



Performance Improvement

Improving the Translation of Research into Primary Care Practice: Results of a National Quality Improvement Demonstration Project

Steven Ornstein, M.D.; Paul J. Nietert, Ph.D.; Ruth G. Jenkins, Ph.D.; Andrea M. Wessell, Pharm.D., B.C.P.S., C.D.E.; Lynne S. Nemeth, Ph.D., R.N.; Heather L. Rose, M.D.

Inadequate translation of research findings into improved quality of health care in the United States has been widely documented¹ and is commonly termed a *quality chasm*.² In response to this deficiency, in May 2002 the Agency for Healthcare Research and Quality (AHRQ) released a request for applications for a new “Partnerships for Quality” initiative. The purpose of the Partnerships initiative was to support models of change led by organizations or groups with the immediate capacity to influence the organization and delivery of health care, as well as to measure and evaluate the impact of their improvement efforts. The Practice Partner Research Network (PPRNet), a practice-based primary care research network among users of a specific electronic medical record (EMR), was one of the 22 organizations awarded a grant in the Partnership program, which addressed a broad spectrum of quality issues among a variety of health care delivery systems.³

The PPRNet project evaluated the impact of a multicomponent intervention identified on the basis of the existing literature⁴ and improvement models. The intervention was intended to enhance adherence with clinical practice guidelines for a broad spectrum of conditions—cardiovascular disease, diabetes mellitus, cancer screening, adult immunizations, respiratory/infectious disease, mental health/substance abuse, obesity/nutrition, and safe medication prescribing in the elderly—and preventive services recommendations most relevant for primary care practices across the United States and most likely to achieve the AHRQ goal of improving the quality of care of patients “numbering in the hundreds of millions.”

This report presents the primary study outcomes—the impact of the intervention on changes over time in adherence with the clinical practice guidelines. Previous articles have described theoretical foundation of the study methods,⁵ specific improvement strategies adopted by participating practices,⁶ initial findings concerning diabetes care,⁷ and achievable benchmarks of performance across the study indicators.⁸

Article-at-a-Glance

Background: There is widespread evidence of inadequate translation of research findings into primary care practice. Theoretically sound demonstrations of how health care organizations can overcome these deficiencies are needed. A demonstration project was conducted from January 1, 2003, through June 30, 2006, to evaluate the impact of a multicomponent intervention and improvement models intended to enhance adherence to clinical practice guidelines across eight broad clinical areas.

Methods: The demonstration project involving 530 clinicians and staff members from 99 primary practices in 36 states entailed practice performance reports (audit and feedback), practice site visits for academic detailing and participatory planning, and network meetings for sharing of “best practice” approaches. Data from electronic medical records (EMRs) of 847,073 patients were abstracted to identify 31 process and 5 outcome quality measures for prevention and treatment of cardiovascular disease and diabetes, cancer screening, adult immunization, respiratory and infectious disease, mental health and substance abuse, obesity and nutrition, safe medication prescribing in the elderly, and a summary measure, the Summary Quality Index (SQUID™).

Results: The yearly adjusted absolute improvement in the SQUID™ was 2.43% (95% confidence interval [C.I.], 2.24%–2.63%). Clinically and statistically significant improvements occurred for 29 of the 36 quality measures, including all 5 outcome measures.

Discussion: The findings suggest that a multicomponent quality improvement intervention involving audit and feedback, academic detailing and participatory planning activities, and sharing of “best practice” approaches in practices with EMRs can have a robust impact in quality of care for Americans seen in primary care practices.



Methods

RESEARCH DESIGN

The study, a four-year demonstration project, "Accelerating the Translation of Research into Practice (A-TRIP)," was approved by the Institutional Review Board at the Medical University of South Carolina. The project involved three specific interventions: practice performance reports (audit and feedback), practice site visits, and network meetings. All participating practices received performance reports; participation in practice site visits and network meetings was optional. Each intervention, individually and through synergies between them, was designed to help practices adopt a quality improvement (QI) model (PPRNet-QI), shown in previous work to improve the translation of cardiovascular disease guidelines into primary care.⁹ PPRNet-QI has five components: prioritizing performance, involving all staff, redesigning delivery systems, activating patients, and using EMR tools to a greater extent.¹⁰ Although each PPRNet practice has a full EMR, it was our experience from previous research that there is great variation in use of its features—for example, note templates to guide the process of care, health maintenance reminders, patient education tools—among practices. PPRNet-QI is similar to other primary care improvement models.¹¹

PRACTICE RECRUITMENT

Practices were recruited for the study from October 1, 2002, through September 30, 2005. All practices using a specific commercially available EMR whose clinicians were predominantly family physicians or general internists were eligible to join PPRNet and participate in the project. They were recruited using several approaches: e-mail, presentations at EMR user group meetings, and personal contacts. Practices that contributed EMR data for at least one consecutive calendar year were included in the analyses.

QUALITY MEASURES

The 36 study quality measures represent a broad cross-section of primary care, including screening and management for cardiovascular disease,¹²⁻¹⁶ diabetes mellitus,¹⁷ cancer screening,^{18,19} adult immunizations,²⁰⁻²³ respiratory²⁴ and infectious disease,^{25,26} mental health²⁷ and substance abuse,^{28,29} obesity and nutrition,³⁰ and safe pharmacotherapy in the elderly.³¹ Thirty-one of the measures reflect the following clinical processes:

- Whether clinical parameters were assessed and screening tests performed within appropriate intervals

- Medications prescribed if indicated and avoided when not indicated

- Indicated immunizations administered
- Recommended counseling performed
- Relevant diagnoses made

Five of the measures reflect clinical outcomes, that is, whether a recommended therapeutic target was achieved. There is substantial overlap between the quality measures in this study and those included in the recommended starter set for ambulatory clinical performance measures,³² although those included in this study cover a broader range of clinical areas.

AUDIT AND FEEDBACK

Each quarter, beginning April 1, 2003, PPRNet staff sent participating practices practice-level performance reports for all A-TRIP indicators. To determine performance, participating practices ran a computer program to extract patient activity during the previous quarter from their EMRs. To protect patient confidentiality, the extract program assigned a unique, anonymous numerical identifier to each patient. The extract program obtained demographic information such as age, race, and gender, and diagnoses, medications, laboratory data, and vital signs. Text of progress notes, consultation reports, and discharge summaries were not extracted.

