

Veterans Affairs Research on Health Information Technologies for Diabetes Self-Management Support

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Abstract

Background:

Like many patients with diabetes, Department of Veterans Affairs (VA) patients frequently fall short of self-management goals and experience multiple barriers to self-care. Health information technologies (HITs) may provide the tools that patients need to manage their illness under the direction of their primary care team.

Methods:

We describe several ongoing projects focused on HIT resources for self-management in VA. VA researchers are developing HITs that seek to bolster a variety of potential avenues for self-management support, including patients' relationships with other patients, connections with their informal care networks, and communication with their health care teams.

Results:

Veterans Affairs HIT research projects are developing services that can address the needs of patients with multiple challenges to disease self-care, including multimorbidity, health literacy deficits, and limited treatment access. These services include patient-to-patient interactive voice response (IVR) calling systems, IVR assessments with feedback to informal caregivers, novel information supports for clinical pharmacists based on medication refill data, and enhanced pedometers.

Conclusion:

Large health care systems such as the VA can play a critical role in developing HITs for diabetes self-care. To be truly effective, these efforts should include a continuum of studies: observational research to identify barriers to self-management, developmental studies (e.g., usability testing), efficacy trials, and implementation studies to evaluate utility in real-world settings. VA HIT researchers partner with operations to promote the dissemination of efficacious services, and such relationships will be critical to move HIT innovations into practice.

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Abbreviations: (AIM) Adherence and Intensification of Medications, (HITs) health information technologies, (IVR) interactive voice response, (QUERI) Quality Enhancement Research Initiative, (QUERI-DM) Diabetes QUERI, (VA) Veterans Affairs

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Introduction

The Department of Veterans Affairs (VA) health care system supports the largest network of applied health services researchers outside of the National Institutes of Health. VA investigators address a broad range of health care problems but emphasize research that can improve the health and health care of veterans. As many as 20% of VA patients have diabetes (more than one million individuals),¹ and the system serves as an ideal laboratory for developing health information technologies (HITs) that can improve diabetes self-management support. The purpose of this article is to describe some examples of ongoing VA HIT research that may enhance diabetes self-care, especially for patients with complex chronic conditions and limited access to traditional health services. More general reviews of HIT in the VA are available elsewhere.^{2,3}

The Need for Self-Management HIT among Diabetes Patients in the VA

Veterans Affairs patients are, on average, some of the sickest in the country. Almost all have at least one chronic health problem and many have three or more.^{4,5} Addressing the complexity of these patients' care highlights some of the weakest links in processes critical to quality diabetes self-management support: treatment coordination, effective patient education, promoting and helping sustain health behavior changes, and ensuring effective communication between patients and their health care teams. These challenges would be daunting under the best of circumstances, but are made even more difficult by the additional risk factors present among diabetes patients in the VA, enumerated next.

Health Literacy Deficits

As many as 62% of VA patients have inadequate functional health literacy.^{6,7} Health literacy deficits affect diabetes patients' health, self-care, and health care costs even when cofactors such as education, income, age, and race are controlled.^{8,9} Diabetes patients with low health literacy have more than twice the risk of retinopathy and nearly three times the risk of cerebrovascular disease compared to those with adequate literacy levels.⁸ Unfortunately, clinicians often do not recognize health literacy problems; one study reported that VA physicians underestimated African-American patients' health literacy problems more than half of the time.¹⁰ Perhaps as a consequence of the gap between patients' literacy levels and standard self-management resources, most patients remember as little

as 50% of what they are told during outpatient visits.¹¹⁻¹⁴ Those with the greatest need for health education (e.g., individuals with health literacy deficits) are often the least likely to absorb, process, and retain information.¹⁵⁻¹⁷

Health literacy deficits can significantly limit the utility of many information technologies for diabetes self-management support. While access to the Internet is increasing among older adults¹⁸ and Web-based diabetes education systems can be ideal for many patients, those with health literacy deficits often lack the ability to use computers and text-based communication as resources for their self-care. Given this reality, VA investigators are developing a range of HIT applications for diabetes self-management support, including those in which patients have little or no direct contact with technologic tools or computer interfaces.

Multimorbidity

Comorbid heart disease, depression, and other conditions are common among VA diabetes patients and complicate their management.¹⁹ Conditions such as depression and chronic pain impair patients' functioning and pose significant barriers to lifestyle changes and regimen adherence.²⁰⁻²³ Other disabling conditions, such as heart failure and dementia, can make standard diabetes self-care goals impossible to reach. Even when comorbid chronic conditions do not present functional barriers to patients' diabetes self-management, these conditions can serve as competing demands, sapping patients' time, energy, and financial resources.^{24,25}

Because many VA diabetes patients have comorbid conditions, patient-centered HIT applications have to focus on clearly defined, diabetes-relevant goals while adapting to patients' many other health care needs. One major challenge for multimorbid diabetes patients is to integrate the volumes of information regarding self-management for their various medical problems. HITs can assist these patients by providing diabetes self-care information in smaller, targeted, and timely doses both during outpatient visits and when patients are in the community.

