Linking internet-based diabetes self-management to primary care: lessons learned and implications for research translation and practice implementation

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Cite this as: *TBM* 2012;2:313–321
doi: 10.1007/s13142-012-0109-8

ABSTRACT

There has been little discussion of or research on the key translational issue of how to integrate patient self-management programs across multiple primary care clinics within an HMO. The purpose of this study was to summarize our experiences and lessons learned in trying to integrate information from a web-based diabetes self-management program into primary care and the electronic health record (EHR). We describe plans, implementation, adaptations made, and data on patient and physician reactions to the My Path diabetes self-management program provided to 331 adult primary care patients. Mixed methods results revealed that, despite the availability of a state-of-the-art EHR, the intervention was not well integrated into primary care. Information from health-promotion and disease management programs, even within the same organization and with advanced EHR systems, is challenging to integrate into busy primary care.

KEYWORDS

Implementation, Primary care, Chronic disease self-management, Integration, Health technology

INTRODUCTION

Interactive health communication applications (IHCAs) for people with chronic diseases that are Internet based and that incorporate health information, chronic care principles, and tailored support for health-behavior change, have been shown to increase patient health knowledge, self-efficacy, and health-related behaviors [1–3]. IHCAs have great potential to augment care for diabetes and other chronic conditions by providing round-the-clock access to the tools and encouragement needed to support daily chronic disease self-management. IHCAs that can harness the interactivity and opportunities for information exchange, enhanced communication, and social connection available through the Internet may also provide an opportunity for clinical recommendations and personalized care to be better tailored and integrated into a patient's unique social ecological context [4].

Practice implications

Practice: Evidence-based interactive health communication applications (IHCA) can support practice goals of improved patient-provider communication and information exchange about diabetes self-management issues, but to be sustainable, they must be integrated into practice work flows and existing EHR systems.

Policy: Policy makers striving to promote fundamental practice systems changes, such as the patient-centered medical home model, need to understand the barriers that practices face when attempting to evaluate, select, and integrate new technology-based tools into practice—and to realize that technology “advances” can often produce unanticipated adverse consequences.

Research: Researchers should benefit from the lessons learned and recommendations shared regarding challenges of integrating IHCA programs into existing electronic systems. Key research opportunities include collaborations among patients, clinicians, administrators, and information technology staff to integrate diverse interactive technology platforms and applications.

Yet healthcare systems and those who implement IHCAs are faced with barriers to the full integration of such programs into usual care [5]. Overcoming these barriers is particularly important given recommendations to establish a “patient-centered medical home” within health care systems to assure comprehensive primary care, including information exchange among health care providers, their patients, and their families [6]. Therefore, guidance is needed on how patient-centered health care teams and organizations can incorporate IHCAs into their standard care.

The need for diabetes self-management support

Diabetes self-management support that addresses key regimen behaviors such as healthy eating,

physical activity, and medication taking has been demonstrated to improve diabetes outcomes and quality of life, and reduce the risk of complications [7–9], at least short term. Self-management support that includes behavioral goal setting and follow-up support is highly recommended as an effective strategy for improving chronic illness [10], but may be insufficient if not well integrated into patients' lives and reinforced through their routine diabetes care [11]. Despite these known benefits and expert recommendations, comprehensive programs have achieved limited translation into routine clinical practice. Many prominent diabetes self-management programs and most IHCA's do not even attempt to send reports to patients' providers [12], and to our knowledge, there are no published reports on efforts to enhance such integration.

The rapid growth in prevalence of obesity, pre-diabetes, and diagnosed diabetes places increased demands on an already-stressed primary care workforce, and it is clear that more efficient and automated ways to support diabetes self-management are needed. With the advent of electronic health record (EHR) and personal health records (PHR) that allow for increased two-way communication between patients and health care team members, it seems logical that adoption of IHCA's that promote chronic disease self-management would be welcome.