The data were sent electronically via a secure server through the EMR vendor to PPRNet. In the PPRNet offices, project investigators combined quarterly data with previous data to construct a longitudinal record for each patient. Standard data dictionaries were applied to the raw data, and SAS (Statistical Analysis System, Cary, North Carolina) was used for data set maintenance and report preparation. The reports showed, for each measure, a practice's 24-month historical performance, current performance, the median performance of all PPRNet practices, the PPRNet benchmark, and, when available, national benchmarks. Reports used statistical process control techniques to help practices assess time trends. Depending on the specific measure, a practice might have anywhere from thousands of eligible patients (for example, blood pressure measurement in all adults) to just a few (hepatitis A vaccine in patients with chronic liver disease.)

PPRNet benchmarks were based on Achievable Benchmarks of Care (ABC).^{33,34} ABCs roughly correspond to the 90th percentile among all practices; however, they are not unduly influenced by practices with relatively small numbers of patients that might bias 90th percentiles upward. PPRNet staff mailed printed practice-level reports and electronically posted each report on a secure Web site for practices to access. Beginning in October 2004, patient-level reports (registries) were also provided on the secure Web site. These reports included search



tools that could identify patients who were not current with process indicators or who were not at clinical targets for outcome measures. Because the PPRNet reports do not include patient identifiers, practices were also provided with an EMR-based utility that they could use to identify specific patients.

PRACTICE SITE VISITS

Beginning in October 2003, interested practices hosted half-day practice site visits by one or more members of the research team. One site visitor was either a physician [S.O.] or clinical pharmacist [A.W.] with expertise in clinical care, academic detailing,³⁵ and the use of the EMR. At some site visits to larger practices, a second visitor included a nurse [L.N.] who is a QI expert. Practices were asked to have all members participate in the site visit, including providers, nurses, medical assistants, receptionists, and administrative personnel. Because of vacation or hospital coverage responsibilities, some providers were occasionally absent in the multiprovider practices, and some practices only involved a few members of their staff. At the initial site visit, a detailed introduction to the project, rationale for QI in primary care, and the PPRNet-QI model were introduced. The site visitors then reviewed the practice's most recent performance report and worked with practice members to identify indicators they wished to target for improvement, considering specific aspects of the PPRNet-QI model they wanted to adopt to affect improvement. Subsequent half-day site visits were held approximately every six months.

Most of the visits were conducted in person, although some were held using Internet-based conferencing tools. At each visit, brief project updates and academic detailing regarding new evidence on the quality indicators measured within the project were provided, but the majority of the visit was dedicated to participatory planning activities. These activities included review of the most recent practice report, highlighting successful improvements and opportunities for future improvement. The planning session also involved practice members identifying specific clinical indicators they wished to work on and improvement activities to conduct before the next site visit.

NETWORK MEETINGS

The network meetings, held in July 2003 through 2005, were intended to promote rapid diffusion of successful techniques as the different sites shared ideas. Network members who had been particularly successful in implementing the PPRNet-QI model and improving their performance on practice reports made "best practice" presentations—and were presented with certificates recognizing the achievements in their

practices. In addition, participants with similar roles in their practices (for example, clinicians, nurses, office staff) met together in small groups to exchange useful approaches.

SETTING/PARTICIPANTS

Study Practices. Practices included in this report are those that sent complete diagnostic, laboratory, and vital sign data for at least 12 months between January 1, 2003, and June 30, 2006.

Study Patients. The analyses for this report are for all active patients—that is, those with progress notes associated with at least one office visit in the EMR within the previous 12 months.

PERFORMANCE MEASUREMENTS

All outcomes used in the analyses were evaluated on a monthly basis and were expressed at the level of the practice. Thus, for a given practice, 36 proportions were calculated each month corresponding to the 36 study indicators. For each study indicator, the proportion corresponded to the percentage of patients in that practice who had met that study indicator's recommended target.

In addition to the individual specific study indicator outcomes, to assess the practices' overall quality, a summary measure was constructed for each practice each month. This summary measure—practice-level SQUID™ (Summary Quality InDex),³⁶ reflected the average percentage of eligible targets met by patients in that practice. Because higher numbers of eligible targets among practices' patients correspond to higher levels of complexity among patients (for example, older patients, patients with more comorbidities), the average number of eligible targets among practices' patients is referred to as the *complexity score* and was used as a covariate in the statistical models. For individual adult patients in this study, the complexity score has a theoretical range of 6 to 36, although at the end of the study (June 30, 2006) the mean (standard deviation) for all adult patients was 10.6 (4.9), ranging from 6 to 32.

STATISTICAL ANALYSES

For the SQUID and each of the individual quality measures, we used general linear mixed regression models to determine whether there were significant improvements over time. Because not all A-TRIP practices were enrolled into the study at the same time, all observations included in the analyses included a term representing the duration of A-TRIP intervention exposure. A-TRIP exposure time was defined for practices as the number of months since the practice received its first A-TRIP report. Observations from practices before their involve-



ment with A-TRIP were excluded from the analyses.

Separate general linear mixed models were constructed for each quality indicator (that is, dependent variable) of interest. In these models, the units of observation were practice-month specific, with the dependent variables being the estimates of practices' quality indicators, and the key independent variable of interest being A-TRIP exposure time (that is, months since A-TRIP initiation). Practice-level covariates included the average age of the practice's adult population and the practice's average patient complexity score. The models included random practice effects with an autoregressive (Type I) error structure to account for the intraclass correlation among individual practices' repeated measurements over the 42-month study period. Statistical analyses were performed with SAS v9.1 Proc Mixed, which allowed us to estimate the adjusted average yearly improvement in the SQUID and individual quality measures across practices and to test whether these estimates differed significantly from zero. All tests were two-tailed, and statistical significance was defined as $p < .05$. Because all hypotheses being tested were *a priori* ones, there was no statistical adjustment for multiple comparisons.

