Translating Effective Clinic-Based Physical Activity Interventions into Practice

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Abstract: An increasing number of studies report on the efficacy of physical activity interventions conducted in, or in conjunction with, clinical settings. This article reviews the status of the literature with regard to translation to practice and describes methods that will heighten the likelihood of translation. In general, few physical activity programs have been designed for translation, and the diffusion models underlying most reported programs have relied on an assumption of linear diffusion into practice. However, recent developments are encouraging and examples are provided of programs that utilize relationship or systems approaches to translation.

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Promoting physical activity during medical visits has intuitive appeal. First, medical clinics are geographically distributed across the nation and have a broad reach into the population.[1–3] Second, physicians are considered credible and objective sources of health-related information.[1] However, there is little evidence that clinical physical activity interventions are being translated into practice.[4] The purpose of this article is to describe the current state of research and clinical practice as it relates to the translation of evidence-based physical activity recommendations and programs conducted in, or in conjunction with, outpatient medical offices. As will be highlighted, research findings and guidelines related to the benefits of different amounts of physical activity for wellness, weight management, and cardiovascular fitness have been disseminated broadly. However, promising clinic-based physical activity interventions have not achieved the same result. We highlight current information on promising clinic-based physical activity interventions and propose models and processes by which the translation of clinic-based physical activity programs can be improved.

Dissemination of Physical Activity Recommendations

Much has been published on the essential nature of regular physical activity across the lifespan for psychological and physical health during pregnancy, physical development of children, and sustained health-related quality of life throughout adulthood and into the senior years.[5–10] These findings have been formulated into a range of recommendations and disseminated, most broadly by the U.S. Surgeon General's report on Physical Activity and Health.[11] As a result of these recommendations and additional research findings,[12–14] the promotion of regular physical activity is a policy goal of *Healthy People 2010*.[15] In addition, physical activity interventions that can be incorporated into primary care have been identified as a high priority area for the National Heart, Lung, and Blood Institute's Working Group on the Primary Prevention of Hypertension.[16] Finally, as with the broad recommendations for primary prevention, secondary prevention recommendations for regular physical activity have also been disseminated broadly.[17]

Current Evidence Base for Medical Office-Based Physical Activity Interventions

The attraction of using medical offices as a location for physical activity interventions developed primarily for two reasons. First, because of the breadth of the population that is served by primary care providers, medical offices represent a location to deliver interventions that could have a broad public health impact. In fact, a recent study suggests that as many as 90% of patients would consider participating in a physical activity intervention initiated through a medical office.[18] Second, patients perceive physicians as highly credible sources of medical information, which extends to physician-delivered prescriptions for physical activity.[19] Based on these tenets, clinical interventions have focused primarily on physician counseling as the channel for physical activity promotion.[19–24] However, the U.S. Preventive Services Task Force (USPSTF) reported that there is inconclusive support for the effectiveness of this approach.[24] It is important to note that the USPSTF did not recommend against physical activity counseling,

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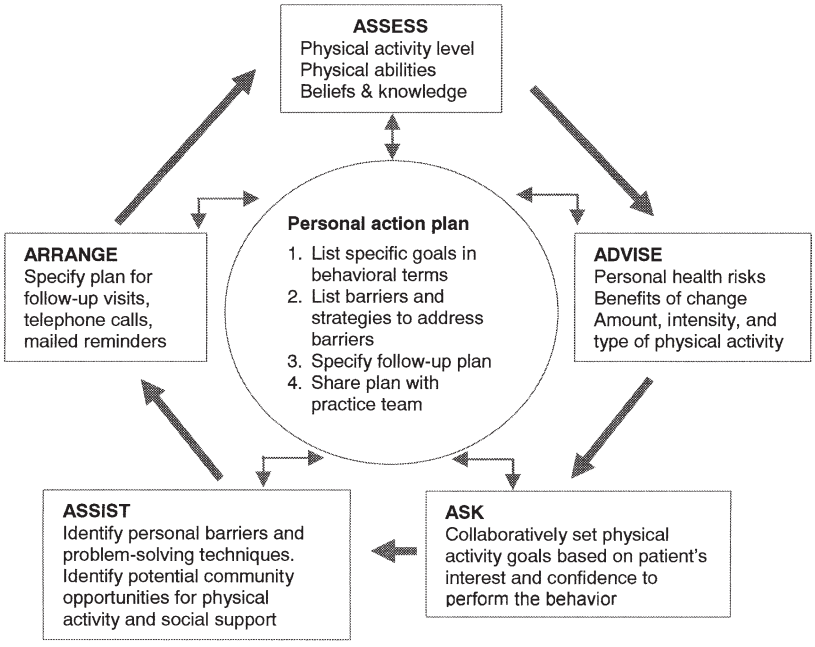

Figure 1. A schematic to direct effective physical activity promotion in a primary care setting.

rather they concluded that at the time of the review there was insufficient evidence to make a conclusive recommendation. In contrast, there is strong evidence that community interventions that include social support and individually tailored health behavior–change programs can lead to increased participation in physical activity.[25]

Coupling recent research with the USPSTF findings of inconclusive evidence for physician counseling alone supports the need for a more-comprehensive model for physical activity promotion delivered in clinical settings that moves beyond the exclusive domain of physician–patient interactions. Specifically, there is good evidence that physical activity promotion initiated and/or supported by healthcare clinics can be effective, but it is necessary to understand that:

(1) Physicians' intervention activity can be reduced to a short period of time, less than 3 minutes in some cases, and still demonstrate an effect,[26,27] but most primary care physicians do not have even this much time.
(2) Sharing the load of intervention activities can be accomplished by health educators, community personnel, or other clinical staff.[26–29]
(3) Tailored interventions that include a focus and input from the patient during the development of a personal action plan that includes collaborative goal setting, strategies to overcome barriers, and monitoring progress are more effective than generic prescriptions of activities.[26–28,30]
(4) Simply asking about and advising increased physical activity will not lead to sustained behavior change.[26,30,31]
(5) A promising path to improve the maintenance of intervention effects is the integration of counseling with community opportunities for physical activity support.[25–27,32,33]

