

| Number of cases         | 5  | 20 | 5  | 19 | 7  | 23 | 6  |
by Bonferroni adjustment. Even after such adjustment, several clinical activities, questions, and procedures showed significant variation. Significant differences were detected among providers when questioning about nausea \((p = 0.00000)\), incontinence \((p = 0.00028)\), dysuria \((p = 0.00129)\), hematuria \((p = 0.00031)\), and vaginal discharge \((p = 0.00094)\). Variations were also prominent among providers for performance of urinalysis \((p = 0.00878)\), temperature measurement \((p = 0.00037)\), urine culture \((p = 0.00104)\), and hospitalization \((p = 0.00202)\).

**Discussion**

The QFES is a flexible tool available for clinical performance analysis and individualized delivery of published scientific evidence. With the rapid growth of clinical practice recommendations and experimental evidence, a need is emerging to manage and channel this information to those physicians who need it for the improvement of clinical practice patterns. The application of expert system technology provides flexibility in the analyses of individual practice styles as well as the potential for influencing those practice styles through direct mailing. The QFES does not require expensive program development for the implementation of new practice guidelines. New parameters can easily be entered by the user, the designated person organizing quality improvement efforts in the provider group. The QFES generates feedback, a widely recommended intervention for quality improvement programs. The analysis of practice patterns in the management of UTIs documented the ability of the QFES to detect and report significant practice variation.

Access to clinical practice data represents a major challenge for guideline implementation and health care quality improvement. The manual data gathering is often much simpler than assumed, but adequate computer support remains the preferred alternative. In our set of 19 parameters, eight parameters can be analyzed in the same group of patients defined by four eligibility criteria. On the other hand, most guideline recommendations require detailed data far beyond the present granularity of computerized patient care databases. For example, symptoms are frequently used in guidelines, while such information is rarely available in coded format. In addition, many database query methods have difficulty in identifying events over time (e.g., annual eye examinations of diabetic patients). The fact that manual chart reviews still represent a major tool of health care quality monitoring indicates the inadequacy of many computer systems in the analysis of practice patterns. Computer systems of patients care have to support not only one-on-one patient care but also cumulative analyses of quality, a substantially different task.

In searching for the most effective ways to influence clinical practice patterns, reminder and feedback type information interventions are frequently compared. Reminders (prompts, alerts) arrive at the time of decision making to trigger the action of the targeted person. Feedback is based on past performance data and aims to influence future decision making. Reminders are widely recognized as very effective interventions. However, reminders are often expensive (require online access), are not flexible (substantial program development is needed for new clinical parameters), and can be redundant (e.g., reminding regardless of the performance of individual physicians). On the other hand, the effect of feedback is likely to be smaller due to the loose relationship with actual decisions. However, the method of feedback has several advantageous features: focus of reports can be shifted easily based on the latest quality improvement needs, and only those providers need to be contacted who have performance problems in particular areas.

The clinical guideline knowledge base is an important resource of the QFES, and the development of practice parameters is in progress. Presently, a total of 19 clinical practice parameters, including substantiating evidence, are available for three primary care subject matters (preventive care, asthma, and diabetes). The indicators are: mammography, cholesterol screening, monitoring the immune status of HIV patients, hypertension screening, Pap testing, ambulatory follow-up after hospitalization for major affective disorder, asthma education, peak expiratory flow rate, management of exacerbation, diabetes eye examination, foot examination, glycylated hemoglobin, serum lipids, proteinuria, blood pressure, education, height and weight, referral to dietician, and fasting plasma glucose. The development of clinical practice parameters involved four steps: 1) identification of the recommendation, which took about an hour per parameter; 2) retrieval of substantiating evidence through literature searches, taking a few hours per parameter; 3) review of the parameters by clinicians in a short meeting; and 4) data entry, requiring about 15-20 minutes per parameter. The University of Missouri and Humana Health Care Plans are currently conducting a clinical trial measuring the difference made by the direct clinical reports of the QFES on practice patterns.
References