Limited Treatment Access

Veterans Affairs patients travel farther to reach their usual source of care than patients in almost any other health care system. As a consequence, missed appointments pose a significant barrier to their disease management.

Although some veterans are able to schedule multiple clinic stops during the same day of VA care,²⁶ many miss visits because of transportation problems or the financial burdens associated with paying for travel.^{27,28} On the health system side, burgeoning caseloads mean that VA clinicians are limited in their ability to meet diabetes patients' needs for self-management support during face-to-face encounters.

Health information technologies may improve VA diabetes patients' access to self-care support both during and between outpatient visits. Many HITs have very low incremental costs once the system is in place and may provide a partial solution to the challenge of meeting guidelines for self-management support within the constraints of limited staff time and budgets.²⁹

Inadequate Informal Support

Patients' social networks can be a key resource for self-management support, particularly when they are elderly.³⁰ Unfortunately, older diabetes patients in the VA and elsewhere increasingly lack the social resources that they could use to meet the day-to-day demands of their conditions. The proportion of people who live alone in the United States is increasing steadily, currently comprising more than 26% of all households.^{31,32} Among people over age 65, the number of people living alone has increased to more than nine million. A recent review of published studies found that roughly 40% of VA patients are unmarried (i.e., two million veterans) with increasing proportions among African-Americans and those who are older. Of course, many diabetes patients need additional self-management support even if they have others in their household; however, the growing number of patients living alone or with inadequate connections to their social network is particularly at risk.

Health information technologies may play an increasingly important role in linking older diabetes patients with significant others who can assist them in managing their self-care. Telephones, email, automated calling systems, specialized Web sites, and other communication tools are being examined to bolster available supports for patients in the VA and elsewhere.

Examples of Diabetes-Focused HIT Research in VA

Veterans Affairs diabetes patients interact with a variety of groups that may serve as either supports or hindrances to their self-care (**Figure 1**). Patients' social networks, other veterans with diabetes, and a variety of clinicians

are all potential resources, although they usually are not as effective as possible because of constraints of time, coordination, and information. The following VA research projects are seeking to bolster patients' self-management support by strengthening these connections.

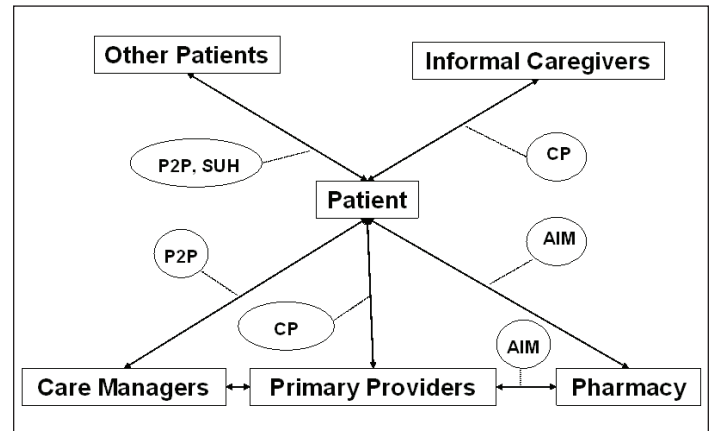


Figure 1. Communication links targeted by HITs for diabetes self-care. P2P, Peer to Peer Study; SUH, Stepping Up to Health; CP, CarePartners; AIM, Adherence and Intensification of Medications

Enhancing Patient-to-Patient (Peer) Support

One promising approach to enhancing diabetes self-management support is to increase mutual support among patients facing similar behavioral challenges. Peer-support interventions can reduce problematic health behaviors and alleviate depressive symptoms.³³ Such interventions also can assist patients in following their medication prescriptions and adhering to diet and exercise plans.³³⁻³⁷

Group visits are one mechanism for bringing patients together to discuss their common problems and to identify strategies for meeting self-care goals. Although group visits can improve outcomes among patients who attend,³⁸⁻⁴⁰ many VA patients cannot access frequent group visits due to the same barriers they face with standard medical encounters. Moreover, some patients prefer the relative anonymity and privacy of talking on a phone. Traditional telephone-based programs, however, have limitations.^{41,42} Participants may be reluctant to share their telephone numbers or pay the cost of long-distance calls. Many patients are willing to participate in peer-support calls but lack the initiative or organization to ensure that they make contacts regularly. From a health system perspective, telephone peer-support programs can be difficult to monitor and few, if any, have been designed to interface with standard outpatient nursing care.⁴²