There are, however, barriers to the adoption of IHCA's into health care delivery systems. Concerns exist regarding their accuracy, scientific basis, timelines, authorship, confidentiality, and ownership. Patient confidentiality must be assured in an age of ever-greater interconnectivity. Also, while IHCA's have the potential to reach a large number of patients at less cost than in-person diabetes education or care management visits [13, 14], they still require funding and staff support to assure their effectiveness in specific settings and integration with the rest of a patient's care to ensure attention to individual patient needs.

Despite these challenges, promising trends in the US health care policy landscape are encouraging the broader use of IHCA's and integration into primary care. Definitions for meaningful use of health information technology (HIT) systems in health care continue to evolve, but the 2009 Health Information Technology for Economic and Clinical Health Act provides the foundations for funding of HIT resources that support chronic disease management and integrated longitudinal use of patient data. Together with the Patient Protection and Affordable Care Act [15], these laws have the potential to steer reimbursement away from a fee-for-service model to an outcomes-based model that enhances primary care and encourages further investments in IHCA research and practice integration.

The specific purposes of this paper are to: (a) describe the process by which information on patient participation and progress in a diabetes self-

management support website-based IHCA program was integrated into a health care delivery system with state-of-the-art EHR; (b) present results concerning integration of the web-based diabetes self-management support program into care using a mixed methods evaluation that included a patient satisfaction survey, qualitative interviews with physicians describing their views on the program, and chart review; and (c) describe logistical and technical barriers encountered and make recommendations for future programs and research attempting to integrate IHCA's and primary care.

METHODS

Participants

Setting and physicians—The study was conducted at Kaiser Permanente Colorado (KPCO), an integrated managed care organization serving more than 450,000 members, including Medicare recipients. Using KPCO's electronic prevention and disease population management system, HealthTrac, and the associated EHR system, HealthConnect, adults with type 2 diabetes were identified from five of the 14 KPCO primary care medical offices. Clinics included both internal medicine and family practice departments, and were selected based on variability in size, location, and socioeconomic status of surrounding neighborhoods, and to maximize Latino participation. The number of primary care physicians (PCPs) per clinic ranged from 9 to 21. All clinics and all physicians in those clinics approached for the study agreed to participate.

Prior to patient recruitment, in-clinic presentations, led by the study project manager, were held to inform the PCPs of the study and to gather feedback about the preferred method of communicating study activities for active study participants. In addition, participating physicians were asked to review a list of patients from their practices who met eligibility criteria and to remove any participants who were medically unfit to participate.

A total of 76 PCPs participated in the study from the five clinics. About half were male and most specialized in internal medicine (68.4%) rather than family practice (31.6%). The physicians had many years of experience ($M=15.1$, $SD=8.1$) and managed relatively large panel sizes ($M=1,560$). At the initiation of the study, 78% of the diabetes patients in KPCO had HbA1c levels less than 8.0%, indicating adequate or better glucose control. At the time of the study, KPCO attempted to have all newly diagnosed patients attend diabetes education group programs and to have primary care clinicians focus on controlling risk factors of HbA1c, blood pressure, and lipids.

Patient participants—All study participants received their care from a participating KPCO clinic. Eligi-

bility criteria included: 25–75 years of age, diagnosis of type 2 diabetes, body mass index (BMI) of 25 kg/m² or greater, and at least one other risk factor for heart disease. Additional inclusion criteria were access to a telephone and at least biweekly access to the Internet, ability to read and write in English or Spanish, and ability to perform mild to moderate physical activity. Eligible and interested patients were scheduled to see a research assistant for a baseline visit at the medical office location of their respective PCPs. During the baseline visit, patients gave informed consent, completed assessments on primary behavioral and psychosocial variables, and were randomized to one of three conditions: enhanced usual care (EUC), a web-based diabetes self-management support (*My Path*) program, or the web-based diabetes self-management support program plus additional in-person support, as described below (*My Path Plus*). The remainder of this paper focuses on the 331 patients randomized to one of the two IHCA (*My Path*) conditions.

Patients were fairly typical of type 2 adult diabetes patients. As shown in Table 1, they were on average obese (BMI $M=34.9$) and had chronic illnesses besides diabetes, 49% were female, and the average age was 58.3 years. Forty-six percent

reported family incomes of less than \$50,000, 24% were Latino, and 17% were African American. Recruitment and participant details are available in Glasgow et al. [16].

