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The RE-AIM framework for evaluating interventions: what can it tell us about approaches to chronic illness management?

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Abstract

Background: The RE-AIM framework is used as a method of systematically considering the strengths and weaknesses of chronic illness management interventions in order to guide program planning. **Method:** The RE-AIM dimensions of Reach, Efficacy, Adoption, Implementation, and Maintenance are used to rate one-on-one counseling interventions, group sessions, interactive computer-mediated interventions, telephone calls, mail interventions, and health system policies. **Results:** The RE-AIM ratings suggest that, although often efficacious for those participating, traditional face-to-face intervention modalities will have limited impact if they cannot be delivered consistently to large segments of the target population. Interventions using new information technologies may have greater reach, adoption, implementation, and maintenance, and thereby greater public health impact. Policy changes received high ratings across a variety of RE-AIM dimensions. **Conclusions:** Program planners should make decisions regarding implementing and funding health services based on multiple dimensions, rather than only considering efficacy in randomized clinical trials. Doing so may improve the resulting public health impact. Directions for future chronic illness management research related to RE-AIM, and implications for decision making, are described. © 2001 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

Care of patients with chronic illnesses is arguably the major health care challenge for the next century [1,2]. Chronic illness management modalities include face-to-face counseling, community outreach programs, and computer-mediated interventions. Often

choices regarding which type of intervention to adopt are based on organizational precedence, convenience for providers, or results in randomized efficacy trials rather than impact in practice settings. More comprehensive evaluation of the strengths and weaknesses of different delivery modalities should lead to greater public health impact and more cost-effective health care.

This article illustrates how many commonly used interventions can result in inequitable and limited patient participation, and poor implementation, impact, and maintenance. Our purpose is to stimulate

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a more comprehensive and systematic comparison of the strengths and weaknesses of different intervention modalities so that resources are allocated in the most efficient and equitable manner. To accomplish this, we use the “RE-AIM” framework [3–6] to help refocus priorities on public health issues and give balanced emphasis to internal and external validity. Like previous work by Green et al. [7], Rogers [8], and Abrams et al. [9], upon which it draws, RE-AIM is concerned with issues related to impact in real-world settings and the translation of research to practice. RE-AIM integrates and extends this previous work by incorporating both individual and organizational setting level variables, and by including long-term maintenance issues at both levels. A major feature of RE-AIM is that it shifts the focus from short-term efficacy among restricted samples of participants in randomized efficacy trials to longer-term effectiveness in real-world settings.

We illustrate the use of RE-AIM for comparing chronic disease intervention modalities. The RE-AIM model consists of five evaluative dimensions that describe the overall population-based impact of an intervention: Reach, Efficacy, Adoption, Implementation, and Maintenance (see Table 1).

Reach refers to the participation rate within the target population and the characteristics of participants versus non-participants. Factors determining reach are the size and characteristics of the potential audience and patients’ barriers (e.g. cost, necessary referrals, scheduling, transportation, and inconvenience) to participation. *Efficacy* pertains to the impact of an intervention on specified outcome criteria, when it is implemented as intended [10,11]. *Adoption* operates at the system level and concerns the percentage and representativeness of organizations that will adopt a given program. Factors associated with adoption include cost, level of resources and expertise required,

and how similar a proposed service is to current practices of the organization. *Implementation* refers to intervention integrity, or the quality and consistency of delivery when the intervention is replicated in real-world settings. Finally, *Maintenance* operates at both the individual and the system level. At the individual level, maintenance refers to how well behavior change efforts hold up in the long term. At the organization level, it refers to the extent to which a treatment or practice becomes institutionalized [12] as a routine part of usual care within an organization.

2. Intervention modalities

To illustrate the application of RE-AIM, we compared 13 common chronic illness intervention modalities (Columns 1–3 in Table 2) using the five RE-AIM dimensions. Of course, different interventions can be used in combination or simultaneously. Nevertheless, each of the interventions we considered is conceptually distinct, and comparisons using the various RE-AIM dimensions can be enlightening. In rating different modalities, we have assumed that the content is appropriate for the audience in terms of cultural and literacy factors, and based on validated self-management principles [1,6]. It may eventually be possible to conduct evidence-based reviews of the literature on each of the RE-AIM criteria, and we referred to evidence-based reviews when possible in making ratings [13–16]. At present, however, there are insufficient data on most RE-AIM dimensions, so a consensus rating approach among the authors was used. Given the inevitable subjectivity involved, we used a three-level qualitative rating scale (high, medium, low) rather than attempting to assign quantitative ratings. The modalities we evaluated were as follows.