In order to build on the strengths of group visits and the potential benefits of mutual patient support, VA investigators are conducting a multifaceted intervention study, the Peer-to-Peer Study, that links group self-management training with a peer-to-peer telephonic service facilitated by a specialized interactive voice response (IVR) system. The IVR service allows patients to (1) call their peer-support partner without charge, (2) enter a peer relationship without the need to share their home phone number or any identifying information, (3) designate times outside of which calls from their partner are blocked, (4) have all patient-to-patient calls blocked if they want to disenroll from the program, and (5) send and receive "live" and recorded telephone messages with a care manager when questions require clinical input.

In a pilot study, investigators found that the telephonic peer-support service was easy for VA diabetes patients to use, that it facilitated peer support, and that many patients were very satisfied with the intervention.⁴³ Over 80% of the peer-support pairs spoke at least once per week for 2 of the 6 weeks, with an average call duration of 24 minutes. At the end of the study, 92% of participants stated that they would be more satisfied with their VA care if a peer-support service like this were available, 65% found the calls helpful in managing diabetes symptoms, 73% felt that they had learned something new about diabetes self-management from the calls, and 82% reported that their partner helped them do things to stay healthy. Qualitative assessments of participants' comments at the end of the 6-week period further supported the hypothesis that participants found meaning and positive reinforcement for their own behavioral goals by supporting their partner's efforts at diabetes self-care.⁴³ VA investigators currently are conducting a randomized trial evaluating the impact of IVR-facilitated peer-support plus group visits on diabetes patients' self-management behavior, glycemic control, and service use.

Leveraging Support from Informal Caregivers

Given the strains on formal care systems and the growing number of older diabetes patients living alone, creative, low-cost strategies are needed to more effectively support informal caregivers in taking a constructive role in patients' self-care. Although studies examining the impact of interventions that include informal caregivers have had mixed results, services enhancing the role of informal caregivers overall can improve patients' self-management and health outcomes.⁴⁴⁻⁵¹

Veterans Affairs investigators are developing an intervention that can link patients with a "CarePartner" living outside of their household (e.g., an adult child living at a distance). Using this service, patients receive regular health and behavioral monitoring as well as feedback on reported problems via IVR telephone calls. Patients' CarePartners receive email reports based on patients' IVR assessments and have access to a comprehensive Web site with more detailed information about how they can help. Urgent health problems are reported to the patient's health care team via email and fax. In an ongoing feasibility study, investigators have found that many veterans are willing and able to identify a "CarePartner" to assist them in managing their cardiovascular risk factors. Patients receiving care at the Ann Arbor, Michigan VA Healthcare System are participating along with CarePartners as far away as California, Washington state, and Florida. Adult children are the most typically chosen CarePartners (selected by 73% of patients), although patients choose a variety of significant others, including other relatives, church members, and friends. Within the first weeks of pilot testing, the intervention was able to identify a patient experiencing an urgent health problem and prompt follow-up and treatment changes.

Improving Medication Adherence and Intensification

Pharmacologic therapy is the cornerstone of effective management for diabetes patients' hyperglycemia, lipids, and blood pressures. Successful clinical management requires an effective partnership between health care providers who initiate and intensify medications and patients who adhere to those treatments.⁵²⁻⁵⁴ However, there are multiple barriers to both patients' and providers' medication management and subsequent risk factor control. As a result, there are high rates of both poor medication adherence and failure to intensify medications on the part of clinicians.⁵⁵⁻⁵⁷ Despite the high prevalence of medication adherence problems, barriers to adherence such as side effects and regimen complexity often are not identified or addressed.^{19,58} Many providers do not have effective ways to identify patients with poor adherence nor the tools needed to address adherence barriers. Even when patients take their medication as prescribed, many fail to reach physiologic targets because their pharmacotherapy is not sufficiently intensified.^{52,54}

Veterans Affairs investigators are launching an implementation study, the Adherence and Intensification of Medications (AIM) Study, combining several approaches shown to be effective in improving diabetes

risk factor control: proactive outreach to patients who have adherence or intensification problems, tailored adherence counseling, and medication management delivered by a clinical pharmacist.^{59–63} Using the extensive electronic medical records of the VA, including comprehensive information about medication filling, clinical pharmacists will receive quarterly reports characterizing patients' history of adherence and medication changes. Pharmacists can use these reports to identify appropriate follow-up. Pilot testing of this intervention found that the majority of patients identified based on refill data as having adherence problems validated those problems via self-report. Almost all patients reported that the pharmacist intervention was helpful in addressing their barriers to medication use. The recently initiated trial will examine the effectiveness of this service on patients' medication doses, adherence, and success in reaching targets for glycemia, lipids, and blood pressure.