PROCESS EVALUATION

Participant surveys, visitor observations at practice site visits, site visit evaluation notes, presentation materials at network meetings, and selected participant interviews were used to assess the specific processes by which practices endeavored to improve their clinical performance. A final Internet-based project evaluation survey was conducted in June 2006. One clinician and one practice staff member from each practice were asked to complete the survey. The process evaluation was guided by the PPRNet-TRIP theoretical framework.¹⁰

Results

PARTICIPATING PRACTICES AND PATIENTS

One hundred twenty-five practices participated in the project at some time from January 1, 2003, through June 30, 2006. These practices represent approximately one quarter to one third of all primary care practices using the EMR at that time.

Twenty-six practices were excluded from the analyses—24 joined the project during the last year and did not have at least 12 months of data for analyses, 1 dropped out early in the study before participating for 12 months, and 1 stopped recording laboratory data in its EMR. The remaining 99 represent 36 states, and among these practices, there were a total of 847,073 patients active during the study time frame. Practice and patient characteristics are summarized in Table 1 (page 383).

PARTICIPATION IN PROJECT ACTIVITIES

During their participation in the project, which ranged from 12 to 42 months (Table 1), these 99 practices received a total of 1,024 quarterly practice reports (mean, 10.3 reports per practice). One hundred ninety-seven site visits were conducted during the study period at 64 of the 99 practices (range, 1–5 site visits per practice). Members from 22 practices participated in the 2003 network meeting, and members from 33 practices participated in each of the 2004 and 2005 meetings. Fifty-nine practices sent representatives to at least 1 network meeting.

CHANGES IN PERFORMANCE FOR STUDY QUALITY MEASURES

The baseline SQUID among the 99 practices was 33.67%. The yearly adjusted absolute improvement was 2.43% (95% confidence interval [C.I.], 2.24%–2.63%). Table 2 (pages 384–386) presents baseline performance and average absolute annual improvements for each of the 36 study quality measures. At baseline, a wide range in performance was present, ranging from no documented counseling of patients with alcohol disorders to very high avoidance of contraindicated medications in the elderly. Statistically significant improvements in care occurred for 24 of the 31 process measures and all 5 outcome measures. A statistically significant decline in care was observed only in the use of antidepressant medication for those with a diagnosis of depression.

MEDIATORS OF IMPROVEMENT

Evaluations of the performance reports revealed that approximately 80% of practices were using their reports to guide improvement efforts and monitor the effect of these efforts.

Evaluations of the practice site visits suggested that they had several salient benefits, including providing a forum to learn more about clinical practice guidelines, motivating clinicians and staff, developing a consensus about improvement activities, improving intrapractice communication, and better understanding their practice performance reports and the impact of their improvement activities.

Network meeting evaluations were also favorable, with specific benefits identified including providing motivation, sharing successful improvement approaches, and learning how to better lead improvement activities in their practices. A prominent theme expressed was the wish that more members of their practice could have attended the meetings.

The specific improvement strategies employed by participating practices have been described in detail elsewhere.⁶

In brief, these strategies included elements in each compo-



ment of the PPRNet-QI model: prioritizing performance, involving all staff, redesigning delivery systems, activating patients, and using EMR tools to a greater extent. Strategies adopted by at least two thirds of practices included the following:

- Involving staff members in the development of QI approaches
- Limiting efforts to three initiatives per quarter to allow focus
- Allowing scheduling at least three months in advance to facilitate chronic disease follow-up
- Reminding patients of upcoming appointments or other services needed
- Limiting medication refills when appointments were needed
- Scheduling laboratory tests for chronic disease measures before office visits or using point-of-care laboratory instruments to allow therapeutic changes to be made at the time of visits
- Staff review of medication lists and overdue health maintenance items with patients
- Standing orders for staff to provide needed immunizations or laboratory monitoring
- Use of EMR-based lab and health maintenance tables and note templates to guide care processes

Two case studies are provided to illustrate best practices in a smaller and a larger family practice (Sidebar, pages 388–389).

A few practices expressed skepticism about the project, including uncertainty about the validity of their performance reports related to their inability to properly record data in their EMR because of inadequate training, lack of time for improvement activities, or even lack of understanding that they were participating in the project. Overall, however, 82% of respondents to the final project survey indicated that they felt the project benefits outweighed any drawbacks, 13% were neutral, and only 5% thought that the drawbacks outweighed the benefits.

Discussion

Previous reports of successful large-scale QI interventions have come from large organizations such as the Veterans Affairs health care system.³⁷ The findings presented in this report suggest that independent primary care practices participating in a QI project involving performance reports and optional practice site visits and annual network meetings can also improve their performance on a broad spectrum of clinical quality indicators.

There are several likely explanations for the enthusiasm participants had for the project and the clinical improvements

Table 1. Characteristics of A-TRIP Practices (N = 99) and Patients (N = 847,073)*

Practice Characteristics	Statistics
<i>Specialty</i>	
Family practice: n (%)	77 (78)
Internal medicine: n (%)	18 (18)
Multi-specialty: n (%)	5 (5)
<i>Number of clinicians (%)</i>	
Number of physicians (%)	424 (80)
Number of physician assistants (%)	48 (9)
Number of nurse practitioners (%)	58 (11)
<i>Number of patients per practice</i>	
Mean (S.D.)	8,556 (10,610)
Median (interquartile range)	5,591 (3,065 to 10,287)
<i>Number of patient-years of follow-up per practice</i>	
Mean (S.D.)	12,151 (14,661)
Median (interquartile range)	8,196 (4,018 to 14,612)
<i>Study participation duration: mean (S.D.)</i> 32.1 (10.2) months	
12–23 months: n (%)	23 (23)
24–35 months: n (%)	23 (23)
36–42 months: n (%)	53 (53)
Patient Characteristics	
<i>Age (in years) on 6/30/2006: mean (S.D.)</i> 42.2 (20.8)	
< 20: n (%)	141,294 (16.7)
20–29: n (%)	129,391 (15.3)
30–39: n (%)	131,542 (15.5)
40–49: n (%)	146,501 (17.3)
50–59: n (%)	130,012 (15.4)
60–69: n (%)	76,538 (9.0)
70–79: n (%)	50,557 (6.0)
80–89: n (%)	32,052 (3.8)
90+: n (%)	9,186 (1.1)
<i>Gender</i>	
Male: n (%)	366,250 (43.3)
Female: n (%)	479,374 (56.7)
Missing gender data: n (%)	1,449 (0.0)

* A-TRIP, Accelerating the Translation of Research into Practice; S.D., standard deviation.