5A's of Behavior Change

Each of these conclusions related to effective clinical physical activity interventions can be operationalized using the 5A's behavior-change schematic that was initially developed to assist in clinic-based smoking-cessation programs[34] and, more recently, has been applied to physical activity promotion.[20,26,35] This schematic (Figure 1) represents a useful tool for planning intervention timing, content, and delivery agent needed for each intervention component. The schematic includes: (1) assessing physical activity status, ability, and readiness to change; (2) providing advice on possible changes relative to personalized benefits and recommended guidelines; (3) collaboratively agreeing with a patient on a plan of action and identifying personal barriers to the plan; (4) assisting participants in the identification of strategies to overcome personal barriers to behavior change; and (5) arranging for follow-up assessment, feedback, and support.[35]

It is clear that under the circumstances and conditions that currently prevail in the U.S. healthcare system, it is simply not possible for the average clinician to implement all or even most of the 5A's strategies for patient support recommended above. As documented by Stange et al.[36] and Yarnell et al.,[37] the primary care physician is faced with an impossible task of accomplishing all the currently recommended care and preventive procedures in a 10- to 15-minute visit, let alone

adding physical activity counseling. In particular, the critically important fourth and fifth A's (Assist and Arrange) are the most challenging to conduct in the usual primary care setting[38] by the physician, who is faced with a multitude of competing demands.[39] Even the researchers of well-designed studies that effectively implemented the majority of the 5A's content via the physician highlight the limitation of the intensity of the intervention for generalizability or use in standard care.[30]

Recent Clinical Trials Using 5A's Components

Three notable trials have been published on clinic-based physical activity interventions since the completion of the USPSTF report that each used multiple components of the 5A's in an attempt to improve on previous physician counseling interventions (Table 1). These studies were selected for review because they reflect a range of physician involvement within successful medical office-based interventions and were not included in the USPSTF review. Petrella and associates[30] determined the effectiveness of the Step Test Exercise Prescription (STEP) intervention. STEP was a physician-led goal-setting intervention that included assessment of participant fitness level, development of a tailored physical activity program, participant self-monitoring and quarterly follow-up with the participants' physician, where feedback on progress and new goals were provided. The comparison condition in the STEP trial included generic physician instruction on general guidelines for physical activity. The researchers found that STEP participants significantly improved cardiovascular fitness when compared to control participants. This difference was sustained at 6 and 12 months after introduction of the intervention. The time spent on physical activity counseling was also significantly higher for participants in the STEP intervention (about 11 minutes per session) when compared to generic counseling (about 7 minutes[30]). In this trial, the physician was responsible for assessing, advising, asking, assisting, and arranging for follow-up—all of the 5A's. In their conclusions, the authors suggest that this model may not be replicable in a typical clinic, but also that the intensity of the intervention may be necessary to produce meaningful improvement.

Similar to Petrella et al.,[30] Pinto et al.[26] also combined and compared a traditional physician counseling intervention with a more-intensive tailored intervention. This study was designed explicitly using the 5A's. Physicians provided basic assessment and advice while the health educators completed each of the 5A's across multiple contact times. The health educator–delivered intervention included a tailored behavioral intervention (based on stages of change) delivered via three face-to-face meetings, a physical activity prescription based on readiness to change, 12 counseling telephone calls averaging 10 to 15 minutes each, and 12 mailed tip sheets—all delivered over a 6-month period. After 3 months of intervention, participants who received the physician advice plus health educator follow-up significantly increased their weekly physical activity by approximately 1 hour per week when compared to the advice-only controls. This change was sustained for 6 months after initiation of the intervention.[26]

Finally, Ackermann and colleagues[27] leveraged community resources as a follow-up to physician counseling for physical activity. In their trial, 31 primary care providers were randomized to a "provider prompt for physical activity" intervention or a "provider prompt for tobacco" control condition. Physicians in the physical activity condition were provided with an assessment card at the time of the visit that indicated if the patient was appropriate for physical activity advice. Those determined to be appropriate also received a physician recommendation to add physical activity to their lifestyle and a detailed physical activity resource guide for their area. The physical activity intervention significantly increased physical activity advice provided by the physicians and patient reports of regular exercise when compared to tobacco controls.[27] In this case, research assistants completed the assessment while the physician's role was simply that of advising patients to be more active and providing modest assistance to help patients achieve general goals. The remainder of the 5A's were left to the patient to discover through community resources. An interesting, but unreported, question related to the study outcomes is if the physical activity intervention decreased physician attention to cessation of tobacco use.

Lack of Evidence That Promising Clinic-Based Interventions Are Translated Into Practice

Translation of research into practice can be defined as the uptake, implementation, and sustainability of research findings within standard care. This brief review of recent studies, the USPSTF review, and *Community Guide* findings suggest that there is evidence that medical office-based physical activity interventions can lead to successful behavior change when applied in a manner that consistently implements the 5A's of behavior-change counseling. As such, there is a need to achieve translation of these programs into practice. In spite of the promising advances in clinic-based physical activity interventions, there is little evidence that this research is being translated into practice.[40] A number of authors have suggested that it may be that the process by which promising or evidence-based interventions are typically identified might, in fact, itself inhibit the ability to translate those interventions into practice.[41,42] For example, a recent article that described the dissemination of innovations in healthcare suggested that there is a

