Beginning With the Application in Mind: Designing and Planning Health Behavior Change Interventions to Enhance Dissemination

Lisa M. Klesges, Ph.D.
Department of Preventive Medicine
University of Tennessee Health Science Center

Paul A. Estabrooks, Ph.D.
Kaiser Permanente Colorado

David A. Dzewaltowski, Ph.D.
Community Health Institute
Kansas State University

Sheana S. Bull, Ph.D.
University of Colorado Health Sciences Center

Russell E. Glasgow, Ph.D.
Kaiser Permanente Colorado

ABSTRACT

Dissemination of behavior change interventions can be enhanced by considering key elements related to public health impact in the study design and planning phases of research projects. In this article we describe a framework of reach, efficacy/effectiveness, adoption, implementation, and maintenance known as RE-AIM and how it can be used to plan and design studies with features that can strengthen the potential translation of interventions. In describing how RE-AIM concepts were introduced to and adopted by 15 behavior change intervention studies as part of the Behavioral Change Consortium (BCC), we provide an example of practical application of the framework. Recommendations for applying the framework to study planning are based on literature reviews conducted by the RE-AIM workgroup and on discussions with investigators who participated in BCC. Utilizing RE-AIM as a planning framework may have increased attention to issues of external validity among BCC studies and enhanced the potential translation and dissemination of intervention findings into practice.

INTRODUCTION

The landmark review by McGinnis and Foege (1) estimated that one third of all deaths in the United States in 1990 were attributable to tobacco, sedentary behavior, or poor dietary habits. In response, researchers and health professionals have developed efficacious interventions to address smoking cessation, increased physical activity, and improved dietary habits (2,3). However, there is little indication that these efficacious interventions are being disseminated into mainstream practice; in fact, there is evidence they are not (4–6).

Translation and dissemination of behavioral intervention research into practice could be thwarted by the way intervention research is currently planned, conducted, and reported. Specifically, recent reviews of health behavior interventions demonstrated that researchers were far more likely to report information on internal validity compared to characteristics of external validity (4,7–10). This lack of reported external validity information reduces the availability of important contextual description relevant to decision making about potential dissemination of efficacious interventions (11). Efficacy studies generally provide internally valid estimates of program effects, primarily because they are conducted under highly controlled and optimal conditions with homogenously selected participants. However, the highly controlled conditions are not feasible to replicate or sustainable in practice or community settings. The classic efficacy research environment is fundamentally different from practice conditions in terms of participant characteristics, resource availability, competing time demands, and level of expertise of those implementing the intervention (4,12,13).

Balancing internal and external validity elements in study designs requires consideration of the purposes of testing an intervention (12,14); in general, researchers tend to focus on

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Lisa M. Klesges is now in the Department of Health Sciences Research at the Mayo Clinic.

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Reprint Address: L. M. Klesges, Ph.D., Department of Preventive Medicine, 66 North Pauline, Suite 633, University of Tennessee Health Science Center, Memphis, TN 38163. E-mail: lklesges@utmem.edu

TABLE 1
RE-AIM Dimensions for Evaluating Evidence for Dissemination of Behavior Change Interventions

RE-AIM Dimension	*Definitions*
Reach (individual level)	1. What percentage of the target population was excluded due to (a) exclusionary/inclusionary criteria and (b) refusal to participate? 2. Were excluded individuals representative to those participating in terms of social, demographic, and health characteristics?
Efficacy/Effectiveness (individual level)	1. Was there a large effect of the intervention on the primary outcomes? 2. Was the effect for positive outcomes, such as quality of life, greater than negative (unintended)? 3. Was the outcome robust across various subgroups (i.e., no or small effect modification)?
Adoption (setting level)	1. What percentage of settings and intervention staff within these settings (e.g., schools/educators, medical offices/physicians) were excluded due to (a) study selection criteria and (b) refusal to participate? 2. Were excluded settings and intervention staff representative to those participating?
Implementation (setting level)	1. To what extent were the various intervention components delivered as intended (in the protocol), especially when conducted by different (nonresearch) staff members in applied settings? 2. What were time and monetary costs of intervention implementation?
Maintenance (both individual and setting level)	Individual level 1. What percentage of participants finished the intervention and follow-up period and were they similar to those that dropped? 2. Was there a sustained intervention effect on the long-term outcome (minimum in 6–12 months following intervention)? Setting level 3. To what extent was the delivery of the intervention or components retained after the initial research period? 4. To what extent was the original program modified over time?