Table 1
RE-AIM evaluation dimensions

Evaluation dimension	Assessment level
Reach (what proportion of the target population participated in this intervention?)	Individual level
Efficacy (what is the success rate if implemented as in protocol?)	Individual level
Adoption (what proportion of settings, practices, and plans will adopt this intervention?)	Organization level
Implementation (to what extent is the intervention implemented as intended in the real-world?)	Organization level
Maintenance (to what extent is the program sustained over time?)	Individual and organization level

Table 2
Types of chronic illness self-management intervention

Modality	Setting	Source/description	Cost	Intensity
One-to-one in-person counseling	Specialty center	Referral to health educator	Highest	Medium-high
	Primary care	By nurse	Medium	Medium
	Home visit/LPN	By outreach worker	Low	Low-medium
Group counseling sessions	Hospital	Referral: ADA program	High	High
	Community/lay	Chronic disease program: trained lay leader	Medium	Medium
Telephone calls	Home: from clinic	Nurse/manager: proactive	Medium	Low-medium
	Home: call-in 800#	Patient calls in	Medium	Low
	Home: automated phone outreach	By AVM computer system	High initially-low later	Low-medium
Interactive computer	Primary care clinic: kiosk	Touchscreen during visits	High initially-low later	Low-medium
	Internet: home	Internet	Low-medium	Medium
Mailed print	Mailed: generic	Brochures/pamphlets	Low	Low
	Mailed: tailored	Tailored mailings	Medium	Low-medium
Health system policy	System-wide	Reimbursement/incentives	Low-medium	Low

2.1. One-to-one counseling

These interventions include patient education conducted during a face-to-face clinical encounter in general practice or specialty clinics as well as home-based education delivered by a nurse who makes visits because the patient is home-bound, requires intensive monitoring (e.g. post-operatively), or requires assistance with procedures (e.g. wound care).

2.2. Group sessions

Often, patients are counseled in groups as part of multi-session, hospital-based health education programs. Group-based programs sometimes are delivered in settings such as churches or community centers, and may be led either by professionals or trained lay leaders [2].

2.3. Telephone care

These interventions include comprehensive disease management interventions delivered most often by nurses [17–19]. In addition, health systems often have call-in telephone advice services available through which patients can speak with a nurse or access health education audiotapes. Outgoing automated telephone

systems have been developed for patient reminders, detection of health and self-care problems between clinic visits, and for the delivery of patient education [20,21].

2.4. Interactive computer interventions

Although not commonly used in the past, we evaluated two forms of computer-mediated interventions because they will undoubtedly be used widely in the future [22,23]. One intervention strategy is to assess patients' self-care using a computer kiosk in the clinic waiting room. Assessment data then can be compiled to provide patients with immediate feedback and advice, help them set goals, and structure conversations with clinicians. A home-based, interactive computer strategy is to use the Internet to increase patients' access to health information, clinician advice, and peer support.

2.5. Mail

Many organizations use letters to inform patients about laboratory test results and remind them of upcoming appointments. Mail also is used to disseminate information about wellness and self-care. Information that patients receive can be generic (the same for all patients), targeted (the same for patients

within broad categories but different across sub-groups), or tailored (unique to each patient's clinical status, readiness to change, barriers, etc.) [24].

2.6. Health policy

Although they usually are not considered an intervention, health policies affect chronic illness management by changing the context within which it takes place. Examples include laws that govern where smokers can light up or the cost to patients for chronic illness education. Policies governing Medicare reimbursement for prescription medications, patient education, or self-care supplies also fall into this category.

3. Results of consensus ratings

Within the broad categories just described, we considered 13 specific intervention types. The four authors each independently categorized each intervention type as high, medium, or low on each of the five RE-AIM dimensions (Table 3). When there were disagreements, majority ratings were used.

3.1. Reach

The reach of one-to-one counseling interventions varies, with referral-based health education relatively high in patient barriers and consequently low in reach. Primary care-based nurse education, which may be scheduled as part of regular clinic appointments, and home visits have high reach due to their decreased barriers and greater convenience. Referral-based hospital group counseling is low in reach, while community-based group sessions have higher reach due to decreased scheduling and transportation barriers.

Telephone strategies can reach participants in their homes and therefore are generally high in reach. However, the need for repeated call attempts can pose difficulties. The reach of the telephone is very low when patients must initiate calls to 800-number "hot-line" systems [25]. Automated voice messaging (AVM), with its ability to make repeated calls until participants are contacted, is very high in reach. Interactive technologies, such as touchscreen kiosks, can be incorporated into regularly scheduled health care visits. While they currently are unavailable within some segments of the population [26], Internet approaches have potential for very high reach in

Table 3
Estimated status of intervention modalities on RE-AIM dimensions

Modality	Reach	Efficacy	Adoption	Implementation	Maintenance
One-to-one in-person counseling					
Health education referral	Low	High	Medium	High	Low
Primary care: nurse	High	Medium	Medium	Medium	Medium
Home-based outreach	High	Medium	Low	Low	Medium
Group counseling sessions					
Hospital-based	Low	Medium	Medium	High	Low
Community-based	Medium	Medium	High	Medium	Medium
Telephone					
Nurse outreach call	High	Medium	High	Medium	Medium
Call-in 1-800#	Low	Low	High	High	Medium
Automated voice	High	Medium	Medium	High	High
Interactive computer					
Kiosk in primary care	Medium	Medium	Low-medium	High	Medium
Internet	Medium	Medium	Medium	High	High
Mailed print					
Generic mailings	High	Low	High	High	Medium
Tailored mailings	High	Medium	Low	Medium	Medium
Health system policy	High	Low	Medium	Medium	High

the near future due to their exponential growth in access, 24 h availability, and information on-demand capability.