Table 1. Applying the 5A's model to recent clinical PA interventions

Strategy	Study	Who	What	Where	When	How
Assess	Petrella[a] (2003)[30]	Physician	Step test to determine fitness level	Exam room	During visit with physician	Patients stepped up and down two small steps 20 times
	Pinto (2005)[26]	Research staff and physician	7-day PA recall	Clinic and exam room	Prior to and during visit with physician	Interview method
	Ackermann (2005)[27]	Research staff	Prompt card and PACE scale	Waiting room	Prior to visit with physician	PACE and prompt card completion facilitated by research staff
	Estabrooks (2005)[40]	Front-desk staff	Patient PA self-assessment card	Waiting room	Provided with regular patient sign-in forms	Patients receive card with single yes/no question related to regular PA
Advise	Petrella[a] (2003)[30]	Physician	Advice based on patient heart rate during step test	Exam room	During visit with physician	Patients were provided with tailored exercise prescription based on current rate and fitness level
	Pinto (2005)[26]	Physician	Advice on CDC/ACSM PA guidelines	Exam room	During a supplemental visit with physician	Focused on providing advice on the amount and intensity of PA that should be completed by patients
	Ackermann (2005)[27]	Physician	Preprinted prescription for PA and comprehensive PA resource guide	Exam room	During visit with physician	Physician reinforces prescription and advises patient to contact community exercise site
	Estabrooks (2005)[48]	Physician	Referral card and tip sheet	Exam room	During visit with physician	Patient PA self-assessment provided physician prior to interacting with the patient. If not meeting PA recommendations then physician refers to PA program
Agree	Petrella[a] (2003)[30]	Physician	Not described	Not described	Not described	Not described
	Pinto (2005)[26]	Health educator	Face-to-face counseling session	Not described	Following physician encounter	Stage-of-change-based intervention strategies that include specific goal setting
	Ackermann (2005)[27]	Community resources	Left to participant to determine with assistance from community resources	Community	At discretion of patient	Patient encouraged to contact community exercise site
	Estabrooks (2005)[40]	Health educator	Developed personalized action plan	Clinic conference room	Within 1 month of physician encounter	Patients worked with health educator to set appropriate goal for PA
Assist	Petrella[a] (2003)[30]	Physician	Provision of information on resources for PA and provided self-monitoring resources	Clinic	During visit	Not described
	Pinto (2005)[26]	Health educator	Additional face-to-face counseling sessions and introduction of 10–15-minute counseling telephone calls	Calls delivered to patient homes	Multiple contacts spread over a 6-month period	Patient assistance is provided based on stage-of-change–matched intervention material

(*continued on next page*)

Table 1. (*continued*)

Strategy	Study	Who	What	Where	When	How
	Ackermann (2005)[27]	Community resources	Left to participant to determine with assistance from community resources	Community	At discretion of patient	Patient encouraged to contact community exercise site
	Estabrooks (2005)[40]	Health educator	Developed personalized action plan	Clinic conference room	During initial group visit	Patients use peer sharing and interaction with health educator to identify potential obstacles and strategies to overcome them
Arrange	Petrella[a] (2003)[30]	Physician	Follow-up step tests	Exam room	3, 6, and 12 months following the initial visit	Physician repeats testing and provides modified PA plans for patient
	Pinto (2005)[26]	Health educator	Additional face-to-face counseling sessions and introduction of 10–15-minute counseling telephone calls	Calls delivered to patients homes	Multiple contacts spread over a 6-month period	Patient assistance is provided based on goal attainment and stage of change matched intervention material
	Ackermann (2005)[27]	Community resources	Left to participant to determine with assistance from community resources	Community	At discretion of patient	Patient encouraged to work with community exercise site
	Estabrooks (2005)[40]	Health educator	Revision of personal action plan	Clinic conference room and call to patients homes	One and 3 months following baseline assessment	Patient revises plan during a second group visit with health educator and a follow-up telephone counseling session

[a]Petrella (2003)[30]: As only a single intervention visit with the physician that lasted 3 to 5 minutes, we chose to characterize physician involvement in only the "advise" column here, but it should be noted that physicians were trained on the 5A's model.

ACSM, American College of Sports Medicine; CDC, Centers for Disease Control and Prevention; PA, physical activity; PACE, Patient-Based Assessment and Counseling for Exercise.

paucity of information related to how a new intervention fits within the variety of medical clinics,[43] and Green pondered, "Where did the field get the idea that evidence of an intervention's efficacy from carefully controlled trials could be generalized as THE best practice for widely varied populations and settings?"[44]

Most research projects do not reflect on the basic five characteristics of an intervention that will heighten the likelihood of adoption in clinical settings.[43,45] First, new interventions should be able to demonstrate a relative advantage over standard care. As such, intervention studies with no treatment or artificial controls are less likely to have information necessary for a practitioner to decide to adopt the innovation. Intervention advantage relative to cost and need for reimbursement is important information, necessary for the future uptake of interventions. Second, interventions need to demonstrate the degree to which they are compatible with existing values, past experiences, and the needs of the organizations that are ultimately targeted to deliver the intervention in practice. Third, the complexity of an intervention related to the level of difficulty associated with understanding and delivering it will influence translation. Fourth, interventions need to be "trialable" or have the ability to be tested easily on a limited basis. Fifth, the results of the intervention must be visible to those who will ultimately adopt and deliver the program.[43,45]

Recent clinic-based physical activity intervention research has provided evidence on relative advantage over and above simple physician advice for physical activity.[26,30] Similarly, results of these intervention studies include observable changes in physical activity.[19,24,28,46–48] Yet, there is very little information related to the compatibility of interventions within primary care settings, the trialability, or if the level of complexity is too high for large-scale translation.

An additional and related challenge to the translation of medical office-based physical activity interventions into practice is lack of information available on the external validity of most studies.[4] This lack of information ties directly to the paucity of evidence that interventions are developed that are compatible with the systems where they are ultimately intended to be implemented. Glasgow and colleagues[4] reviewed the extent to which physical activity, nutrition, and smoking cessation intervention studies collected and reported on data related to internal and external validity. The RE-AIM planning and evaluation framework was used as a template to structure the review and includes the following components: (1) the reach of the intervention—percent and representativeness of participants; (2) the efficacy or effectiveness of the intervention to promote health behavior change, improved quality of life, and avoid unintended negative consequences; (3) the adoption or proportion of clinical settings that agree to deliver the intervention and their representativeness to the target population of settings; (4) the implementation of the intervention based on study protocol and associated costs; and (5) the maintenance of physical activity at the individual level and the sustainability of delivery at the clinic level. They found that a low proportion of studies report on external validity dimensions, such as the representativeness of the sample to the target population, the proportion of settings that agree to deliver the intervention, and the likelihood for organizational sustainability. They concluded that there is a large cumulative imbalance in researchers' attention to internal versus external validity and that those concerned with the translation of their results should report more consistently on RE-AIM dimensions that target external validity.[4]

Models of Research Translation

The short history of efforts to translate physical activity research programs into practice closely parallels that of the dissemination of evidence-based healthcare practices in general.[49–51] Best et al.,[51] in their White Paper document for the National Cancer Institute of Canada (NCIC) working group on "Research Translation and Knowledge Integration," outlined and discussed three different stages and historical approaches to knowledge translation that apply quite well to physical activity.