Promoting Physical Activity with Enhanced Pedometers

For people with diabetes, physical activity is essential for effective weight management and cardiovascular risk factor control.^{64,65} Unfortunately, interventions used to promote physical activity in clinical settings have been generally ineffective and/or too resource intensive to be feasible in real-world practices.⁶⁶ Pedometers may assist diabetes patients in increasing their walking by providing objective feedback on their activity levels.^{67,68} However, pedometer use is extremely difficult for a patient's health care team to monitor, and some clinicians fail to encourage activity among their diabetes patients because of concerns regarding cardiovascular risks. Tailored behavior change messages may enhance the potential benefits of pedometer use,^{69,70} but are rarely used effectively by a patient's primary care team.

The Veterans Walk for Health Study is a multicenter randomized controlled trial investigating the effectiveness of two different modes of pedometer step-count feedback on walking behavior. Veterans with risk factors for cardiovascular disease who have been referred by a physician for nutritional counseling are being enrolled from five sites nationally. Participants are assigned to a control arm or either (1) nutrition counseling with a simple pedometer to help with walking self-monitoring and goal setting or (2) nutrition counseling with an enhanced pedometer that captures detailed time-stamped step-count data. Step counts are uploaded from the enhanced pedometer to a Web site, and participants can review detailed graphs of their daily walking activity

online at home or with the dietitian during nutritional counseling sessions. The Veterans Walk for Health is part of a larger program of research called "Stepping Up to Health" that is developing comprehensive physical activity interventions that include enhanced pedometers and Web-based communication, including communication between patients and other people with using the system to increase their activity levels.

Discussion

This brief review highlights only a few of the HIT-related research studies being conducted by VA investigators that may improve self-management support for people with diabetes. Other VA groups outside of the research service are continually making significant advances in HIT as well. One of the most exciting is the "My HealthVet" program, in which the VA is developing a patient-accessible version of its electronic medical record, allowing more effective communication about self-care and disease management between face-to-face visits (see myhealth.va.gov). Prior studies suggest that shared electronic medical records can increase patients' satisfaction with care and self-care behaviors.⁷¹ More broadly, the evidence base for HITs in chronic disease care is growing, and a number of creative modalities have been shown to improve patients' treatment process and health outcomes.⁷²

As described earlier, VA investigators are developing HITs that increase self-management support for diabetes patients facing multiple challenges, including health literacy deficits, multimorbidity, and access barriers (**Table 1**). Given resource constraints and patients' diverse needs for assistance, investigators are developing HIT services that can leverage multiple possible supportive relationships in patients' lives (**Figure 1**). Based on our experience with these and other efforts, we believe that several lessons are important to consider in developing HIT interventions, as well as programs that foster innovation in diabetes-focused technologies.

Leveraging Existing Information Systems

Most of the interventions described earlier are being designed with a recognition that many health care systems lack a strong information infrastructure and that the patients such systems serve may be among those who benefit the most from innovation in self-management HIT. As such (with the exception of the AIM study), these interventions are being developed at least initially as stand-alone services, independent of any interfaces with medical records or other information tools. However,

Table 1.
Examples of Self-Management HIT under Development in the VA

Study	Description
Peer-to-Peer Study	Group self-management support visits plus patient-to-patient telephone calls between visits facilitated by specially designed telephonic technology allowing for toll-free calling, patient anonymity, call blocking, and reminder calls.
AIM	Graphical reports based on patients' electronic medication refill data to inform pharmacist counseling and decisions about medication changes.
The CarePartner study	Regular, automated patient assessment calls with email feedback to informal caregivers living outside of the home, an Internet patient status page, and faxes to primary care providers after urgent health problems.
Stepping Up to Health	Advanced pedometers uploading to personalized Web sites with tailored information promoting physical activity. Advanced sites include opportunity for patient-to-patient comparison of step counts and team-based competition.

the AIM study demonstrates the potential power of leveraging the valuable medication refill and treatment effectiveness data available in the VA as well as other integrated health care systems. New HIT programs may be able to tailor communication based on patients' existing records, making these services more effective agents of behavior change and conveying to patients that the HIT is part of a coordinated effort to improve their health under the direction of their primary provider.