Table 2. Mean Baseline Values and Adjusted Yearly Improvements Across the 99 Practices for Each Quality Measure*

Measure	Criteria	Baseline Performance	Unadjusted Yearly Improvement (95% C.I.)	Adjusted [†] Yearly Improvement (95% C.I.)	p Value
Cardiovascular Disease & Diabetes Mellitus Processes					
Blood pressure measurement	Measure in prior 24 mo for all adults, in prior 6 mo for those with DM or HTN	87.24%	+0.86% (0.31% to 1.41%)	-0.31% (-0.74% to 0.11%)	.1463
Total cholesterol measurement	Measure in prior 60 mo for all adults	43.44%	+6.61% (5.25% to 7.96%)	+4.44% (4.04% to 4.83%)	.0001 [‡]
HDL-cholesterol measurement	Measure in prior 60 mo for all adults, in prior 12 mo for those with DM	41.07%	+6.64% (5.37% to 7.91%)	+4.62% (4.23% to 5.02%)	.0001 [‡]
LDL-cholesterol measurement	Measure in prior 60 mo for all adults, in prior 12 mo for those with DM, CHD, or other atherosclerotic disease	57.22%	+5.53% (3.77% to 7.28%)	+4.60% (3.68% to 5.52%)	.0001 [‡]
Triglyceride measurement	Measure in prior 12 mo for those with DM	60.40%	+5.10% (3.16% to 7.04%)	+4.47% (3.34% to 5.60%)	.0001 [‡]
Hypertension diagnosis	Recorded DX for patients with ≥ 3 SBPs > 139 mm Hg or DBP > 89 mm Hg in prior 12 mo	69.13%	+2.96% (1.03% to 4.89%)	+1.20% (0.31% to 2.09%)	.0083
Lipid-lowering therapy	Rx of lipid-lowering agents in prior 12 mo for patients with CHD or other atherosclerotic disease	53.66%	+1.89% (0.59% to 3.19%)	+3.06% (1.98% to 4.15%)	.0001 [‡]
Beta-blocker therapy	Rx of beta-blocker in prior 12 mo in patients with HF	43.69%	+3.64% (1.96% to 5.33%)	+1.57% (-0.01% to 3.15%)	.0520
ACE inhibitor or ARB therapy	Rx of ACE inhibitor or ARB in prior 12 mo in patients with HF or DM and HTN	68.54%	+0.43% (-0.57% to 1.42%)	+0.34% (-0.64% to 1.31%)	.4974
Anti-platelet or anticoagulant therapy	Rx of either anti-platelet therapy or anticoagulant therapy in prior 12 mo for patients with atrial fibrillation; anti-platelet therapy for patients ≥ 40 y.o. with DM, HTN, HL, CHD, or other atherosclerotic disease	21.01%	+3.52% (2.23% to 4.81%)	+3.62% (2.96% to 4.28%)	.0001 [‡]
HgbA1C measurement	Measure in prior six mo	52.49%	+3.59% (1.98% to 5.20%)	+2.60% (1.35% to 3.84%)	.0001 [‡]
Urinary microalbumin measurement	Measure in prior 12 mo in patients with DM	16.80%	+4.89% (3.53% to 6.24%)	+4.90% (4.11% to 5.69%)	.0001 [‡]
Cardiovascular Disease & Diabetes Mellitus Outcomes					
Blood pressure control	Last SBP < 140 mm Hg and DBP < 90 mm Hg for patients with HTN, SBP < 130 mm Hg and DBP < 80 mm Hg for patients with DM	50.79%	+3.66% (2.74% to 4.57%)	+3.78% (3.10% to 4.46%)	.0001 [‡]
HDL-cholesterol control	Last HDL-cholesterol > 45 mg/dl for patients with diabetes	32.03%	+3.60% (2.22% to 4.98%)	+3.12% (2.40% to 3.85%)	.0001 [‡]

(continued on page 385)



Table 2. Mean Baseline Values and Adjusted Yearly Improvements Across the 99 Practices for Each Quality Measure* (continued)

Measure	Criteria	Baseline Performance	Unadjusted Yearly Improvement (95% C.I.)	Adjusted [†] Yearly Improvement (95% C.I.)	p Value
LDL-cholesterol control	Last LDL-cholesterol < 100 mg/dl for patients with diabetes, CHD, or other atherosclerotic disease	30.47%	+6.54% (5.40% to 7.69%)	+5.71% (5.03% to 6.39%)	.0001 [‡]
Triglyceride control	Last triglyceride < 150 mg/dl for patients with diabetes	32.34%	+5.76% (4.73% to 6.79%)	+4.89% (4.17% to 5.60%)	.0001 [‡]
HgbA1C control	Last HgbA1c < 7%	39.16%	+4.31% (2.88% to 5.74%)	+3.36% (2.51% to 4.20%)	.0001 [‡]
Cancer Screening					
Pap smear	Within prior 36 mo for females 18–64 y.o. without recorded hysterectomy	32.13%	+2.92% (1.61% to 4.23%)	+2.28% (1.89% to 2.67%)	.0001 [‡]
Mammogram	Within prior 24 mo for females ≥ 40 y.o.	37.10%	+3.62% (2.30% to 4.94%)	+2.68% (2.24% to 3.12%)	.0001 [‡]
Colorectal	FOBT within prior 12 mo, sigmoidoscopy within 60 mo, or colonoscopy within 120 mo for patients ≥ 50 y.o.	24.54%	+3.36% (2.35% to 4.37%)	+2.81% (2.42% to 3.19%)	.0001 [‡]
Adult Immunizations					
Tetanus	Within prior 120 mo for all adults	17.30%	+3.62% (2.76% to 4.47%)	+3.56% (3.31% to 3.81%)	.0001 [‡]
Influenza	Within prior 12 mo in patients ≥ 65 y.o. or adults with DM, CHD, HF, asthma, or other CPD, CKD, or alcohol disorders	21.46%	+3.05% (1.60% to 4.50%)	+2.61% (1.41% to 3.81%)	.0001 [‡]
Pneumococcal	Ever recorded in patients ≥ 65 y.o. or adults with DM, CHD, HF, CPD, CKD, or alcohol disorders	23.16%	+3.93% (2.97% to 4.90%)	+3.95% (3.55% to 4.34%)	.0001 [‡]
Hepatitis A	Two recorded for adult patients with chronic liver disease	1.37%	+0.37% (–0.20% to 0.93%)	+0.31% (–0.11% to 0.73%)	.1445
Respiratory and Infectious Disease					
Chlamydia screening	Within prior 12 mo for females 16–25 y.o.	3.40%	+1.44% (0.83% to 2.05%)	+1.13% (0.78% to 1.48%)	.0001 [‡]
Avoiding inappropriate antibiotic use	No Rx of antibiotic within 3 days of contact for acute respiratory illness unless streptococcal pharyngitis, otitis media, pneumonia, or sinusitis diagnosed	45.84%	–0.14% (–2.20% to 1.92%)	+0.26% (–1.54% to 2.06%)	.7791
Asthma controller therapy	Rx of controller medication in prior 12 mo for patients with asthma	56.27%	–0.44% (–1.67% to 0.79%)	–0.40% (–1.28% to 0.49%)	.3829