Linear models of translation. The first approach, which predominated from 1960 to the mid-1990s, they term **linear (diffusion) models**. The key assumptions in this model are that knowledge is a product; that it is generalizable across contexts; that it is a logical process; and that if researchers publish their results, then clinicians and decision makers would naturally read and adopt efficacious programs. This linear diffusion model has not worked well for any area of science[52,53] and results primarily in dissemination of intervention information from one research group to other research groups. However, a positive example, The Cancer Control PLANET (Plan, Link, Act, Network with Evidence-based Tools) website, provides an updated version of the linear diffusion model (http://cancercontrolplanet.cancer.gov), where researchers can place the description and content of their interventions, and practitioners are encouraged to find appropriate research-tested interventions. Unlike traditional linear diffusion, the content provided on the PLANET website does report on many of the issues relevant to broader dissemination and outreaches to practitioners.

Relationship models of translation. Best et al.[51] identified and termed **relationship models** as a second wave in translational efforts. Relationship models have received increasing attention from the mid-1990s to the present, although they have their roots in much earlier work on patient-centered counseling and community-based participatory or action research.[54] The key assumptions that underlie such partnership or "knowl-

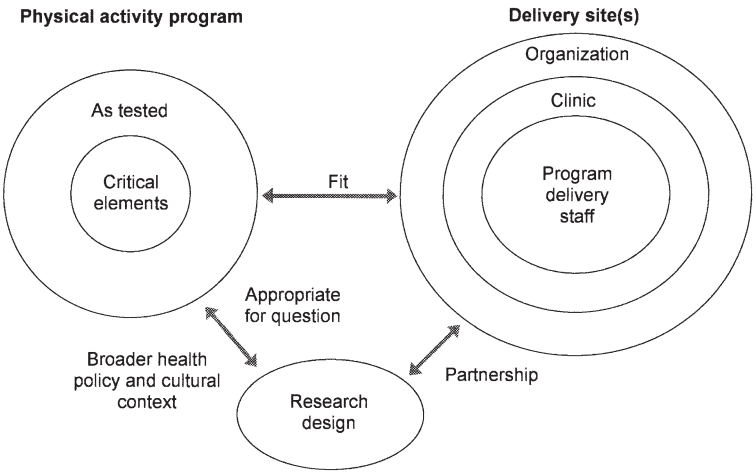

Figure 2. Simplified systems model of physical activity translation research.

edge exchange" approaches are that knowledge comes from multiple sources—research **and** practice; that the key translational processes are interpersonal and involve social relationships; and that translation partnerships are most successful if they are collaborative.

An example of the relationship approach is the Robert Wood Johnson Foundation–supported Active for Life project. This national program is funding nine different organizations across the United States to employ their choice of one of two evidence-based physical activity programs for older adults,[55–58] and—in partnership with program developers—to determine the effectiveness of these programs when delivered in practice. This model is based on the assumption that delivery organizations will bring practical knowledge from the field on the methods to best apply the physical activity interventions into practice. The program developers bring a different knowledge—the research expertise to identify effective intervention strategies and to ensure treatment fidelity. Across the implementation of the evidence-based programs in these organizations, ongoing communication between practice representatives and program developers allowed for a successful demonstration of effectiveness.[59]

Systems models of translation. The final "systems model" of research translation is just starting to be implemented, according to the NCIC working group authors. They feel that the key concept to this approach is of knowledge integration, and the key assumptions to this systems model are that transfer is above all contextual, and tied to priorities and culture. This evolving model also assumes that relationships are critical, but must be understood from a multilevel systems perspective. Although this model has not yet been widely applied, it has great potential to incorporate the contributions of the earlier models and also to fill gaps by focusing attention on issues not included in the earlier models. The systems model is more comprehensive and inherently transdisciplinary. It is consistent with social-ecologic models of health behavior and has implications for the nature of the evidence considered. The systems model posits that (1) knowledge integration depends heavily on the context; and (2) strategies for translation will be different at the individual, organizational, and broader network levels.

A multilevel systems approach (Figure 2) to translation is helpful because it underlines the importance of context. Physical activity programs take place, and patients participate (or decline to do so) under a complex and interacting set of social, medical, economic, family, physical, and behavioral conditions. Thinking broadly, using a systems approach to consider programs and patients in context offers great promise to enhance our understanding, explain apparently discordant findings, and ultimately succeed in the application of research findings in practice contexts.

Space does not permit a detailed discussion, but a fertile area for future research and translation suggested by a systems approach concerns the effects of and interfaces of physical activity programs with policy. Health policies can affect all stages of physical activity program translation and substantially alter participation rates and effects. Policy can also have large impacts on adoption (e.g., clinics or physicians will consider a program based on whether or not they are reimbursed); implementation (e.g., what gets measured, reported, and considered—such as pay for guidelines performance); and sustainability (if program goals are not aligned with policy and organization contexts, the program is unlikely to be continued). To date, there have been relatively few reports on the interface of health policies and physical activity. With increased emphasis on healthy communities and healthy environments,[60] we look forward to more reports on the impact and moderating effects of health policies.