questions of internal validity in testing interventions (i.e., will it work *when compared to controls*?), whereas health practitioners are interested in external validity of interventions (i.e., will it work *in my setting*?), and policy- and decision makers extend external validity to include larger aspects of generalizability of an intervention (i.e., will it work *across diverse populations and settings in comparison to other alternatives*?). Methods and evaluation tools that incorporate aspects of both internal and external validity elements would facilitate the translation of research to practice by providing sound assessment of causal inferences and sound extrapolations to diverse populations and settings. The RE-AIM framework, developed by Glasgow, Vogt, and Boles (13), provides such a method to give balanced attention to both internal and external validity elements of research design and evaluation, and it can be used to estimate the potential public health impact of interventions.

The RE-AIM framework includes five dimensions (see Table 1) of reach, effectiveness, adoption, implementation, and maintenance (4,12,13,15) relevant to evaluating the potential for dissemination and public health impact of interventions

1. *R*each—the percentage and representativeness of individuals who are willing to participate in a given program.
2. *Efficacy* or Effectiveness (depending on the study)—the impact of an intervention on important outcomes, including potential negative effects, quality of life, and economic outcomes.
3. *A*doption—the percentage and representativeness of settings and intervention staff that are willing and able to adopt or try a health promotion program.
4. *I*mplementation—how consistently various elements of a program are delivered as intended by different intervention delivery personnel and the time/cost requirements of intervention.
5. *M*aintenance—the extent to which participants maintain behavior change and the sustainability of a program or policy in the settings in which it was applied.

The purpose of the reach and translation workgroup of the Behavioral Change Consortium (BCC; 16) was to offer BCC investigators information and suggestions from the RE-AIM framework that could be applied to their study planning and evaluation. It was our hope that by providing this information, investigators could increase the potential for dissemination and public health impact of their interventions. In this article we describe supporting literature and provide recommendations for applying the RE-AIM framework in future work to enhance the potential dissemination of behavioral medicine interventions. The recommendations are based on our discussions and experiences with BCC investigators and consultants and in response to literature reviews conducted by our workgroup (4). In this article we also describe the experience of the BCC investigators in

applying RE-AIM concepts. Specifically, surveys of investigators' plans to evaluate RE-AIM dimensions were administered early and later in the BCC projects, and these responses were compared to the literature review that summarized recently published behavior change studies and whether they had reported on RE-AIM elements (4).

APPLYING THE RE-AIM FRAMEWORK TO STUDY PLANNING FOR DISSEMINATION

Reach and Representativeness: Who Is Intended to Benefit From the Intervention?

The dissemination and public health impact of an intervention is enhanced if large and representative segments of the target audience can be included. Fostering recruitment and retention strategies to include a representative and diverse sample in the early stages of efficacy trials increases the saturation in a targeted population (17). For example, if a study goal is to apply a given intervention to a general diverse community, then sampling strategies, recruitment procedures, and eligibility requirements should be designed to target diversity in income, cultures, age, gender, and health status. Including multiple groups will provide generalizability estimates to calculate potential effect modification and prevention effectiveness for diverse populations (14).