(continued on page 386)



Table 2. Mean Baseline Values and Adjusted Yearly Improvements Across the 99 Practices for Each Quality Measure* (continued)

Measure	Criteria	Baseline Performance	Unadjusted Yearly Improvement (95% C.I.)	Adjusted [†] Yearly Improvement (95% C.I.)	p Value
Mental Health and Substance Abuse					
Depression screening	Recorded screen for or Dx of depression in prior 24 mo for all patients	10.29%	+1.11% (0.43% to 1.79%)	+0.33% (0.15% to 0.51%)	.0004 [‡]
Antidepressant therapy	Rx of antidepressant medication in prior 12 mo for patients with Dx of depression	71.81%	-1.82% (-2.80% to -0.84%)	-2.03% (-2.82% to -1.23%)	.0001 [‡]
Alcohol screening	Recorded screen for or Dx of alcohol disorder in prior 24 mo for all patients	6.51%	+3.85% (2.32% to 5.38%)	+3.26% (2.80% to 3.72%)	.0001 [‡]
Alcohol counseling	Recording counseling about alcohol in prior 12 mo for patient with alcohol disorder	0.00%	+3.19% (1.41% to 4.97%)	+2.29% (1.42% to 3.15%)	.0001 [‡]
Tobacco counseling	Recording counseling about tobacco cessation in prior 12 mo for patient with tobacco disorder	6.28%	+3.50% (1.94% to 5.07%)	+2.51% (1.60% to 3.42%)	.0001 [‡]
Obesity and Nutrition					
Blood glucose measurement	Measure in prior 12 mo in patients with obesity	55.70%	+3.78% (1.70% to 5.86%)	+2.79% (1.48% to 4.09%)	.0001 [‡]
Diet/nutritional counseling	Recorded counseling in prior 12 mo for patients with obesity, HTN, HL, or DM	10.42%	+2.84% (1.51% to 4.17%)	+2.07% (1.64% to 2.49%)	.0001 [‡]
Inappropriate Medication in the Elderly					
Avoiding medication always considered inappropriate	No Rx in the prior 12 mo for barbiturates, flurazepam, meprobamate, chlorpropamide, meperidine, pentazocine, trimethobenzamide, belladonna alkaloids, dicyclomine, hyoscyamine, or propantheline	97.33%	+0.09% (-0.03% to 0.20%)	+0.14% (0.03% to 0.24%)	.0112 [‡]
Avoiding medication rarely considered appropriate	No Rx in the prior 12 mo for chlordiazepoxide, diazepam, propoxyphene, carisoprodol, chlorzoxazone, cyclobenzaprine, metaxalone, or methocarbamol	91.21%	-0.02% (-0.37% to 0.33%)	+0.45% (0.18% to 0.71%)	.0008 [‡]
TOTAL PERFORMANCE ACROSS ALL MEASURES					
Summary Quality Index (SQUID™)		33.67%	+3.34% (2.68% to 3.99%)	+2.43% (2.24% to 2.63%)	.0001 [‡]

* C.I., confidence interval; mo, months; DM, diabetes mellitus; HTN, hypertension; CHD, coronary disease; Dx, diagnosis; SBP, systolic blood pressure; DBP, diastolic blood pressure; Rx, prescription; HF, heart failure; ACE, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; y.o., years old; HL, hyperlipidemia; HgbA1C, glycosylated hemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FOBT, fecal occult blood test; CPD, chronic pulmonary disease; CKD, chronic kidney disease.

[†] Yearly improvements, confidence intervals, and p values were obtained from general linear mixed regression models that accounted for repeated measures on practices and adjusted for practices' average age among adults and average patient complexity score, as defined in the text.

[‡] Statistically significant.



noted. First, that intensity of participation in the project could be titrated to a practice's needs and interests led to broad acceptance of the project. At a minimum, the project simply required a few minutes of practice time each quarter to run the data extract program. In return, practices received regular reports that helped clinicians break through the denial about the adequacy of the care they delivered and that stimulated improvement efforts. At the other extreme, practices could host regular site visits, participate in annual network meetings, and engage in regular internal activities focused on analyzing their reports, designing improvement activities, and monitoring the results of these activities. Second, the project provided other tangible benefits for participants in addition to regular reports. These included continuing education credit for those participating in practice site visits and network meetings, limited financial support to attend the network meetings, and membership in a national network of peers that were involved in similar efforts. These benefits catalyzed practice participation in site visits and network meetings that led to integration of outside perspectives both for clinicians to approach care in new ways and for staff to develop and adopt new roles. Third, the specific improvement approaches discussed at site visits and network meetings helped practices avoid having to "reinvent the wheel" to achieve improvement. Although none of the individual improvement approaches were particularly novel, focusing greater attention on practice guidelines, increasing staff involvement in care management, and using their existing EMR more effectively represented a true paradigm change for some practices. Fourth, the broad scope of measures included in the practice reports meant that, even if a practice disagreed with a particular guideline or measure, there was ample opportunity to focus on other areas. Finally, there was some evidence that informal competition with other practices played a role in a practice's improvement efforts. Although all clinicians express a desire to do what is best for their patients, the inclusion of performance targets based on the ABC and provision of awards to high-performing practices at network meetings provided an additional impetus.