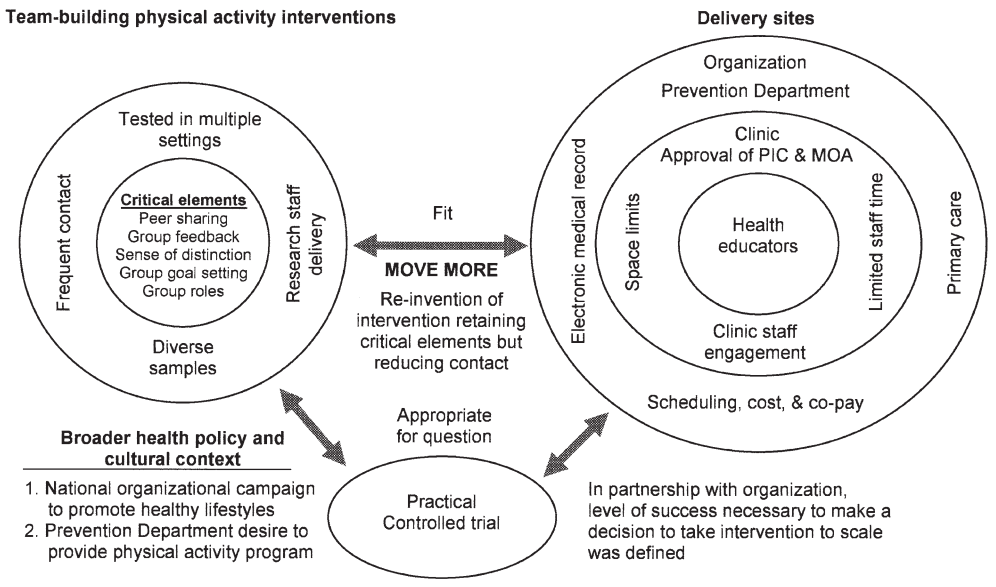

Figure 3. Application of simplified systems model to physical activity intervention research.
PIC, physician in charge; MOA, medical office manager.

Move More: An Example of a Multilevel Systems Approach to Translation

A trial was recently completed that utilized a multileveled systems approach to heighten the likelihood of system uptake, implementation, and sustainability of the intervention.[40,61] Figure 3 depicts the application of a systems model to the development, testing, and translation of Move More, a medical office-based team building physical activity intervention (see Table 1 and Estabrooks et al.[40] for the Move More application of the 5A's).

The targeted delivery sites for Move More were primary care clinics housed with Kaiser Permanente Colorado. Kaiser Permanente Colorado (KPCO) is a group model, closed panel, nonprofit health maintenance organization providing integrated healthcare services to approximately 430,000 members. KPCO has a fully integrated computerized medical record system in the patient-care arena, that in addition to patient charts, includes scheduling functions, coding capabilities (i.e., what a visit was for), and payment structure—all important issues when developing new program content. KPCO currently has over 270 primary care physicians in 16 separate ambulatory medical offices spread geographically across the greater metropolitan area of Denver. Each clinic has a physician in charge (PIC) and medical office manager (MOA) who have control over space use, office staff time and activities, and programmatic decision making for their clinic. KPCO also includes a prevention department that employs health educators, weight-management specialists, and dietitians who deliver programs across KPCO clinics.

A team-building intervention based on the conceptual model developed by Carron and Spink[62] to apply the principles of group dynamics to physical activity promotion was used as a template to identify the appropriate evidence-based properties of Move More. The conceptual model provides a number of principles that can be used to improve group cohesion and adherence to physical activity. The principles include developing a sense of group distinctiveness; targeting norms through group goal setting; composing groups of individuals within geographic proximity of one another; and fostering ongoing group interactions and communication to provide feedback, information sharing, and collective problem solving. These principles are the foundation for a number of physical activity interventions that demonstrated efficacy when tested using randomized controlled trials with a variety of samples.[62–67]

The broader health policy and cultural context of KPCO facilitated the project's completion. Specifically, the chief of preventive medicine identified a need to provide patients with support to improve physical activity that was similar to the organizational structures in place to promote healthful eating and smoking cessation. This resulted in development of a physical activity task force that included representation from the prevention department leadership and family medicine. Health educators who were targeted to ultimately deliver physical activity counseling and who had experience utilizing the electronic medical record for coding and scheduling were included in the task force. Finally, the PIC and MOA from a KPCO clinic who were interested in being a pilot site for a physical activity

promotion intervention participated as regular members of the task force. Concurrent with the development of the physical activity task force, Kaiser Permanente National adopted a mission to support members in participating in regular physical activity and healthful eating.

One of the first decisions of the task force was to adopt a group-based model for physical activity promotion. The decision was made in part because of evidence documenting the efficacy of such physical activity interventions and in part because of the understanding of the contextual issue that limited resources would not allow for one-on-one counseling opportunities. Ultimately, the Move More intervention was developed as two 2-hour small-group sessions, spaced 1 month apart, followed by a single supportive telephone counseling session 2 months later. It was developed to ensure that all of the critical intervention elements were addressed (Figure 3). The task force agreed that the success of the program could be improved through the process of physician counseling on physical activity. However, given numerous competing demands and logistical challenges, rather than completing training on appropriate counseling styles, physicians were simply instructed to determine the physical activity level of a patient (via patient self-report card) and refer them to a physical activity program. Health educators then completed proactive outreach recruitment calls to all referred patients.

With the program developed and ready for testing, KPCO leadership was involved in the discussion of outcome information that would be necessary to take Move More to scale, across the region and at multiple clinics. KPCO leadership identified two critical questions that needed to be answered to allow for wide application of the program. First, is the program better than providing patients with self-help materials that are currently available at KPCO? Second, does the program help patients to sustain behavior change even after the program is complete?

To make the research design appropriate to the organizational question, a practical controlled trial approach was adopted.[41] The 115 patients who received a referral to increase their physical activity were randomized to receive Move More or a standard care physical activity self-help kit. Patients in the control group received the content via mail in the form of: (1) a letter from their physician, (2) a personal action plan workbook, and (3) materials on local resources for physical activity. Multivariate analyses of variance indicated a significant time effect at follow-up. By three months, all participants, regardless of condition, increased weekly minutes of moderate physical activity up to approximately 115 minutes. However, at six months post-intervention, patients in the control group were participating in approximately 40 minutes per week, compared to approximately 140 minutes per week for patients who participated in Move More—a difference that was statistically significant. In addition, participant characteristics were compared to the population characteristics of the census tracts that surrounded the intervention clinic and demonstrated good ethnic representation (approximately 25% African American and 15% Latino). Study participants were slightly older and more likely to be female (60%) than the general census-tract population. Based on findings of the practical controlled trial, the process to implement Move More throughout the region is well underway. In addition, space and resources have been secured to expand program delivery to four clinics over the next quarter.

Move More explicitly addressed KPCO system priorities, culture, and context by using an integrated systems research model, as summarized in Figure 3. Through the KPCO physical activity task force, research evidence was integrated with tacit knowledge of system resources, structure, and policies to inform organizational decision making. Issues beyond simply changing physical activity, such as facility scheduling, coding in the electronic medical record, resource availability, and cost of delivery were addressed to ensure the ability to sustain Move More once the formal research study was complete. Finally, Move More was integrated into KPCO practice because it was built to fit a managed care system, it demonstrated relative advantage over standard care, and it identified early the necessary information and resource constraints.