Assembling a large and representative sample from a target population presents a challenge to researchers. Participatory methods are an avenue to build relationships with communities that could enhance recruitment of a target population (18–20). These partnerships are useful in identifying potential barriers to recruitment, designing intervention modalities that would enhance participation, and receiving feedback on specific recruitment and intervention materials, especially regarding their value and credibility. Delivering behavior change interventions in locations serving high-need populations can enhance the reach and participation. As examples within the BCC studies, the Healthy Youth Places Project described the necessity to target behavioral settings to improve both the reach and effectiveness of a physical activity and fruit and vegetable promotion intervention (21). Sedentary minority participants for Health Opportunities with Physical Exercise were recruited primarily through an urban health clinic for the working poor (22), and older adults, targeted for a nutritional intervention to increase fruit and vegetable intake, were recruited through senior centers (23). The Mediterranean Lifestyle program relied on letters and recommendations from primary care physicians, a known and credible source, to enhance participation rates (24). Additional recruitment strategies used by BCC investigators to address the challenge of reaching a diverse group of participants are described in further detail in this journal issue (25).

Evaluating the potential of an intervention for dissemination can begin by comparing the study sample to the intended target population on relevant social, demographic, and health characteristics. This is key to evaluating the eventual reach and generalizability of an intervention (7–10). Key assessments for Reach might include an estimate of the number and percentage of (a) people in the local population that have the targeted risk factor of interest (e.g., number of smokers, sedentary adults, or postmyocardial infarction cases), (b) the targeted population that will be eligible due to specific study inclusion and exclusionary criteria, (c) persons recruited by the study of this targeted population, and (d) eligible participants who agree to participate in the study. Comparing differences in health status, social and demographic characteristics, residence, and other intervention or target behaviors between those agreeing and declining to participate can estimate the representativeness of a sample. It is also possible to compare participants to persons with similar risk factors living in the same geographic area through reference to national surveillance data (e.g., Behavioral Risk Factor Surveillance System), community surveys, or other publicly available data such as census information. This is particularly useful when it is not possible, due to logistical or informed consent issues, to characterize those who decline participation. Querying for reasons for responding to the study recruitment as well as reasons for refusing study participation provides qualitative information to inform future work in this target population. Assistance with calculations and detailed explanations of reach are available (see http://www.re-aim.org/calc_reach.html).

Effectiveness: How Favorably Will the Intervention Perform in Practice?

Although a minimal intervention effect can produce public health benefit by reaching large numbers of people, dramatic change is more likely if robust interventions can maximize individual effects among numerous target groups. Interventions that are robust, relevant, and feasible, while minimizing attrition, nonadherence, and negative consequences across various constituents, are key to producing large effects when disseminated. In addition, appropriate and sensitive measures of behavior change are needed to determine the effectiveness of interventions. Many resources are available to help guide the development of interventions and their evaluation (26–28), so only brief overviews of behavior change principles, emerging approaches in intervention design, and discussion of measurement approaches to assess outcomes are outlined here.

Intervention effectiveness. In behavioral and social cognitive theory, individual behavior change is maximized when benefits of behavior change are apparent to the individual and have a high probability of occurrence, benefits are realized soon after new behaviors are enacted, and the response cost of behavioral change is low relative to the benefits realized (29). These tenets applied to intervention design might include tailoring communication to individuals (30,31), supporting individual change with social and environmental strategies (32), and reinforcing new behaviors by using personalized feedback (33,34), especially when noticeable health effects will be delayed. Goal setting also appears to be a useful innovation (35,36) as well as including other motivational aspects in interventions (37).

Within BCC projects, examples of tailored communication include stage-tailored interventions to increase fruit and vegetable intake (38) and multiple risk factor behavior change in a

health care setting (39). Motivational interventions among BCC studies were implemented to promote smoking cessation among parents of asthmatic children (40) and to increase physical activity and fruit and vegetable consumption in African American adults (41) and in firefighters (42). Goal setting was used to modify lifestyle risk factors in postmenopausal women with type 2 diabetes (24) and to increase physical activity among sedentary overweight adults (22).