One of the most difficult challenges facing behavioral interventions is maintaining behavior changes over extended periods. Unfortunately, patients' use of HITs often decreases over time, thereby limiting the potential for long-term effectiveness.⁷³⁻⁷⁶ Studies suggest that patients are much more likely to maintain their use of HITs when those services are seen as tightly linked with their overall care.⁷⁷ By integrating information from these services with patients' electronic medical records, primary care providers, case managers, nutritionists, and diabetes educators will be better able to play a role in tailoring patients' interactions with novel self-management support technology and to use the information from these interactions in their ongoing counseling for patients during outpatient visits and over the telephone.

A Range of Research Must Support New Diabetes-Focused HITs

The axiom "more research is needed" has frequently frustrated patients, clinicians, and funders looking for answers to pressing health care problems. However, too often HIT interventions are developed based on inadequate evidence on the barriers faced by diabetes patients to improving their self-care. Development of new diabetes-focused HITs should recognize that effective research programs must employ a range of strategies,

including (a) *observational research* to identify gaps in care, patient and clinician barriers to disease self-management, and the factors facilitating translation of innovations into practice; (b) *developmental research* (e.g., alpha and beta testing) to ensure that new patient-centered technologies are designed in ways that are acceptable and accessible to patients; (c) *interventional research* to determine the efficacy of new modalities to support diabetes self-care; and (d) *implementation research* to determine and enhance the effectiveness of these interventions in real-world health care and community settings. The VA has been successful in encouraging research along this continuum with an emphasis on creating effective and disseminatable new services. Like the National Institutes of Health and other large funders, the VA has been somewhat more reluctant to invest in development for novel HIT interventions. Developing new services can be time and resource intensive, and the payoff for such investments in the short term is often uncertain. Nevertheless, large funders should devote some resources as "venture capital" to foster novel technology development by research teams with the experience and skills needed to make timely progress.

Researchers, Clinicians, and Health System Managers Must Work Together to Translate Research into Practice

Recognizing the need to both develop and translate interventions into clinical practice, in 1998 the VA began the Quality Enhancement Research Initiative (QUERI). QUERI centers bring together expertise to develop, implement, and evaluate interventions to improve quality of care and outcomes for veterans with common conditions, including diabetes. Improving self-care support is a priority area for the Diabetes QUERI (QUERI-DM). The QUERI program focuses on enhancing real-world effectiveness of programs whose efficacy has been

demonstrated previously. As such, QUERI-DM research emphasizes the essential role of working with partners in operations (at local and national levels) to identify clinical and health system needs and to work together to implement and evaluate solutions.⁷⁸ Such partnerships will be critical if HIT self-management support systems are to be effective and reach a broad audience.^{79,80}

Conclusions

Like many large health care systems, the VA health care system is struggling with how to meet the growing needs of patients with diabetes and other chronic health problems. Numerous VA investigators are working to develop HITs that may improve self-management support for veterans and other people with diabetes. To be most effective, patient-centered HITs should focus on bolstering the full array of diabetes patients' supportive relationships and include a complement of observational, developmental, interventional, and implementation research.

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References:

1. Department of Veterans Affairs Office of Public Affairs. VA achievements in diabetes care: fact sheet. Available from: <http://www.va.gov.health.diabetes.default.htm>.
2. Kupersmith J, Francis J, Kerr E, Krein S, Pogach L, Kolodner RM, Perlin JB. Advancing evidence-based care in diabetes through health information technology: lessons from the Veterans Health Administration. *Health Aff (Millwood)*. 2007;26(2):w156-68.
3. Dorr D, Bonner LM, Cohen AN, Shoai RS, Perrin R, Chaney E, Young AS. Information technology to support improved care for chronic illness. *J Am Med Inform Assoc*. 2007;14(2):156-63.
4. Kazis LE, Miller DR, Clark J, Skinner K, Lee A, Rogers W, Spiro A 3rd, Payne S, Fincke G, Selim A, Linzer M. Health-related quality of life in patients served by the Department of Veterans Affairs: results from the Veterans Health Study. *Arch Intern Med*. 1998;158:626-32.
5. Frayne SM, Parker VA, Christiansen CL, Loveland S, Seaver MR, Kazis LE, Skinner KM. Health status among 28,000 women veterans: the VA Women's Health Program Evaluation Project. *J Gen Intern Med*. 2006;21:S40-6.
6. Chew LD, Bradley KA, Boyko EJ. Brief questions to identify patients with inadequate health literacy. *Fam Med*. 2004;36:588-94.
7. Arozullah AM, Lee SY, Khan T, Kurup S, Ryan J, Bonner M, Soltysik R, Yarnold PR. The roles of low literacy and social support in predicting the preventability of hospital admission. *J Gen Intern Med*. 2006;21:140-5.
8. Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, Palacios J, Sullivan GD, Bindman AB. Association of health literacy with diabetes outcomes. *JAMA*. 2002;288:475-82.
9. Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs AMA. Health literacy: report of the Council on Scientific Affairs. *JAMA*. 1999;281:552-7.
10. Kelly PA, Haidet P. Physician overestimation of patient literacy: a potential source of health care disparities. *Patient Educ Couns*. 2007;66(1):119-22.
11. Rost K, Carter W, Inui T. Introduction of information during the initial medical visit: consequences for patient follow-through with physician recommendations for medication. *Soc Sci Med*. 1989;28:315-21.
12. Crane JA. Patient comprehension of doctor-patient communication on discharge from the emergency department. *J Emerg Med*. 1997;15:1-7.
13. Rost K, Roter D. Predictors of recall of medication regimens and recommendations for lifestyle change in elderly patients. *Gerontologist*. 1987;27:510-5.
14. Thom DH, Kravitz RL, Bell RA, Krupat E, Azari R. Patient trust in the physician: relationship to patient requests. *Fam Pract*. 2002;19:476-83.
15. Williams MV, Baker DW, Honig EL, Lee TM, Nowlan A. Inadequate literacy is a barrier to asthma knowledge and self-care. *Chest*. 1998;114:1008-15.
16. Schillinger D, Piette J, Grumbach K, Wang F, Wilson C, Daher C, Leong-Grotz K, Castro C, Bindman AB. Closing the loop: physician communication with diabetic patients who have low health literacy. *Arch Intern Med*. 2003;163:83-90.
17. Williams MV, Baker DW, Parker RM, Nurss JR. Relationship of functional health literacy to patients' knowledge of their chronic disease. A study of patients with hypertension and diabetes. *Arch Intern Med*. 1998;158:166-72.
18. Madden M. Internet penetration and impact. 2006 Apr 26. Available from: http://www.pewinternet.org/PPF/r/182/report_display.asp pewinternet.org 2006.
19. Piette JD, Kerr E. The role of comorbid chronic conditions on diabetes care. *Diabetes Care*. 2006;29:239-53.
20. Ciechanowski PS, Katon WJ, Russo JE. Depression and diabetes: impact of depressive symptoms on adherence, function, and costs. *Arch Intern Med*. 2000;160:3278-85.
21. Piette JD, Heisler M, Krein S, Kerr EA. The role of physician trust as a buffer against medication non-adherence due to cost pressures. *Arch Intern Med*. 2005;165:1749-55.
22. Schoenberg NE, Drungle SC. Barriers to non-insulin dependent diabetes mellitus (NIDDM) self-care practices among older women. *J Aging Health*. 2001;13:443-66.
23. Krein SL, Heisler M, Piette JD, Makki F, Kerr EA. The effect of chronic pain on diabetes patients' self-management. *Diabetes Care*. 2005;28:65-70.
24. Jaén CR, Stange KC, Nutting PA. Competing demands of primary care: a model for the delivery of clinical preventive services. *J Fam Pract*. 1994;38:166-71.