Intervention

The web-based diabetes self-management support program, *My Path To Healthy Life/Mi Camino A La Vida Sana* (*My Path*), is a self-administered, stand-alone IHCA available in both English and Spanish. *My Path* was developed based on social-ecological theory and the “5 As” self-management model [17]. Patients completed a brief online assessment on their eating, exercise, and medication-taking habits; set tailored goals in each area; identified barriers to achieving their goals; and developed an action plan to improve behaviors. Patients were encouraged to track progress at least weekly on the website and received feedback and e-mail/interactive voice response reminders to track, revisit goals, and complete future assessments.

In addition to the web-based *My Path* program, *My Path Plus* participants received live support, including a follow-up call with a diabetes care manager and an invitation to attend three in-person

Table 1 | Baseline characteristics of *My Path* intervention participants ($n=331$)

Characteristic	All M (SD) or % $n=331$	<i>My Path</i> M (SD) or % $n=169$	<i>My Path Plus</i> M (SD) or % $n=162$	Significance level ^a
Age (years)	58.3 (9.3)	58.7 (9.2)	57.9 (9.4)	.45
% Female	49%	45%	54%	.11
Race				.89
American Indian/Alaskan native	4.8%	4.9%	4.8%	
Asian	1.6%	1.8%	1.4%	
Black or African American	16.8%	15.3%	18.4%	
White	76.8%	77.9%	75.5%	
Hispanic ethnicity	24%	26%	22%	.36
Income				.86
Less than \$49,999	46.2%	45.9%	46.5%	
\$50,000–\$89,999	34.6%	33.8%	35.5%	
\$90,000 or more	19.2%	20.4%	18.1%	
High school or less education	22%	20%	23%	.40
% Low-moderate health literacy	5%	6%	4%	.50
Computer use				
Never to 2 1/2 h per week	16.6%	16.6%	16.7%	
3 to 6 1/2 h per week	16.3%	20.1%	12.3%	
7 to 8 1/2 h per week	6.6%	5.3%	8.0%	
9 or more hours per week	60.4%	58.0%	63.0%	
Smoke cigarettes	12.4%	11.8%	13.0%	.76
Body mass index (kg/m ²)	34.9 (6.5)	34.5 (6.2)	35.3 (6.8)	.25
Type of diabetes medication				.76
Oral	59.1%	59.3%	59.0%	
Insulin	8.5%	7.2%	9.9%	
Both oral and insulin	25.9%	27.5%	24.2%	
None	6.4%	6.0%	6.8%	
Number of chronic illnesses (Quan score)	3.2 (1.9)	3.1 (1.7)	3.3 (2.0)	.27

^a Chi-square or t test, as appropriate

group sessions to develop problem-solving and practical healthy eating skills (i.e., selecting healthier foods when grocery shopping or eating out), to improve communication with their health care team and to search for information on the Internet. There were no significant differences between the My Path and My Path Plus groups on either patient characteristics, outcomes, or participant satisfaction items (with one exception: those in the My Path Plus condition on average rated more highly the helpfulness of the My Path program in managing their diabetes [$\chi^2=11.9$, $p=.02$]), so the two conditions were combined for analysis.

Details about the main study and its results can be found elsewhere [18, 19]. In brief, the intervention produced significantly greater improvements than the EUC condition on three of four behavioral outcomes (effect sizes [d] for healthy eating=0.32, fat intake=0.28, physical activity=0.19) in both intent-to-treat and complete-cases analyses; however, these changes did not translate into differential improvements in biological outcomes [20].

Evaluating integration into primary care

To evaluate the extent to which the My Path intervention was integrated into patients' primary care, we employed a mixed methods approach [21], including qualitative interviews with PCPs, descriptions of the implementation process from study staff, chart reviews of participants, and survey data. Data were collected from April 2008 to October 2010. All procedures were approved by the KPCO institutional review board.