Measuring effectiveness. Effective outcomes for dissemination can only be documented if sensitive, specific, and reliable measures that are appropriate for the targeted population and responsive to change by the intervention are included (43). Measuring multiple relevant outcomes can provide information to various constituents interested in evaluating the potential for dissemination of an intervention. In addition to strong measurement of the targeted behavioral outcome, assessing potential benefits and harms (44) of the intervention and participant quality of life (45) are important considerations for decisions regarding dissemination. In addition, evaluating the effects of specific intervention components to identify the critical elements of a program can be useful to judge the essential strategies needed in dissemination. Program planners are often interested in the minimal set of strategies that are needed to elicit behavior change or in incremental approaches, where the need for additional intervention or outside resources is "stepped up" after-evaluating responses to briefer, less-intensive interventions (46).

Estimating effectiveness of behavior change interventions for larger prevention efforts relies on explicit measurement of program retention and costs of the various aspects of the study including recruitment, retention, assessment, intervention delivery, and maintenance costs. Documenting intervention costs at very specific levels in terms of intervention materials, equipment, personnel, time, and space requirements allows potential program adopters to estimate replication costs in new settings. In addition, more sophisticated economic analysis of cost-effectiveness, projected cost-benefit, and sensitivity analyses for different size audiences are often useful to decision makers (47). As an example among BCC projects, the Stanford CHAT project is tracking the cost of a telephone-based intervention to promote physical activity to estimate its cost-effectiveness for public health application (48).

Adoption: How Many Settings and Interventionists Will Adopt the Intervention, and How Will They Do So?

Similar to the element of individual Reach into populations, designing an intervention to enhance its potential adoption by various settings and constituents can improve its dissemination and public health impact. Theoretically, organizations are more likely to adopt programs for dissemination when they are aware of the need for health promotion or risk reduction, perceive benefits for offering an intervention, evaluate the intervention program as having advantage to existing practice and other alternative programs, and have the capacity to participate and implement the intervention (49,50). However, little research has been conducted to test these theories empirically.

Experience suggests that adoption and dissemination of interventions may be enhanced by characteristics such as low complexity, ease of understanding program communications, compatibility with organizational values, low disruption of social environment, minimal time investment by an organization, limited risk of poor or uncertain results, observable intervention results, simplicity of reversing program or discontinuing intervention, ease of customizing or modularizing the intervention, and the ability to update and modify a program over time (51,52). Uptake of health and medical interventions is more likely to occur if contextual factors such as incentives and support, organizational structures, and visibility are included (53). Building interventions to fit the specific workflow of the organizational setting should increase its adoption; examples include office reminder systems built into routine health care practice that have increased immunization rates (54) and improved preventive screening in primary care settings (55).

Research is needed to better understand the specific elements related to dissemination of behavior change interventions. In a recent conference report, *Designing for Dissemination* (56), conclusions from a literature review of dissemination of cancer control approaches were discussed. Dissemination studies that had targeted health professionals, health organizations, or individuals revealed isolated techniques that appeared promising, but insufficient evidence prevented conclusive recommendations. A dearth of controlled studies comparing dissemination approaches was noted as a limiting characteristic. As evidence emerges, recommendations that indicate how best to design studies that will be widely adopted are anticipated (11).

A practical method to improve potential adoption of interventions is to conduct formative work with intervention settings and agents. This is helpful in determining whether a proposed intervention addresses an area of importance and relevance to the targeted settings and those delivering the program; addressing potential staff and setting barriers to participation; assessing concerns regarding program content, adoption, and implementation; and identifying unanticipated costs and potential adverse events. Needs assessments to describe delivery system characteristics will allow for intervention strategies to be developed to match resources. Preparing low-cost and detailed intervention and training materials that are easy to replicate and implement in practice settings and useful to a variety of delivery agents will also facilitate adoption. Several BCC interventions were delivered in collaboration with community organizations such as schools, fire stations, and health centers and appear to have potential for future dissemination through these and similar agencies (3).