25. Chernof BA, Sherman SE, Lanto AB, Lee ML, Yano EM, Rubenstein LV. Health habit counseling amidst competing demands: effects of patient health habits and visit characteristics. *Med Care.* 1999;37:738-47.
26. McCarthy JF, Piette JD, Fortney JC, Valenstein M, Blow FC. Outpatient visit chaining among patients with serious mental illness. *Med Care.* 2006;44:257-64.
27. Piette JD, Moos RH. The influence of distance on ambulatory care use, death, and readmission following a myocardial infarction. *Health Serv Res.* 1996;31:573-91.
28. Schmitt SK, Phibbs CS, Piette JD. The influence of distance on utilization of outpatient mental health aftercare following inpatient substance abuse treatment. *Addict Behav.* 2003;28:1183-92.
29. Glasgow RE, Bulls SS, Piette JD, Steiner JF. Interactive behavior change technology: a partial solution to the competing demands of primary care. *Am J Prev Med.* 2004;27:80-7.
30. Arno PS, Levine C, Memmott MM. The economic value of informal caregiving. *Health Aff (Millwood).* 1999;18:182-8.
31. Bureau of Labor Statistics and the Bureau of the Census. CPS (Current Population Survey) basic monthly survey. Available from: [HUhttp://www.bls.census.gov/cps/bovrwv1.htm](http://www.bls.census.gov/cps/bovrwv1.htm)UH, 2003.
32. [www.census.gov: http://www.census.gov/Press-Release/www/releases/archives/families_households/006840.html](http://www.census.gov/Press-Release/www/releases/archives/families_households/006840.html).
33. Malchodi CS, Oncken C, Dornelas EA, Caramanica L, Gregonis E, Curry SL. The effects of peer counseling on smoking cessation and reduction. *Obstet Gynecol.* 2003;101:504-10.
34. Joseph DH, Griffin M, Hall RF, Sullivan ED. Peer coaching: an intervention for individuals struggling with diabetes. *Diabetes Educ.* 2001;27:703-10.
35. Keyserling TC, Samuel-Hodge CD, Ammerman AS, Ainsworth BE, Henríquez-Roldán CF, Elasy TA, Skelly AH, Johnston LF, Bangdiwala SI. A randomized trial of an intervention to improve self-care behaviors of African-American women with type 2 diabetes: impact of physical activity. *Diabetes Care.* 2002;25:1576-83.
36. Wilson W, Pratt C. The impact of diabetes education and peer support upon weight and glycemic control of elderly persons with noninsulin dependent diabetes mellitus (NIDDM). *Am J Public Health.* 1987;77:634-5.
37. Gildeen JL, Hendryx MS, Clar S, Casia C, Singh SP. Diabetes support groups improve health care of older diabetic patients. *J Am Geriatr Soc.* 1992;40:147-50.
38. Sadur CN, Moline N, Costa M, Michalik D, Mendlowitz D, Roller S, Watson R, Swain BE, Selby JV, Javorski WC. Diabetes management in a health maintenance organization. Efficacy of care management using cluster visits. *Diabetes Care.* 1999;22:2011-7.
39. Clancy DE, Brown SB, Magruder KM, Huang P. Group visits in medically and economically disadvantaged patients with type 2 diabetes and their relationship to clinical outcomes. *Top Health Inf Manage.* 2003;24:8-14.
40. Taylor CB, Miller NH, Reilly KR, Greenwald G, Cunning D, Deeter A, Abascal L. Evaluation of a nurse-care management system to improve outcomes in patients with complicated diabetes. *Diabetes Care.* 2003;26:1058-63.
41. Stewart MJ, Hart G, Mann K, Jackson S, Langille L, Reidy M. Telephone support group intervention for persons with hemophilia and HIV/AIDS and family caregivers. *Int J Nurs Stud.* 2001;38:209-25.
42. Rudy RR, Rosenfeld LB, Galassi JP, Parker J, Schanberg R. Participants' perceptions of a peer-helper, telephone-based social support intervention for melanoma patients. *Health Commun.* 2001;13:285-305.
43. Heisler M, Piette JD. "I help you, and you help me": facilitated telephone peer support among patients with diabetes. *Diabetes Educ.* 2005;31:869-79.
44. Peak T, Toseland RW, Banks SM. The impact of a spouse-caregiver support group on care recipient health care cost. *J Aging Health.* 1995;7:427-49.
45. DiMatteo MR. Social support and patient adherence to medical treatment: a meta-analysis. *Health Psychol.* 2004;23:207-18.
46. Hogan BE, Linden W, Najarian B. Social support interventions, do they work? *Clin Psychol Rev.* 2001;22:381-440.
47. Stewart S, Vandenbroek AJ, Pearson S, Horowitz JD. Prolonged beneficial effects of a home-based intervention on unplanned readmissions and mortality among patients with congestive heart failure. *Arch Intern Med.* 1999;159:257-61.
48. Pearson S, Inglis SC, McLennan SN, Brennan L, Russell M, Wilkinson D, Thompson DR, Stewart S. Prolonged effects of a home-based intervention in patients with chronic illness. *Arch Intern Med.* 2006;166:645-50.
49. Martire LM, Lustig AP, Schulz R, Miller GE, Helgeson VS. Is it beneficial to involve a family member? A meta-analysis of psychosocial interventions for chronic illness. *Health Psychol.* 2004;23:599-611.
50. Kalra L, Evans A, Perez I, Melbourn A, Patel A, Knapp M, Donaldson N. Training carers of stroke patients: randomised controlled trial. *BMJ.* 2004;328:1099.
51. Holder B. Family support and survival among African-American end-stage renal disease patients. *Adv Ren Replace Ther.* 1997;4:13-21.
52. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, Materson BJ, Oparil S, Wright JT Jr, Roccella EJ; National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure: the JNC 7 Report. *JAMA.* 2003;289:2560-72.
53. Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. *Med Care.* 2005;43:521-30.
54. Clinical Practice Recommendations 2005. *Diabetes Care.* 2005;28: S1-79.
55. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med.* 2005;353:487-97.
56. Berlowitz DR, Ash AS, Hickey EC, Friedman RH, Glickman M, Kader B, Moskowitz MA. Inadequate management of blood pressure in a hypertensive population. *N Engl J Med.* 1998;339:1957-63.
57. Phillips LS, Branch WT, Cook CB, Doyle JP, El-Kebbi IM, Gallina DL, Miller CD, Ziemer DC, Barnes CS. Clinical inertia. *Ann Intern Med.* 2001;135:825-34.
58. Heisler M, Vijan S, Anderson RM, Ubel PA, Bernstein SJ, Hofer TP. When do patients and their physicians agree on diabetes treatment goals and strategies, and what difference does it make? *J Gen Intern Med.* 2003;18(11):893-902.
59. Bosworth HB, Olsen MK, Gentry P, Orr M, Dudley T, McCant F, Oddone EZ. Nurse administered telephone intervention for blood pressure control: a patient-tailored multifactorial intervention. *Patient Educ Couns.* 2005;57:5-14.
60. Bosworth HB, Olsen MK, Oddone EZ. Improving blood pressure control by tailored feedback to patients and clinicians. *Am Heart J.* 2005;149:795-803.