Several common components of the PPRNet-QI and the Chronic Care Model¹¹ were infrequently used by participating practices. Although introduction of the patient-level reports (registries) midway through the project helped some practices focus their efforts on patients needing additional care, a minority of practices used these reports extensively. Privacy and data security issues necessitated the use of an electronic utility to identify specific patients, which created a barrier to the use of the patient-level reports. Time spent reviewing these reports

and contacting patients were uncompensated new activities on the part of the practice staff. Reports with patient identifiers would likely have been more useful. Use of community resources for patient education was also limited, largely because of limited resources in individual communities. Financial incentives for improvement also played a small role for practices participating in the project because few of the practices were involved in pay-for-performance programs with their payers.

There are three important limitations of this study. First, there was no comparison group, and it is not possible to be certain that the improvements noted among the practices were due to the study interventions and not just secular changes occurring for other reasons. The magnitude and breadth of the observed changes may mitigate against this possibility. Second, some of the improvement may have been due to better recording rather than improved performance. As clinicians became better aware of how PPRNet reports were generated, they may have paid more attention to documentation in a manner that would be reflected in the reports. Improvements noted in recommended prescriptions and counseling may have been due to better documentation; however, the improvements noted for these measures were not greater than for other measures, such as laboratory monitoring and clinical outcomes. Most practices have automated laboratory interfaces, which obviate the need for manual entry of laboratory results. Also, the improvements seen in lipid, glycosylated hemoglobin, and blood pressure control could not have been due to better documentation. Finally, our study was not designed to determine which of the intervention methods or improvement approaches accounted for the improvements noted. Post-hoc exploratory analyses suggested that practices that attended at least one network meeting and hosted at least two site visits had better improvements than practices that had neither.

Despite these limitations, the current study adds to the existing literature on how organizations can influence the delivery of health care as well as measure and evaluate the impact of their improvement efforts. There are several specific strengths of this study. The broad spectrum of primary care practices across the United States, with data from the EMRs of over 800,000 patients, is one. The improvements noted were robust across the set of indicators, an important finding since others have reported weak associations between quality measures across different clinical conditions.³⁸ The theoretical foundations for the study interventions were comprehensive, incorporating theories of social influence, adult learning, and readiness for change and organizational theories of learning organizations, complex adaptive systems, and innovation-diffusion.



Sidebar: Case Studies

Plymouth Family Physicians (PFP)

Plymouth Family Physicians (PFP) is a small medical practice in a small town an hour north of Milwaukee. Run since 1985 by a husband-wife physician team with a devoted long-term staff, it faces the same challenges as any other small practice. Yet, PFP has managed to design a high-technology, high-quality experience for its patients that would be the envy of larger practices with greater resources.

PFP chose the electronic medical record (EMR) in 1998, in part because of Practice Partner Research Network (PPRNet). The transition to the EMR was bumpy, and physicians and staff members initially developed negative attitudes toward the software vendor. However, PFP's initial contact with PPRNet in 2001 catalyzed both more productive use of the software and a reengineering of the way the organization worked.

The physicians' initial response to their disappointment with their performance on PPRNet reports was to try to work harder and to get more done in the same amount of time. However, they quickly realized that their time was finite and that the solution to both better productivity and improvement on the PPRNet indicators was to optimize the use of their staff. Their critical insight was to break down the traditional dichotomy between the providers and staff, and their practice motto became "everyone is a provider."

Translating this motto into practice was greatly facilitated by the EMR, specifically, the health maintenance tracking and reminder features. Each staff member—nurse, medical assistant, laboratory technician, receptionist, and office manager—was empowered through standing orders to act on any health maintenance reminder. Every contact between a practice staff member and

patient, whether in person or by telephone, was seen as an opportunity to improve performance on the PPRNet measures. The receptionist was both allowed and expected to check the health maintenance reminders for any patient who called and schedule needed tests in advance of appointments. The laboratory technician could authorize needed laboratory tests for patients and send the patient across the hall for a needed immunization. Medical assistants and nurses review health maintenance issues in the examination rooms before the physician enters. Rates of laboratory monitoring, immunization, and procedures, such as mammography, rapidly improved once these processes were implemented.

Staff training was a key part of this transition. The entire practice meets monthly at noon to hold an open dialogue about data and its progress toward goals, what works and what doesn't, and documentation. Each quarter, when the practice receives its PPRNet report, all staff members review it and establish new goals. The practice has learned to focus on at most three new goals per quarter. The physicians quickly learned that the staff was eager to learn the science behind their care processes and came to appreciate that an individual's ability to advance care is not dependent on his or her formal training. Staff members report satisfaction with feeling a more integral part of the medical team.

Although staff motivation was largely intrinsic, the physicians also decided to create financial incentives for improvement. Practice contributions to staff retirement accounts were pegged to performance on PPRNet reports. In the first year this plan was operational, the practice contributed 13.6% more to these accounts than in the previous year.

(continued on page 389)

These foundations address the concern that much of QI research itself is not evidence-based³⁹ and add to the likelihood that the study findings are valid, sustainable, and reproducible. Our findings suggest that broader adoption of EMR and specific QI activities among primary care practices can improve the quality of primary care in the United States. **■**

Steven Ornstein, M.D., is Director, Practice Partner Research Network, and Professor, Department of Family Medicine, Medical University of South Carolina, Charleston, South Carolina. **Paul J. Nietert, Ph.D.**, is Associate Professor, Department of Biostatistics, Bioinformatics, and Epidemiology. **Ruth G. Jenkins, Ph.D.**, is Assistant Professor, Department of Family Medicine. **Andrea M. Wessell, Pharm.D., B.C.P.S., C.D.E.**, is Assistant Professor, College of Pharmacy. **Lynne S. Nemeth, Ph.D., R.N.**, is Associate Professor, College of Nursing and Clinical Services. **Heather L. Rose, M.D.**, is Assistant Professor, Department of Family Medicine. Please address requests for reprints to Steven Ornstein, ornstesm@muscc.edu.