Evaluating the representativeness of participating sites or organizations is key to estimating the potential for an intervention to be disseminated. Indicators parallel to those described earlier under Reach can be applied to evaluate Adoption at the level of contexts and settings. Tools to estimate appropriate denominators of eligible settings (when not available) and calculate adoption are available online (see

http://www.re-aim.org/2003/calculate-adoption.html). Recording and analyzing contextual elements relevant to various intervention delivery settings or staff allows estimates of differential impact on intervention outcomes. For example, different settings such as worksites; medical offices; community organizations; and agents such as teachers, physicians, and health educators can vary on the number of resources, level of expertise, and commitment to intervention programs (57). Understanding these contextual elements and other moderating variables is critical to understanding the current and potential impact of an intervention.

Implementation: How Will the Intervention be Delivered and Received in Practice?

Participatory research methods have been advocated (17,58,59) to improve the potential dissemination of interventions into practice. These methods are defined by involvement of potential users of research such as practitioners, service providers, and community members in the various stages of research planning and execution. This participatory process between research, practice, and community can enhance the relevance and acceptability of intervention approaches and methods of delivering the intervention to the target population (60–62).

Participatory methods of formative evaluation and feasibility prior to full-scale use of an intervention can be used to judge the acceptability and value of various strategies to the intended target population. This is important so materials can be adapted for cultural sensitivity, literacy, and local norms. Published examples of feasibility testing from BCC are not available, but other behavior change researchers have reported success in using these methods. For example, formative work for the Girls Health Enrichment Multi-site Studies (63) uncovered several key themes such as centrality of family, dislike of sports, and preference for dance that were considered in designing weight gain interventions among African American girls. Feasibility studies are important to assess how the intervention will work in various delivery settings and for various intervention staff, especially if delivery agents who are not health professionals (e.g., extension agents, teachers, volunteers, or lay health workers) will be used to deliver the intervention (57). Participatory process evaluation that establishes feedback loops and regular debriefing with those delivering the initial intervention and with participants can be key to identifying problems with attendance, adherence, or compensatory activities so that modifications can be made. Quality improvement methods such as the Plan, Do, Study, Act cycles and short-term evaluation have proven helpful in chronic illness management (64) and prevention (65) and can provide important qualitative information to revise materials and methods for future use. Standardized training materials and straightforward protocols bring greater consistency in intervention delivery and modular activities allow settings to identify choices compatible with local interest.

Evaluating the potential for successful dissemination of an intervention includes assurance that a program was delivered as intended and that an individual's participation occurred at a level to effect behavior change (66,67). These assessments are essential to understand intervention failures to determine whether the intervention was not potent or not implemented to the extent intended. Designing interventions with "built-in" process evaluation measures provides a way to maintain the ongoing implementation of the program and provides a tool to modify the program before it is disseminated. Further suggestions for assessing elements of implementation and treatment fidelity by BCC investigators are available (68).

Maintenance: Is Behavior Change Maintained and the Intervention Sustained?

Individual behavioral maintenance. Large investments or inputs by individuals or organizations may lead to short-term behavior change but are difficult to sustain over a long period of time (69,70). Although intensive behavioral interventions targeted at individuals can often elicit short-term improvement, relapse occurs at high rates and limits the effectiveness of interventions when disseminated. Empirical evidence to reduce relapse and improve maintenance is still accumulating, but recommendations to improve long-term behavior change include (a) continuing contact with participants perhaps through telephone, mail, Internet, or fax communications; (b) combined behavioral and pharmacological interventions; (c) increased social support and policies supporting individual behavior change; and (d) tailoring interventions to specific barriers to maintenance (69,70). Long-term follow-up assessment is an important aspect in evaluating maintenance of an intervention effect. Unfortunately, long-term maintenance information is not often reported in the behavior change intervention literature (4), and this makes it difficult to arrive at decisions about dissemination performance.

Sustaining intervention delivery. For organizations, sustaining the delivery of existing behavior change interventions after initial research has been completed is key to achieving successful dissemination and high public health impact. Therefore, planning for the resources and methods that can be sustained in each setting after the initial funding period expires may lead to greater long-term change. Factors related to the sustainability of programs are poorly understood. Theoretically, as with Adoption elements, interventions with low complexity and disruption, requiring minimal time and other investment, and that can absorb adaptation over time (51,52) are more likely to be sustained.