Measures

Implementation lessons learned and adaptations made—Lessons learned data were collected and maintained by staff throughout the study. The study team documented issues of concern, resolved problems or ongoing issues related to the research process, recruitment and retention, and the intervention. At study completion, a research assistant reviewed minutes from the team's weekly meetings to ensure that all information about linkage to primary care was included. The information was categorized into key themes [22–24].

Participant satisfaction/12-month user survey—Satisfaction surveys were collected from participants at the 12-month assessment. The survey included two sections. The first used a 5-item Likert scale to assess My Path website utilization, helpful program features, self-reported primary care utilization, and use of computers and additional diabetes/health-related Internet programs. In the second section, participants responded to open-ended questions on program use, most and least favorite features, and recommendations for improvement. Questionnaire data were entered by a research assistant, and Spanish replies were translated to English. Comments were analyzed and coded for key themes [22–

24]. First-cycle coding was conducted by two individual coders to organize preliminary concepts, after which coders met to clarify and define data codes. Using the set definitions and inclusion/exclusion criteria, three coders completed a second-cycle coding of the data [25, 26]. Coders met to discuss any ambiguous data or non-agreement codes, and preliminary findings were debriefed with the research team to confirm findings [23, 27]. Detailed and reflective memos regarding data analysis were maintained to document all intervention adaptation research decisions [22].

Physician interviews—Open-ended, semi-structured interviews [22, 23] were conducted with 11 KPCO physicians having multiple study participants to inquire about My Path discussions with patients, use of staff messaging, addressing My Path issues when necessary, impact of My Path on care, and recommendations for program changes. We attempted to interview three physicians from each of the five participating clinics but were not able to interview three clinicians at all clinics before funding expired. We selected the clinicians who had the largest number of participants at each clinic to interview. Since HMO care managers were not assigned to individual clinics and the intervention protocol involved only physicians and not other clinic staff, we did not interview other staff members. Twenty-minute interviews were conducted by the study project manager and study physician in the PCP's clinic. Careful notes were taken and then coded by two separate coders to identify initial concepts. After initial coding, the data were quantified [28] according to code categories for analysis to describe the frequency of comments by the group of physicians.

Medical record review—Medical records were reviewed for mention of the My Path program (“yes” or “no”), either from the health care provider or the patient, within the context of usual care with a provider.

RESULTS

Implementation challenges and adaptations

We encountered multiple challenges that required protocol and implementation modifications. Efforts to link study participant goals and action plans to the patients' PCPs through the EHR system proved difficult on top of process and technical changes that were simultaneously occurring at KPCO, including EHR modifications and major changes in appointment scheduling. We focus on the challenges with the greatest impacts on our linkage efforts and staffing and clinical care process modifications.

Our initial plan to automatically provide patient goals and action plans to providers and to verify that these plans and patient progress were available for non-emergency primary care visits was circumvented early in the study. A direct link from the study website to the EHR was unavailable because

of the unanticipated costs of implementing such a system and the backlog of clinical work the EHR information technology (IT) staff was doing at the time (the new EHR at KPCO was 1 year into its initial rollout at the start of our study). Since a direct link was no longer possible, we asked participating physicians how they would like to receive information about patient goals and action plans to discuss at clinic visits. They strongly preferred the EHR “staff message” feature, which, similar to e-mail, provided patient goals and action plans to the provider, but did not directly link to the patient's chart. The provider could attach the message to an electronic note in the EHR at the time of the visit. However, as the familiarity and growth of the EHR grew during its first year, overuse of the staff message feature became a burden to PCPs, and it was not as convenient a link during a health care visit as intended.

KPCO implementation of same-day appointments also markedly impacted our linkage process. We programmed a weekly data pull for upcoming appointments among active study participants, which triggered a staff message containing the relevant My Path patient information to the PCP before the appointment. KPCO guidelines to have all appointments scheduled the same day, or within 2–3 days at most, prevented us from supplying many PCPs with the information at the time of the visit. We did incorporate scanned patient goals and action plans into the EHR, but these were not easy to locate quickly during a clinic visit. On the recommendation of a participating PCP, we changed the title to “health survey/goal,” but the change did not increase review of study action plans during a clinic visit.