Issues of Cost and Generalizability

Some obvious questions arise about the cost and generalizability of Move More. These are typically the most frequent concerns that potential adopters have about health-promotion programs: what does it cost and will it work here? Usually, a decision maker is concerned about the costs to their organization in the short-run, rather than the total "societal costs" of a program.[43,68] Such information should include both the direct and indirect costs of recruitment of participants, program materials, equipment, and staff to deliver the program.[69] The intent is to estimate the "replication or purchase costs" and, therefore, costs of delivering the program in a different setting.[70,71] Two caveats are in order here. First, "costs are not costs are not costs": most organizations have different budgets for personnel versus equipment, and up front versus ongoing costs. Second, because other settings will almost definitely differ from the organization that develops and initially evaluates a program, "sensitivity analyses" are often appropriate that can vary factors such as the cost of personnel, the number of potential participants, type of recruitment or delivery mechanisms, and the impact of different costing and cost-sharing structures or policies.[68]

This brings up the complex issue of disseminating or introducing a research-tested intervention into settings different from that in which it was originally developed. Because local opinion leaders and input will, by definition, not be able to be involved in the initial program development and testing, the issue of social marketing, or presenting the program in ways congruent with the values, priorities, and context of potential adopting organization(s) becomes important.[42] The same attributes that Rogers recommended above are important, and trialability and adaptability to fit local conditions may be especially important.[43,45] To facilitate adoption, it is also helpful to "package" the intervention (e.g., http://cancercontrolplanet.cancer.gov) and to specify those essential functions or principles of a program that cannot be altered versus those that are customizable or able to be adapted to fit local conditions.[45]

Recommendations for Researchers to Enhance Translation of Clinic-Based Physical Activity Interventions

We recommend three general areas of consideration prior to the development and efficacy testing of any clinic-based physical activity intervention. First, consistent with a systems approach to translation, it is necessary to identify and understand the system structure(s) in which the intervention will be delivered.[45] It is advisable to complete an assessment of the explicit purpose or mission of an organization. The research team should also understand the roles of individuals within the organization based on various positions and duties. This includes an understanding of the authority structure—who is responsible to whom or who can give orders to whom. A final systemic consideration includes having a clear picture of the informal practices, norms, and social relationships among members, as well as more formal organizational rules and regulations. Implicit within this recommendation is that researchers must partner with representatives from the system where the intervention is ultimately intended for delivery.

Second, we recommend that researchers attend to the characteristics of an intervention that will heighten the likelihood of translation.[43,45] It is necessary to understand current practices that may compete with a new intervention and demonstrate the degree to which the new intervention is better than the existing program or idea that precedes it or is currently in place. Intervention activities should be framed in ways that are consistent with existing values, past experiences, and the mission and needs of the organization. The intervention should be easy to understand and implement. Finally, the planning group should consider ways to improve the degree to which the intervention can be tested on a limited basis while demonstrating observable effects, and allowing for reinvention.

Many of the issues and challenges in translating physical activity research into practice concern generalization or external validity. There are two primary sets of generalization questions relevant to physical activity. The first set is of concern to policymakers and organizations such as the Centers for Medicare and Medicaid Services or the Centers for Disease Control and Prevention. These questions revolve around the "robustness" or breadth of conditions under which research results apply. For example, can similar results be obtained when programs are administered to different population subgroups, in different (especially low-resource) settings, when delivered by staff having levels of expertise and experience different from those in the research study?

The second set of questions is asked most often by clinicians or local decision makers and is related to specificity. These parties want to know, "Will this program work in MY setting, with my patients, under our conditions?" The robustness and specificity questions can be considered different ends of a continuum regarding the external validity of study findings. Both types of generalization questions can be addressed productively by the transparency of reporting and by adopting a systems perspective, as discussed above. Transparency of reporting[72] involves reporting methods and results concerning patient recruitment and representativeness, staff training and expertise, and results across a variety of potential moderator variables or conditions, so that judgments can be made regarding how broadly and under what conditions the findings from a study can be applied.

Third, it is recommended that researchers develop strong partnerships with potential delivery systems to plan for translation of clinic-based interventions at the outset, rather than at the conclusion of a research study or when they are attempting to disseminate an efficacious program.[54] Partnerships are critical in agenda setting and aligning research interests with systemic needs. Strong delivery-system partners can also aid in the matching of areas of need with intervention strategies and can assist in redefining and restructuring strategies to improve the chances of robust implementation. Finally, organizational partners can provide compelling testimonials in support of translation and ultimately the integration or assimilation of intervention implementation into standard care. This does not limit intervention research to scientists who are embedded within delivery systems, but it does highlight the need for better partnerships with systems that could deliver an intervention once efficacy is demonstrated.

Conclusion

As illustrated in Figures 2 and 3, a systems perspective model of physical activity translation research focuses on interactions among the physical activity program, the delivery setting(s), and the research or evaluation design. This model stresses the importance of contextual factors and the interactions among contextual factors and outcomes (moderator effects). Although oversimplified, these figures illustrate the complexity and importance of understanding that program delivery staff is embedded within clinics or other practice settings, which in turn are embedded within larger organizations. Because of these consistencies across systems, although Move More may not be generalizable to a community health center, the process that was used to develop and translate it is.

Relationships and alignment issues are also important in a systems model. Figure 3 calls attention to the degree of alignment between: (1) the physical activity program and the delivery site(s) in terms of mission and values (fit); (2) the delivery site and research evaluation design and researchers (partnership); and (3) research design and the physical activity program (appropriateness for the questions asked and decisions to be made). As can be seen, all of the interactions take place within the broader health policy and cultural/social-environmental context.

To advance the current state of physical activity translation, it is important to understand the contextual elements in Figures 2 and 3. As detailed in Green and Glasgow,[73] transparent reporting on the topics of (1) reach and representativeness at both individual and setting levels, (2) program implementation and adaptation over time, (3) outcomes important for decision making (including costs and moderator effects), and (4) maintenance and program sustainability would do much to improve the current state of knowledge. These issues are as important for translation research and knowledge integration as the Consolidation of Standards for Reporting Trials criteria are for efficacy research.