Evaluation of sustainability for dissemination purposes would include verifying that an intervention is still available in a given setting after the initial research period, assessing the number of participants still accessing the intervention program, and documenting any modifications to program delivery or materials. Describing policies, incentives, and organizational characteristics related to program maintenance can provide qualitative information on the potential for program sustainability. Models and assessment tools to evaluate sustainability and the level of institutionalization of health promotion programs are available (71–73). Evaluation of the organizational maintenance and last-

ing effects of health behavior interventions is seldom done (4) but could provide delivery staff and settings with information that will improve the understanding of the timing of behavior change, potential effectiveness of interventions at the individual level, and sustainability and institutionalization at the setting level.

Applying RE-AIM to the BCC

The BCC is a collaboration among 15 research grants funded by the National Institutes of Health (NIH) funded to investigate theory-based behavioral interventions designed to change tobacco use, sedentary lifestyle, poor diet or alcohol abuse (2). Interventions were aimed at either comparing alternative theories related to behavior change mechanisms or assessing a single theoretical model in changing multiple health-risk behaviors. The BCC involved efforts of investigators, program staff at NIH, and representatives from the American Heart Association and the Robert Wood Johnson Foundation and a number of workgroups were established to explore new opportunities in the behavior change field. As part of the BCC, a representativeness and translation (RE-AIM) workgroup was formed to promote and evaluate methods to increase the translation, potential dissemination, and eventual public health impact of behavior change interventions. The BCC provided an opportunity to further evaluate and apply tenets of the RE-AIM framework, based on earlier work by Glasgow and colleagues (13).

One of the goals of the RE-AIM group was to increase awareness and provide resources to BCC grantees regarding translation of their studies into eventual practice. Assessing how investigators approached study design elements related to reach

TABLE 2
Investigator Surveys of RE-AIM Elements in the Behavior Change Consortium Comparing Prevalence With Those in a Review of Published Literature

	Baseline Yes (%)	*Follow-Up Yes (%)*	*Review*[a] *Yes (%)*
Study planning			
Conducted a needs assessment in the target group	—	60	—
Conducted a needs assessment with organizational settings[b]	—	29	—
Estimated the available number of constituents in the target population	—	87	—
Experienced difficulty with location of data or calculating reach	—	< 15	—
Experienced difficulty estimating the number of eligible constituents[c]	—	43	—
Reach			
Estimate ineligibility in the target population	25	67	—
Calculate participation rate of target population	87	80	76
Calculate representativeness of participants	79	40	14
Evaluate reasons for nonparticipation	87	—	—
Efficacy/Effectiveness			
Quality of life or negative outcomes measured	93	87	7
Outcomes measured as behavioral change	100	100	92
Adoption[d]			
Estimated ineligibility of targeted settings	29	20	—
Calculate participation rate of settings	38	53	16
Calculate representativeness of participating settings	31	27	2
Implementation			
Intervention fidelity process evaluation	100	100	46
Track costs of the intervention	64	53	31[e]
Record time needed for intervention delivery	—	87	31[e]
Maintenance/Sustainability			
Individual level			
Conduct ≥ 6-month follow-up	54	100	36
Conduct ≥ 12-month follow-up	83	87	—
Calculate % of attrition at follow-up	—	80	79
Setting level			
Collect information on intervention sustainability after funding ends	23	27	—
Plan to facilitate institutionalization of intervention	54	47	2
Make intervention available to others after study completion	77	71	—

Note. Survey $n = 15$.

[a]Glasgow RE, Klesges LM, Dzewaltowski D, Bull SS, Estabrooks P: The future of health behavior change research: What is needed to improve translation of research into health promotion practice? *Annals of Behavioral Medicine.* 2004, *27:*3–12. [b]Only seven sites responded to this item. [c]Combined responses of "somewhat, fair, or great amount" of difficulty on a 5-point scale. [d]Missing responses, not all studies were conducted in organizational settings. [e]Coded in combined format "time or cost."

and dissemination in their studies was also of interest. To address these goals, BCC sites were surveyed early in their study planning and implementation phases (in summer 2000) and again at the completion or near the end of their study period (in fall 2002). The surveys asked how investigators had planned to and then actually were able to include internal and external validity elements of reach, adoption, implementation, efficacy/effectiveness, and maintenance and sustainability of their various interventions. They were also asked to identify challenges and barriers to including RE-AIM concepts and measures in their studies.