Additional technical issues led to more modifications for linking patient data from the EHR to the My Path website. We had designed a website page which provided study participants their recent lipid and hemoglobin A1C results, but the link could not be implemented because of the cost from the HMO IT staff to design and monitor the link as well as additional programming time and security issues.

Staffing changes and policies also impacted our original linkage plans. When we were designing the study, the KPCO Certified Diabetes Educators (CDEs) met with the research team to discuss the intervention and how they might supplement the linkage piece with education and goal review as part of their standard clinic activities. We planned for the CDE at each participating clinic to provide two outreach calls during the study, discuss goals and progress, and provide motivational assistance. During the study, the responsibilities and patient panels of the KPCO CDEs changed frequently. There were substantial CDE and care manager reductions, and each clinic varied in its care management and follow-up processes. We were forced to modify the design by utilizing only two CDEs from a central location rather than the patient's home clinic and by

limiting CDE involvement to one call, with back-up assistance available on the Ask An Expert component of the website.

Regarding the linkage of the web program to primary care, coded staff notes revealed two key themes: (a) compliance requirements change, and adaptations to best-laid plans often must be made (e.g., Medicaid numbers changed, and automated data pulls had to be reprogrammed), and (b) EHR and other electronic systems change, especially during early EHR implementation, and reprogramming time and financial support must be budgeted for ongoing modifications (e.g., new data coding and data fields required new programming; use of the new “Research Tab” and “Pre-visit Summary” features added to the EHR would have been useful if available at the launch of our program or if funds and support were available to incorporate these into the program when they became available).

Patient satisfaction surveys

Comments from four open-ended items were coded by three project coders. Kappa was computed for each item between coders 1 and 2, coders 1 and 3, and coders 2 and 3 and then averaged across coder dyads and items. Average kappa was .80, which is “very good agreement.” Qualitative and quantitative satisfaction survey results are presented in Table 2. We present here only items from the survey related to linkage to primary care. Patients did not report discussing the program in much detail with their physicians ($M=2.1$ on a 5-point scale), despite having an average of two physician visits during the program. Almost three quarters of participants had used the HMO's PHR, so we infer that greater linkage to primary care was possible if My Path could have been integrated with this record as we had planned originally.

Physician perceptions of My Path

Physician interviews—Semi-structured interviews with physicians included six open-ended questions on respondents' perceptions of the program, the electronic interfaces and information provided, how the study impacted their practice, any particular recollections about participating patients related to My Path, and any recommendations. Nearly half of the physicians interviewed remembered patients mentioning the My Path program; the other half were uncertain. Of the five physicians who responded affirmatively, most could not remember the specific patient or group of patients but noted that these patients were highly motivated and spoke positively about the program. One physician stated, “She did very well and as soon as the study was over, her A1C shot up. I called her, and she said it was because the study ended, and she was not tracking anymore, especially her physical activity.” The physicians who were unsure whether patients men-