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References

1. Green LA, Dodoo MS, Ruddy G, et al. Physician workforce of the United States: a family medicine perspective. Washington DC: Robert Graham Center; 2004.
2. Zuvekas A. Health centers and the healthcare system. J Ambul Care Manage 2005;28:331–9.
3. Chin MH, Cook S, Jin L, et al. Barriers to providing diabetes care in community health centers. Diabetes Care 2001;24:268–74.
4. Glasgow RE, Bull SS, Gillette C, Klesges LM, Dzewaltowski DA. Behavior change intervention research in health care settings: a review of recent reports, with emphasis on external validity. Am J Prev Med 2002;23:62–9.
5. Janz KF, Burns TL, Torner JC, et al. Physical activity and bone measures in young children: the Iowa Bone Development Study. Pediatrics 2001;107:1387–93.
6. American College of Sports Medicine. Position stand: exercise and physical activity for older adults. Med Sci Sports Exerc 1998;30:992–1008.
7. Rejeski WJ, Mihalko SL. Physical activity and quality of life in older adults. J Gerontol A Biol Sci Med Sci 2001;56(Spec No 2):23–35.
8. Blair SN, Kohl HW, Paffenbarger RS, et al. Physical fitness and all-cause mortality: a prospective study of healthy men and women. Jama 1989;262:2395–401.
9. Blair SN, Kohl HW, Barlow CE, et al. Changes in physical fitness and all-cause mortality: a prospective study of healthy and unhealthy men. Jama 1995;12;273:1093–8.
10. Blair SN, Connelly JC. How much physical activity should we do? The case for moderate amounts and intensities of physical activity. Res Q Exerc Sport 1996;67:193–205.
11. U.S. Department of Health and Human Services. Physical Activity and Health: A report of the Surgeon General. Pittsburgh, physical activity: Superintendent of Documents; 1996.
12. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. Jama 1995;1;273:402–7.
13. American College of Sports Medicine. Position stand: the recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. Med Sci Sports Exerc 1998;30:975–91.
14. Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fatty acids, cholesterol, protein, and amino acids. Washington DC: National Academy Press; 2002.
15. U.S. Department of Health and Human Services. Healthy people 2010: understanding and improving health. Washington DC: Office of Disease Prevention and Health Promotion, U.S. Department of Health and Human Services; 2000. p. 1–50.
16. National High Blood Pressure Education Program. Working group report on primary prevention of hypertension, 1993. Report no. NIH Pub No. 93-2669.
17. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care 2004;27:S15–35.
18. Jimmy G, Martin BW. Implementation and effectiveness of a primary care based physical activity counseling scheme. Patient Educ Couns 2005;56:323–1.
19. Activity Counseling Trial Writing Group. Effects of physical activity counseling in primary care: the activity counseling trial: a randomized controlled trial. Jama 2001;286:677–87.
20. 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.
21. Swinburn BA, Walter LG, Arroll B, Tilyard MW, Russell DG. The Green Prescription Study: a randomized controlled trial of written exercise advice provided by general practitioners. Am J Public Health 1998;88:288–91.
22. Pfeiffer BA, Clay SW, Conatser RR. A Green Prescription Study: does written exercise prescribed by a physician result in increased physical activity among older adults? J Aging Health 2001;13:527–38.
23. Whitlock EP, Orleans CT, Pender N, Allan J. Evaluating primary care behavioral counseling interventions: an evidence-based approach. Am J Prev Med 2002;22:267–84.
24. Eden KB, Orleans T, Mulrow CD, Pender NJ, Teutsch SM. Does counseling by clinicians improve physical activity? a summary of the evidence for the U.S. Preventive Services Task Force. Ann Intern Med 2002;137:208–15.
25. Kahn EB, Ramsey LT, Brownson RC, et al. The effectiveness of interventions to increase physical activity: a systematic review. Am J Prev Med 2002;22(4s):73–107.
26. Pinto BM, Goldstein MG, Ashba J, Sciamanna C, Jette A. Randomized controlled trial of physical activity counseling for older primary care patients. Am J Prev Med 2005;29:247–55.
27. Ackermann RT, Deyo RA, LoGerfo JP. Prompting primary providers to increase community exercise referrals for older adults: a randomized trial. J Am Geriatr Soc 2005;53:283–9.
28. Eakin EG, Glasgow RE, Riley KM. Review of primary care-based physical activity intervention studies: effectiveness and implications for practice and future research. J Fam Pract 2000;49:158–68.