As part of the RE-AIM workgroup activities, several literature reviews (4,7–10) were also conducted, in part, to provide a comparative estimate of how other non-BCC investigators have incorporated dimensions of external validity into their study reports. A summary of these reviews was presented to the BCC in the interim period between collections of the two surveys.

Table 2 shows the responses of the BCC investigators to the baseline and follow-up surveys in comparison to previously reported RE-AIM characteristics in a published literature review of recent "state of the art" literature in leading behavioral journals (4). The results of the BCC survey showed that a majority (87%) of sites were attending to elements of reach into their target populations, and they were evaluating reasons for nonparticipation and potential differences between participants and nonparticipants. Attention to intervention fidelity and implementation was very high, with virtually all sites documenting the amount and type of the intervention delivered by staff and received by individual participants. Efficacy/effectiveness assessment of outcomes was also good, with all sites reporting multiple objective measures of behavior change. Negative outcomes such as quality of life were being assessed by 93% of sites, but only 64% were recording and planning on reporting costs of the intervention. In addition, formative work had been conducted by just over half of the sites, and over 80% had estimated the characteristics of the target population related to selection criteria.

Primary areas identified as needing improvement for potential translation of BCC interventions were adoption and maintenance elements. Only 38% of sites had estimated or were planning on assessing the percentage participation of the settings targeted for intervention. Plans for intervention maintenance among BCC sites were also less encouraging. Only 54% of sites had plans to offer a revised intervention protocol for adoption by targeted settings, and 23% of sites had plans to determine whether the intervention was maintained after primary funding was terminated. As a sign of the collaborative nature of the BCC, all sites endorsed the possibility of sharing data for reports related to RE-AIM dimensions (data not shown).

Comparing responses on the follow-up survey with anticipated activity at baseline and with estimates from other recent behavioral studies in the literature yielded several observations. There appeared to be some influence of the collaborative efforts of the reach and translation workgroup on BCC investigators' plans to assess RE-AIM dimensions of reach and adoption. For example, whereas only 25% of sites had planned on estimating the number of ineligible individuals in the target population as a result of exclusionary criteria, 67% had calculated this figure when surveyed at follow-up. Adoption calculations improved, with 53% of sites estimating participation rates of settings compared to only 38% that had planned on doing so.

RE-AIM dimensions related to representativeness of individuals and settings were apparently problematic to include or calculate because plans to estimate them were not completed at follow-up. Only half of sites (79% at baseline, 40% at follow-up) that had planned on comparing characteristics of participants with nonparticipants had calculated this representativeness element. Because only a few sites reported difficulties obtaining data and calculating reach elements, it is not currently evident what barriers investigators faced.

BCC sites generally emphasized elements of external validity to a much greater extent than behavioral change interventions reported in the current literature (Table 2). Representativeness of individuals and settings were calculated less frequently by the BCC than hoped for by the workgroup, but they were much higher among BCC investigators than what had been previously reported in the field. In addition, measures of negative outcomes and quality of life measures were rarely assessed by studies in the literature, compared to almost 90% of BCC studies. Costs of intervention implementation in terms of time and money were more frequent among BCC studies than those in the literature. Elements related to sustainability of interventions in study settings are rarely reported in the literature (4); however, BCC investigators showed particular gains by facilitating the institutionalization of their intervention at the study sites and in planning to make their study interventions available to others.