Table 2 | Summary of patient satisfaction survey results

Item	All <i>M</i> (SD) or % <i>n</i> =235	My Path <i>M</i> (SD) or % <i>n</i> =119	My Path Plus <i>M</i> (SD) or % <i>n</i> =116	Significance level
How helpful was it to access your ABCs (A1c, blood pressure, cholesterol results)? (scale=0–5)	3.5 (1.4)	3.4 (1.5)	3.6 (1.3)	.55
How helpful was it to develop your own individualized action plans? (scale=0–5)	3.3 (1.3)	3.2 (1.3)	3.3 (1.3)	.96
How helpful was “Ask an Expert” on the website? (scale=0–5)	2.4 (1.6)	2.3 (1.6)	2.5 (1.6)	.80
How helpful was “My Resources” on the website (recipes, exercise tips, doctor’s advice, etc.)? (scale=0–5)	2.9 (1.5)	2.8 (1.6)	3.1 (1.5)	.23
How many times did you visit your primary care doctor over the past 12 months? (scale=0–4)	2.0 (1.1)	1.9 (1.1)	2.1 (1.1)	.73
Over the past 12 months, in how much detail did you and your primary care doctors discuss the My Path program? (scale=1–5)	2.1 (1.1)	2.1 (1.1)	2.1 (1.0)	.22
Over the past 12 months, to what extent did participating in the My Path program improve the quality of care you received for your diabetes? (scale=1–5)	2.9 (1.0)	2.8 (1.1)	2.9 (1.0)	.06
How much did the My Path program help you to manage your diabetes? (scale=1–5)	3.3 (1.1)	3.2 (1.1)	3.5 (1.1)	.02
Over the past 12 months, have you used the Kaiser My Health Record website? (% yes)	72%	73%	71%	.74
Over the past 12 months, have you used any other website to help manage your diabetes? (% yes)	17%	15%	19%	.45
Over the past 12 months, have you used any other website related to healthy eating or exercise? (% yes)	25%	26%	23%	.62

tioned the program vaguely recalled hearing about the program but could not provide specific information. One physician stated that a patient might have mentioned the program but “nothing specific or in detail. More like, I am in a study or something vague like that.” The only physician with a negative response offered that “there is no time for this type of thing” during a visit.

Because few providers recalled specific discussions of the My Path program with patients, only a few of those interviewed could address our concern related to time used to address My Path issues. In general, providers indicated that, when they discussed My Path issues, it was not time consuming, but they prefer to enhance the efficiency of information exchange. One provider commented, “[Addressing issues] did not take too much additional time, but I am open to anything that is time efficient and will enhance patient care.”

Physician recommendations for improved linkage—Overall, providers said that either the study had no impact on clinical care or that it improved care for few patients. Indicating that they needed support in the areas of behavioral goal setting, tracking, and counseling, most physicians were open to study improvements that could complement clinical care.

Their recommendations are summarized in Table 3 by frequency of mention.

Program implementation and chart review

About 30% of patients had goal information sent to providers within a day or two before a scheduled visit. All other intervention patients had goal information from the *My Path* program sent to their physicians, but not near a scheduled visit. Specific action plan goals were more frequently sent than the initial goals (68.5% action plans vs. 31.5% initial goals for *My Path* patients; 66.7% action plans vs. 33.3% initial goals for *My Path Plus* patients). Electronic messages were sent to 52 of the 76 PCPs. At least one physician comment about *My Path* was logged and noted in our chart review for 7.3% of the patients (5.3% for *My Path* participants; 9.3% for *My Path Plus*) who had information sent to their provider.

Physician notation in the EHR concerning the *My Path* program was extremely variable. Of those interviewed, five physicians documented discussing the *My Path* program in the patient’s chart; the remaining physicians were sent goal information but made no documentation. One physician was sent

Table 3 | Physician recommendations for program improvement

Recommendation	Description	Quotation
Easy access to behavioral goals	Problem list, pre-visit report, patients include goals with glucose readings, wallet size goal card	"If there is time during clinic visit that would be a good place to see [goals] and to act on them."
Establish a research specialty visit to review goals	Highlight patient and appointment as research, specific phone visit with PCP, nurse/diabetes care manager, specific e-mail visit with PCP. Combine visits on same day	"I think this is a good use of my time or care manager's or nurse's time." "Set up phone visit with 20 questions with PCP to review goals. Studies show better outcomes if advice comes from PCP and then the patient would see engagement from the PCP on care and management issues." "Set up nurse visit same day as the office visit to encourage goals and provide a cohesive appointment."
Make it simple and efficient	Physicians only have time to reinforce goals	"I would love to be able to reinforce the lifestyle changes and support the patient goals, but it must be very quick and simple."
Concerns related to computer access and literacy	Expressed concerns related to the use of technology to compliment care	"It is harder to reach the unmotivated patients. They also may have less access to computers." "I agree that using more modern technology with applications and smart phones...but many patients cannot afford their medications right now and will not be upgrading technology any time soon."
Integrate with existing programs	Greater utilization of diabetes care manager; population management	"I am more interested in how we integrate [research] with the other programs. You need to let other programs know about the process and how it will work with them."
Primary care recruitment	Recruit or refer patients to program through primary care with smart sets	"I would like to see something automated with the first visit. For example, type in a smart set and patients are automatically linked to this program and other resources." "I am willing to add website referrals to the after visit summary (AVS) along with the KP resource links I already provide if he can be included in a smart set."