29. Lobo CM, Frijling BD, Hulscher MEJL, et al. Improving quality of organizing cardiovascular preventive care in general practice by outreach visitors: a randomized controlled trial. Prev Med 2002;35:422–9.
30. Petrella R, Koval J, Cunningham D, Paterson D. Can primary care doctors prescribe exercise to improve fitness. Am J Prev Med 2003;24:316–22.
31. Glasgow RE, Eakin EG. Medical office-based interventions. In: Snoek FJ, Skinner CS, eds. Psychological aspects of diabetes care. London: John Wiley and Sons, Ltd.; 2000. p. 142–68.
32. Brownson RC, Housemann RA, Brown DR, et al. Promoting physical activity in rural communities: walking trail access, use, and effects. Am J Prev Med 2000;18:235–41.
33. Sallis JF, Owen N. Physical activity & behavioral medicine. Thousand Oaks CA: Sage Publications; 1998.
34. Goldstein MG, Whitlock EP, DePue J. Multiple health risk behavior interventions in primary care: summary of research evidence. Am J Prev Med 2004;27:61–79.
35. Estabrooks PA, Glasgow RE, Dzewaltowski DA. Physical activity promotion through primary care. Jama 2003;289:2913–6.
36. Stange KC, Woolf SH, Gjeltema K. One minute for prevention: the power of leveraging to fulfill the promise of health behavior counseling. Am J Prev Med 2002;22:320–3.
37. Yarnell KSH, Pollak KI, Ostbye T, Krause KM, Michener JL. Primary care: is there enough time for prevention? Am J Public Health 2003;93:635–41.
38. Glasgow RE, Eakin EG, Fisher EB, Bacak SJ, Brownson RC. Physician advice and support for physical activity: results from a national survey. Am J Prev Med 2001;21:189–96.
39. Nutting PA, Rost K, Smith J, Werner JJ, Elliot C. Competing demands from physical problems: effect on initiating and completing depression care over 6 months. Arch Fam Med 2000;9:1059–64.
40. Estabrooks PA, Smith-Ray RL. Clinical social cognitive physical activity interventions. Ann Behav Med 2005;29:SO30.
41. Tunis SR, Stryer DB, Clancy CM. Practical clinical trials: increasing the value of clinical research for decision making in clinical and health policy. Jama 2003;290:1624–32.
42. Glasgow RE, Magid DJ, Beck A, Ritzwoller DP, Estabrooks PA. Practical clinical trials for translating research to practice: design and measurement recommendations. Med Care 2005;43:551–7.
43. Berwick DM. Disseminating innovations in health care. Jama 2003;289:1969–76.
44. Green LW. From research to "best practices" in other settings and populations. Am J Health Behav 2001;25:165–78.
45. Rogers EM. Diffusion of innovations. 5th ed. New York: Free Press; 2003.
46. Eakin EG, Brown WJ, Marshall AL, Mummery K, Larsen E. Physical activity promotion in primary care: bridging the gap between research and practice. Am J Prev Med 2004;27:297–303.
47. Albright CL, Cohen S, Gibbons L, et al. Incorporating physical activity advice into primary care: physician-delivered advice within the activity counseling trial. Am J Prev Med 2000;18:225–34.
48. Blair SN, Applegate WB, Dunn AL, et al. Activity counseling trial (ACT): rationale, design, and methods. Med Sci Sports Exerc 1998;30:1097–106.
49. Zerhouni EA. Translational and clinical science—time for a new vision. N Eng J Med 2005;353:1621–3.
50. Rogers EM. Diffusion of innovations. 5th ed. New York: Free Press; 2003.
51. Best A, et al. NCIC Working Group on Translational Research and Knowledge Integration. The language and logic of research transfer: Finding common ground. Toronto: National Cancer Institute of Canada; 2005.
52. Glasgow RE, Marcus A, Bull SS, Wilson K. Disseminating effective cancer screening interventions. Cancer 2004;101(suppl 5):1239–50.
53. Glasgow RE, Lichtenstein E, Marcus AC. Why don't we see more translation of health promotion research to practice? Rethinking the efficacy to effectiveness transition. Am J Public Health 2003;93:1261–7.
54. Minkler M, Wallerstein N. Improving health through community organization and community building. In: Glantz K, Lewis F, Rimer B, eds. Health behavior and health education: theory, research & practice. San Francisco: Jossey-Bass; 1997. p. 279–311.
55. Dunn AL, Andersen RE, Jakicic JM. Lifestyle physical activity interventions—history, short- and long-term effects, and recommendations. Am J Prev Med 1998;15:398–412.
56. Dunn AL, Blair SN, Kohl HWI, Kampert JB, Marcus BH, Garcia ME. Project active: a randomized clinical trial of lifestyle and structured physical activity programs. Med Sci Sports Exerc 1997;29(5):S75.
57. King AC, Pruitt LA, Phillips W, Oka R, Rodenburg A, Haskell WL. Comparative effects of two physical activity programs on measured and perceived physical functioning and other health-related quality of life outcomes in older adults. J Gerontol 2000;55:74–83.
58. King AC, Brassington G. Enhancing physical and psychological functioning in older family caregivers: the role of regular physical activity. Ann Behav Med 1997;19:91–100.
59. Wilcox S, Dowda M, Griffin SF, et al. Results of the first year of Active for Life®: translation of two evidence-based physical activity programs for older adults into community settings. Am J Public Health. In press.
60. Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. Am J Prev Med 1998;15:379–97.
61. Almeida FA, Smith-Ray RL, Van Den Berg R, et al. Using a simple stimulus control strategy to increase physician referrals for physical activity promotion. J Sport Exerc Psychol 2005;27.
62. Carron AV, Spink KS. Team building in an exercise setting. Sport Psychologist 1993;7:8–18.
63. Rejeski WJ, Brawley LR, Brubaker PH, et al. Older adults with chronic disease: benefits of group-mediated counseling in the promotion of physically active lifestyles. Health Psychol 2003;22:414–23.
64. Brawley LR, Rejeski WJ, Lutes L. A group-mediated cognitive-behavioral intervention for increasing adherence to physical activity in older adults. J Appl Biobehav Res 2000;5:47–65.
65. Estabrooks PA, Carron AV. Group cohesion in older adult exercisers: prediction and intervention effects. J Behav Med 1999;22:575–88.
66. Spink KS, Carron AV. The effects of team building on the adherence patterns of female exercise participants. J Sport Exerc Psychol 1993;15:39–49.
67. Estabrooks PA, Fox EH, Doerksen SE, Bradshaw MH, King AC. The feasibility and effectiveness of a physical activity promotion intervention delivered in conjunction with congregate meals for frail older adults. J Aging Phys Act 2005;13:121–44.
68. Gold MR, Siegel JE, Russell LB, Wenstein MC. Cost effectiveness in health and medicine. New York: Oxford University Press; 2003.
69. Ritzwoller DP, Toobert DJ, Sukhanova A, Glasgow RE. Economic analysis of the Mediterranean Lifestyle Program. Diabetes Educ. In press.
70. Ritzwoller DP, Goodman MJ, Maciosek M, et al. Creating standardized cost measures across integrated health care delivery systems. J Natl Cancer Inst 2005;35:80–7.
71. Meenan RT, Stevens VJ, Hornbrook MC, Glasgow RE, Hollis JF. Cost-effectiveness of a hospital-based smoking cessation intervention. Med Care 1998;36:670–8.
72. Des Jarlais DC, Lyles C, Crepaz N, TREND Group. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. Am J Public Health 2004;94:361–6.
73. Green LW, Glasgow RE. Evaluating the relevance, generalization, and applicability of research: issues in translation methodology. Evaluation and the Health Professions. Eval Health Prof 2006;29:126–53.