This study was supported by a grant from the Agency for Healthcare Research and Quality (Grant 1 U18 HS013716). Drs. Ornstein and Wessell are consultants for Practice Partner® (part of the McKesson Corporation), the vendor of the Practice Partner electronic medical record used by practices participating in this study. This work was presented in part at the 2006 North American Primary Care Research Group Annual Meeting in Tucson, Arizona. An abstract was published in the proceedings of that conference. Chris Feifer, Dr.P.H., conducted aspects of the process evaluation. Loraine Roylance, M.S., contributed extensively to many aspects of the project.

References

1. Agency for Healthcare Research and Quality: *National Healthcare Quality Report, 2005*. <http://www.ahrq.gov/qual/nhqr05/nhqr05.htm> (last accessed May 15, 2007).
2. Institute of Medicine: *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy of Sciences, 2001.
3. Agency for Healthcare Research and Quality: *Press release: New AHRQ Initiative Will Move Research into Practice More Quickly*. Nov. 15, 2002. <http://www.ahrq.gov/news/press/pr2002/poqpr.htm> (last accessed May 15, 2007).
4. Weingarten S.R., Henning J.M., Badamgarav E.: Interventions used in disease management programmes for patients with chronic illness—Which ones work? Meta-analysis of published reports. *BMJ* 325(7370):925–932.



Sidebar. Case Studies (continued)

PFP physicians view their efforts as expanding their staff's efforts from simply patient satisfaction to a wider set of goals involving quality outcomes and documented performance. They say, "We accept the idea that we are only as good as our data says we are." At the conclusion of Accelerating Research into Practice (A-TRIP), PFP had reached 46 measure benchmarks, better than all but three PPRNet practices. Its final Summary Quality Index (SQUID™) was 62.0%, better than all but four PPRNet practices.

Family Medicine of Port Angeles (FMPA)

Family Medicine of Port Angeles (FMPA) is a six-physician, three-nurse-practitioner, full-service family practice on Washington's Olympic peninsula. Well connected with emerging national trends in quality improvement through affiliations with the Washington State Academy of Family Physicians (WSAFP) and other organizations, FMPA joined PPRNet after A-TRIP was underway and quickly emerged as an exemplar practice.

FMPA implemented the EMR in 1998 as a tool to reduce the increasingly burdensome paperwork in its nearly 20-year-old practice, and in 2003 turned its attention to quality improvement (QI). FMPA had its first A-TRIP site visit in September 2004, more than two years into the project. Initially, some physicians and staff were skeptical about whether PPRNet could add anything to the learning the practice had incorporated from its medical director's presidency and continued involvement with the WSAFP and its hospital's QI projects. They were particularly concerned about previous problems with EMR software updates, the cost for QI activities, and distractions from QI efforts because of their multiple roles as primary care providers.

During the next 18 months, however, FMPA made simple yet dramatic changes in its approach to care on the basis of concepts such as planned care and lean thinking. Care plans were developed for common chronic illnesses and preventive care and were shared with all staff members and patients through the practice's Web page (<http://www.fmpa.net>). The care plans served as standing orders for all staff members, eliminating the physician as a bottleneck for ordering needed services. All staff provided consistent messages about care pathways, and quality became "everybody's business." PPRNet practice-level reports were used to monitor the success of its interventions and, as registries, to reach out to patients not at goal for clinical targets or receiving needed care.

The impact on quality was dramatic. In two years, from June 2004 to June 2006, the practice went from exceeding 8 PPRNet measure benchmarks to 33, and its SQUID had reached 55.3%. In the same period, the proportion of its hypertension patients whose last blood pressure measure was controlled (< 140/90 mm Hg) improved from 45.4% to 77.6%, twice national averages and well above the PPRNet benchmark. Special efforts were undertaken to reach out to patients with diabetes mellitus to encourage flu vaccination, resulting in the rate's more than doubling.

Empowering the staff required adjustment on the part of some physicians, who were used to having the final say about every decision made about the patient. But most were pleased to have the additional help. One of the most powerful morale boosters for staff was the physicians' decision to include everyone equally in a bonus when the practice received a \$20,000 quality award from a local insurer. Everyone on the staff received a \$500 check.

Oct. 26, 2002.

5. Feifer C., et al.: The logic behind a multi-method intervention to improve adherence to clinical practice guidelines in a nationwide network of primary care practices. *Eval Health Prof* 29(1):65-88, Mar. 2006.

6. Nemeth L.S., et al.: Strategies to accelerate translation of research into primary care within practices using electronic medical records. *J Nurs Care Qual* 22:343-349, Oct.-Dec. 2007.

7. Ornstein S.M., et al.: Improving diabetes care through a multi-component quality improvement model in a practice-based research network. *Am J Med Qual* 22(1):34-41, Jan.-Feb. 2007.

8. Wessell A.M., et al.: Achievable benchmarks of care for primary care quality indicators in a practice-based research network. *Am J Med Qual* 23:39-46, Jan.-Feb. 2008.

9. Ornstein S., et al.: Multi-method quality improvement intervention to improve preventive cardiovascular care: A cluster randomized trial. *Ann Intern Med* 141:523-532, Oct. 5, 2004.

10. Feifer C., Ornstein S.M.: Translating research into small primary care practices: Development and evaluation of a new improvement model. *Jt Comm J Qual Saf* 30:432-441, Aug. 2004.

11. Bodenheimer T., Wagner E.H., Grumbach K.: Improving primary care for patients with chronic illness. *JAMA* 288:1775-1779, Oct. 9, 2002.

12. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) Final Report. *Circulation*

106:3143-3421, Dec. 17, 2002.

13. Chobanian A.V., et al.: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 report. *JAMA* 289:2560-2572, May 21, 2003.

14. Hunt S.A., et al.: ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure). *Circulation* 112:e154-e235, Sep. 20, 2005.

15. Grundy S.M., et al.: When to start cholesterol-lowering therapy in patients with coronary heart disease. A statement for healthcare professionals from the American Heart Association Task Force on Risk Reduction. *Circulation* 95:1683-1685, Mar. 18, 1997.