Based on our experience with the BCC, the RE-AIM workgroup applied for and received funding from Robert Wood Johnson Foundation to develop Web-based and additional materials to support future researchers in adopting the RE-AIM framework. Resources for community leaders and program planners were also developed to improve their ability to plan and evaluate programs that are likely to be successfully adopted, implemented, and sustained in real-world settings. To disseminate this information and to provide a network of support for enhancing the translation of research to practice, a Web site (http://www.re-aim.org) was created (for details, see 74). Of particular relevance to this article, concrete tools are available to conduct a self-test to evaluate and consider RE-AIM elements in study planning (http://www.re-aim.org/2003/commleader.html#), locate datasets to estimate the size and characteristics of targeted population and settings, and assist with calculations of elements of reach and adoption.

CONCLUSIONS

The RE-AIM framework provides a format to organize key elements in evaluating an intervention's potential for successful dissemination. Broadening evaluation criteria beyond internal validity elements to describe aspects of external validity will expand the evidence base for decisions regarding dissemination effectiveness. RE-AIM organizes intervention planning efforts by asking questions about which interventions to deliver to which target populations, highlighting strategies to improve in-

TABLE 3
RE-AIM Planning Approach to Enhance Translation and Dissemination

Dimensions for Dissemination	*Questions to Ask of Potential Programs*	*Strategies to Enhance Future Translation and Dissemination*
Reach (individual level)	1. What percentage of the target population would come in contact with your program?	Formative evaluation with potential users and nonusers
	2. Will you reach the most needy?	Small-scale recruitment studies to enhance methods
	3. Will research participants reflect the targeted population?	Identify and reduce participation barriers
		Use multiple channels of recruitment
Effectiveness (individual level)	1. Will the intervention likely affect key targeted outcomes?	Incorporate tailoring to individuals
	2. What unintended adverse consequences may occur?	Reinforce messages via repetition, multiple modalities, social support and systems change
	3. How will impact on quality of life be assessed?	Consider stepped care approaches
		Evaluate adverse outcomes and quality of life for program revision and cost-to-benefit analysis
Adoption (setting or organizational level)	1. What percentage of target settings and organizations will use the program?	Conduct formative evaluation with adoptees and nonadoptees
	2. Do organizations include high-risk or underserved populations?	Recruit settings that have contact with the target audience
	3. Does program fit with organizational goals and capacities?	Develop recruitment materials outlining program benefits and required resources
		Provide various cost options and customization of the intervention
Implementation (setting or organizational level)	1. Can different levels of staff successfully deliver the program?	Provide delivery agents with training and technical assistance
	2. What proportion of staff within a setting will agree to program delivery?	Provide clear intervention protocols
		Consider automating all/part of the program
	3. What is the likelihood that various components will be delivered as intended?	Monitor and provide staff feedback and recognition for implementation
Maintenance (individual and setting levels)	1. Does the program produce long-term individual behavior change?	Minimize level of resources required
	2. Will organizations sustain the program over time?	Incorporate "natural environmental" and community supports
	3. What are characteristics of persons and settings showing maintenance?	Conduct follow-up assessments and interviews to characterize success at both individual and setting levels
		Consider incentives and policy supports

tervention success, and comprehensively evaluating the potential dissemination impact of health behavior interventions. Guided by principles of participatory research and with a focus on external validity, Table 3 summarizes key points to consider in planning and designing health behavior change interventions to improve their applicability to public health.

Planning interventions for eventual translation and dissemination requires anticipation and evaluation of how and why a program might be adopted into practice. The BCC provided an opportunity to introduce the RE-AIM framework to the process of planning behavioral interventions with their "end use" focus in mind. The BCC comprised primarily research investigators, so future efforts engaging participants, delivery staff, and potential adopters in the planning process will be essential in further improvements in the reach, feasibility, and acceptability of future behavior change interventions. Adopting RE-AIM as a planning framework does not ensure a program will be successful, but assessing RE-AIM dimensions yields essential information to evaluate the potential for future dissemination of an intervention. Understanding the potential translation and dissemination characteristics of an intervention might improve the linkage between researchers, program adopters, delivery staff, and community settings in improving population health. Such linkages will be increasingly important to address public health priorities related to disease prevention and health promotion.

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