PCP primary care physician

goal information about seven patients, yet documented no *My Path* discussions. In contrast, two physicians, who were not interviewed, documented discussing the *My Path* program with 75%–100% of patients for whom they were sent goal information via the staff messaging feature.

DISCUSSION

Our experience and data indicate that, in general, patients accepted the IHCA program [16]. They found it useful and moderately helpful but did not discuss it in much detail with their care providers, despite prompts to both parties to do so. Despite the implementation of this study within a health care system having a state-of-the-art EHR, we encountered considerable and ongoing challenges to integrating the IHCA into patients' clinical care, as evidenced by the low volume of clinical documentations. Most of the linkage challenges were not due to technical challenges or to limitations of the website but rather to the

understandable lower priority given to the research project than to urgent clinical care and demands made on a small information technology staff. We learned that it is not a good idea to implement a research project involving EHR components during a major EHR system upgrade. In addition, although we had good support from the clinical staff and administration, the project was not given priority from IT staff.

Results from the physician interviews indicate that, although physicians see the need for self-management support for their patients, they may not have the time or resources to continuously engage in the process. As in other areas of clinical care, physicians said they prefer to "write a prescription" which results in appropriate actions being taken as opposed to the more nuanced activity of setting or adjusting tailored goals for eating and exercise. The extent to which physicians are or should be engaged in ongoing behavioral support in self-management programs remains a question [29]. An optimal

self-management support system would engage all members of the primary care team, with specific activities customized to individual offices [30]. This project only minimally engaged non-physician staff, which is a limitation. Our initial plan to have care managers actively engaged with the project fits with the diabetes care models used in KPCO, but this level of involvement had to be substantially reduced because of multiple changes and major reductions in the care management department.

Experience with tobacco-cessation programs is mixed on the extent to which physician involvement, beyond initial referral to programs such as quit lines and prescriptions of tobacco-cessation medications, is associated with quit success rates [31]. A review of health care information technologies to improve cardiovascular and diabetes medication adherence suggests that IHCA that provide real-time data to health care providers can enhance intervention effectiveness, and those that prompt providers to discuss adherence with their patients can result in modest intervention effects [32]. It is clear that, for optimal results, self-management support should be provided before, during, and after medical encounters; should support patient autonomy [33]; and should be tailored to patients and customized to local offices.

Summary and implications—This study was conducted within one HMO, one EHR, and one IHCA, which limits generalizability of results. Other limitations are that our evaluation primarily involved a retrospective approach and that the intervention was restricted in terms of the pervasiveness of its contact with patients and the extent to which it involved office staff besides the physician. Strengths include use of mixed methods to provide richer information regarding the viewpoints of both patients and providers and multiple data sources, including EHR data, surveys, interviews, and staff notes. Use of the participant's EHR to validate the extent to which reinforcement and advice for diabetes self-management occurred—and, more specifically, whether our study intervention penetrated or influenced communication during patient-provider encounters—was enlightening, if disappointing, and superior to relying on patient and physician recall alone. More mixed methods research is needed to explicate the implementation issues involved in attempting to link research-based chronic disease self-management programs with the rest of a patient's health care.

Acknowledgments: This paper is dedicated to the memory of Dr. Osuna, whose commitment to reducing health disparities and to integrating research and practice was an inspiration to us. This study was supported by grant DK35524 from the National Institute of Diabetes and Digestive and Kidney Diseases. All authors declare no conflicts of interest. Dr. Glasgow is now Deputy Director for Implementation Science, Division of Cancer Control and Population Sciences, National Cancer Institute. The opinions in this article do not necessarily represent those of the National Cancer Institute or any other body.

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