16. Singer D.E., et al.: Antithrombotic therapy in atrial fibrillation: The Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. *Chest* 126(suppl. 3):429S-456S, Sep. 2004.

17. American Diabetes Association: Standards of medical care in diabetes. *Diabetes Care* 29(suppl. 1):S4-S42, Jan. 2006.

18. Humphrey L.L., et al.: Breast cancer screening: Summary of the evidence for the U.S. Preventive Services Task Force. Originally in: *Ann Intern Med* 137(5 pt. 1):344-346, Sep. 3, 2003.

<http://www.ahrq.gov/clinic/3rduspstf/breastcancer/bcscrnsu1.htm> (last accessed May 15, 2008).



19. Hartmann K.E., et al.: *Screening for Cervical Cancer*. Systematic Evidence Review Number 25. <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hstat3.chapter.4180> (last accessed May 15, 2008).
20. Centers for Disease Control: Diphtheria, tetanus, and pertussis: Recommendations for vaccine use and other preventive measures: Recommendations of the Immunization Practices Advisory Committee. *MMWR Recomm Rep* 40(No. RR-10), 1991. <http://www.cdc.gov/mmwr/preview/mmwrhtml/00041645.htm>. (last accessed May 15, 2008).
21. Smith N.M., et al.: Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 55 (RR10):1-42, Jul. 28, 2006. <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5510a1.htm>. (last accessed May 15, 2008).
22. Prevention of Hepatitis A Through Active or Passive Immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 48(RR12):1-37, Oct 1., 1999. <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr4812a1.htm>. (last accessed May 15, 2008).
23. Prevention of pneumococcal disease: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 46(RR-08):1-24, Apr. 4, 1997. <http://www.cdc.gov/mmwr/preview/mmwrhtml/00047135.htm>. (last accessed May 15, 2008).
24. National Asthma Education and Prevention Program Expert Panel:

- Guidelines for the Diagnosis and Management of Asthma—Update on Selected Topics 2002*. National Institutes of Health (NIH) Publication No. 02-5074, Jun. 2003. http://www.nhlbi.nih.gov/guidelines/archives/epr-2_upd/index.htm (last accessed May 15, 2008).
25. *Screening for Chlamydia Infection: Summary of the Evidence*. Article originally in: *Am J Prev Med* 20(suppl. 3):95-107, Apr. 2001. <http://www.ahrq.gov/clinic/ajpmsuppl/nelson1.htm> (last accessed May 15, 2008).
26. Snow V, Mottur-Pilson C., Gonzales R., for the American College of Physicians—American Society of Internal Medicine: Principles of Appropriate Antibiotic Use for Treatment of Nonspecific Upper Respiratory Tract Infections in Adults. *Ann Intern Med* 134:487-489, Mar. 20, 2001.
27. U.S. Preventive Services Task Force: *Screening for Depression. Recommendations and Rationale*. May 2002. <http://www.ahrq.gov/clinic/3rduspstf/depression/depressrr.htm> (last accessed May 15, 2008).
28. U.S. Preventive Services Task Force: *Counseling to Prevent Tobacco Use and Tobacco-Caused Disease: Recommendation Statement*. Nov. 2003. <http://www.ahrq.gov/clinic/3rduspstf/tobaccoun/tobaccounr.pdf> (last accessed May 15, 2008).
29. U.S. Preventive Services Task Force: *Screening and Behavioral Counseling Interventions in Primary Care to Reduce Alcohol Misuse: Recommendation Statement*. Apr. 2004. <http://www.ahrq.gov/clinic/3rduspstf/alcohol/alcomisrs.htm> (last accessed May 15, 2008).
30. National Heart, Lung and Blood Institute and North American Association for the Study of Obesity: *The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*. Oct. 2000. http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_b.pdf (last accessed May 15, 2008).
31. Zhan C., et al.: Potentially inappropriate medication use in the community-dwelling elderly: Findings from the 1996 Medical Expenditure Panel Survey. *JAMA* 286:2823-2829, Dec. 12, 2001.
32. Agency for Healthcare Research and Quality: *The Ambulatory Care Quality Alliance Recommended Starter Set: Clinical Performance Measures for Ambulatory Care*. <http://www.ahrq.gov/qual/aqastart.htm> (last accessed May 16, 2008).
33. Kiefe C.I., et al.: Identifying achievable benchmarks of care: Concepts and methodology. *Int J Qual Health Care* 10:443-447, Oct. 1998.
34. Weissman N.W., et al.: Achievable benchmarks of care: The ABCs of benchmarking. *J Eval Clin Pract* 5:269-281, Aug. 1999.
35. Soumerai S.B., Avorn J.: Principles of educational outreach ("academic detailing") to improve clinical decision making. *JAMA* 263:549-556, Jan. 26, 1990.
36. Nietert P.J., et al.: Using a summary measure for multiple quality indicators in primary care: The Summary Quality InDex (SQUID). *Implement Sci* 2:11, Apr. 2, 2007.
37. Jha A.K., et al.: Effect of the transformation of the Veterans Affairs Health Care System on the quality of care. *N Engl J Med* 348:2218-2227, May 29, 2003.
38. Parkerton P.H., et al.: Physician performance assessment. Nonequivalence of primary care measures. *Med Care* 41:1034-1047, Sep. 2003.
39. Shojania K.G., Grimshaw J.M.: Evidence-based quality improvement: The state of the science. *Health Aff (Millwood)* 24:138-150, Jan.-Feb. 2005.



Chief Medical Officer sought for Hays Medical Center. Located midway between Kansas City and Denver, this 194-bed medical center is the

sole tertiary care service provider in western Kansas. With an overriding goal "To Be the Best Tertiary Care Center in Rural America," Hays partnered with Michael DeBakey, MD to open the DeBakey Heart Institute of Kansas in 1989. Focus for the CMO position will be driving clinical excellence and superior quality through organized performance improvement initiatives, implementing the new hospitalists program, creating efficiencies in contracted physician groups, assisting with the evolving electronic medical records initiative and working towards Level III trauma certification. Requests for additional information should be directed to Christine Mackey-Ross through the office of Adriane Willig (630-575-6199) or via e-mail at HaysCMO@wittkiewer.com.