61. Britt E, Hudson SM, Blampied NM. Motivational interviewing in health settings: a review. *Patient Educ Couns*. 2004;53:147-55.
62. Bero LA, Mays NB, Barjesteh K, Bond C. Expanding the roles of outpatient pharmacists: effects on health services utilization, costs, and patient outcomes. *Cochrane Database Syst Rev*. 2000;CD000336.
63. Shojania KG, Ranji SR, McDonald KM, Grimshaw JM, Sundaram V, Rushakoff RJ, Owens DK. Effects of quality improvement strategies for type 2 diabetes on glycemic control: a meta-regression analysis. *JAMA*. 2006;296:427-40.
64. American Diabetes Association. Standards of medical care in diabetes--2006. *Diabetes Care*. 2006;Suppl 1:S4-42.
65. Bassuk SS, Manson JE. Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease. *J Appl Physiol*. 2005;3:1193-1204.
66. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM; Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393-403.
67. Talbot LA, Gaines JM, Huynh TN, Metter EJ. A home-based pedometer-driven walking program to increase physical activity in older adults with osteoarthritis of the knee: a preliminary study. *J Am Geriatr Soc*. 2003;51:387-92.
68. Schneider PL, Bassett DR Jr, Thompson DL, Pronk NP, Bielak KM. Effects of a 10,000 steps per day goal in overweight adults. *Am J Health Promot*. 2006;21:85-9.
69. Pincus HA, Tanielian TL, Marcus SC, Olfson M, Zarin DA, Thompson J, Magno Zito J. Prescribing trends in psychotropic medications: primary care, psychiatry, and other medical specialties. *JAMA*. 1998;279:526-31.
70. Peterson TR, Aldana SG. Improving exercise behavior: an application of the stages of change model in a worksite setting. *Am J Health Promot*. 1999;13:229-32.
71. Earnest MA, Ross SE, Wittevrongel L, Moore LA, Lin CT. Use of a patient-accessible electronic medical record in a practice for congestive heart failure: patient and physician experiences. *J Am Med Inform Assoc*. 2004;11:410-17.
72. Ross SE, Moore LA, Earnest MA, Wittevronge L, Lin CT. Providing a web-based online medical record with electronic communication capabilities to patients with congestive heart failure: randomized trial. *J Med Internet Res*. 2004;6:e12.
73. Tate DF, Jackvony EH, Wing RR. Effects of internet behavioral counseling on weight loss in adults at risk for type 2 diabetes. *JAMA*. 2003;289:1833-6.
74. Tate DF, Wing RR, Winett RA. Using internet technology to deliver a behavioral weight loss program. *JAMA*. 2001;285:1172-7.
75. Pinto BM, Lynn H, Marcus BH, DePue J, Goldstein MG. Physician-based activity counseling: intervention effects on mediators of motivational readiness for physical activity. *Ann Behav Med*. 2001;23:2-10.
76. McKay HG, Feil EG, Glasgow RE, Brown JE. The feasibility and use of an Internet support service for diabetes self-management. *Diabetes Educ*. 1998;24:174-9.
77. Piette JD. Using telephone support to manage chronic disease. California Health Care Foundation. Available from: <http://www.chcf.org/topics/chronicdisease/index.cfm> 2005.
78. Hayward RA, Hofer TP, Kerr EA, Krein SL. Quality improvement initiatives: issues in moving from diabetes guidelines to policy. *Diabetes Care*. 2004;Suppl 2:B54-60.
79. Lefant C. Clinical research to clinical practice: lost in translation. *N Engl J Med*. 2005;349:868-74.
80. Glasgow RE. Translating research to practice: lessons learned, areas for improvement, and future directions. *Diabetes Care*. 2003;26:2451-6.