Mailed print material is high in reach because it is delivered directly to the patient. Finally, health system policies have the highest reach, given that they apply to all persons, affect the context of health care, and influence service delivery equitably across all population groups.

3.2. Efficacy

One-to-one strategies delivered by health education professionals can be tailored to the specific disease conditions, behaviors, and abilities of patients, leading to high efficacy. Programs delivered in a clinic (e.g. nurse educator) have the advantages of the expertise and credibility of the clinician and the availability of supporting materials onsite. However, there is usually much less time available in primary care for health promotion counseling, leading to the medium efficacy rating. Moderate efficacy is also seen in home-based programs due to difficulties in creating a controlled educational environment. Group sessions often sacrifice tailoring of the intervention to the individual. However, their efficacy is increased by the availability of social support, resulting in an overall medium rating. Community-based group sessions are taught by a wide range of individuals with diverse skills, potentially leading to lower efficacy. For telephone interventions, nurse outreach and AVM systems produce moderate levels of efficacy, with some decrement in performance due to the elimination of face-to-face contact and reduced intensity of intervention. These systems, however, maintain their ability to tailor material to the individual. Reactive telephone services deliver a lower dose of intervention and were rated as less efficacious. Clinic-based, interactive computer programs can be tailored to individuals, and provide timely information just prior to the clinical encounter, resulting in more effective clinical decision making and greater impacts on self-management and an overall medium rating.

Ratings for Internet interventions vary. Some applications, including e-mail messages and interactive websites, should have higher efficacy than passive websites. Generic print approaches provide information, but are unlikely to influence behavior [13]. In

contrast, substantial empirical support exists for the moderate efficacy of tailored print materials [13]. Health policy produces change indirectly by affecting financial support for disease management or other systems changes. Because the effects are indirect, efficacy is somewhat lower and it can be difficult to predict whether patients will take advantage of services made available [27].

3.3. Adoption

The settings in which health education research has been conducted have received little attention [3,28]; thus the adoption ratings are more speculative than for other dimensions. As can be seen in Table 3, most intervention types received medium Adoption ratings. Community-based groups, nurse outreach phone calls, reactive 800-number phone lines, and generic mailings received high ratings because they are relatively less expensive and require little or no change in general operating systems. In general, intervention modalities likely to require new staff (home-based outreach) or considerable initial outlay (e.g. additional health educators, expensive hardware or software) received low adoption ratings. An issue for future research is that several of the modalities rated highly on adoption (e.g. 1–800 number and generic mailings) tend to have poor efficacy or reach ratings (see Table 3).

3.4. Implementation

More complex interventions tend to have lower implementation ratings, while experience of the provider tends to enhance implementation. Implementation of one-to-one and hospital-based group health education is high, given referrals are made to staff with particular expertise. Implementation by primary care nurses is rated lower than referrals to health educators, but higher than for less skilled staff usually employed to do home-based visits. Implementation via group sessions is rated as medium when delivered by less experienced community interventionists.

Telephone strategies such as proactive, outgoing nurse calls and call-in 800 advice line numbers are rated as moderate to high on implementation as these interventions are often highly scripted and easier to deliver consistently. The AVM strategy has the above

strength and is also likely to deliver health education even more consistently, given its high degree of automation.

Similarly, touchscreen-based kiosks and the Internet approaches have high implementation ratings as they can be programmed to provide consistent, algorithm driven, tailored health care interventions. Generic mailed print material received consistently high implementation ratings due to its unwavering consistency of delivery. Tailored print materials involve very challenging requirements for handling missing data and repeated tailoring, resulting in considerable complexity of health messages, and a low overall rating. Health system policies have the most widely varying implementation because some policies (i.e. differential costs) are simple and automatic to implement, while others (e.g. no smoking policies) are less consistently enforced.

3.5. Maintenance

Assessing maintenance is complex because it has both individual and system level referents. We combined ratings across these two levels for the overall Maintenance ratings in Table 3. At the individual level, one-to-one interventions can be well maintained — if the program includes appropriate follow-up contacts. At a system level, referral-based education is expensive to support and may suffer cuts in funding over time. Hospital-based group education may have low likelihood of maintenance at both individual and system levels due to its high cost and difficulties in retaining contact with participants. In contrast, community-based programs often are mounted by groups with intrinsic motivation to sustain the programs, leading to medium maintenance ratings. At the individual level, these programs may lead to good maintenance if participants form lasting social networks [29].

Nurse outreach and proactive telephone services are often cost-effective methods of enhancing maintenance [18,19]. At the system level, they are low cost, flexible, and easily managed, increasing the likelihood of long-term maintenance. However, they are infrequently reimbursed, and compete with other clinical duties, resulting in an overall medium rating. Interactive kiosk-based computer systems received medium maintenance ratings at both the individual

and system levels; they have few ongoing costs, but participants need to return for repeat sessions. Internet-based intervention received high maintenance ratings due to continued on-demand availability and ongoing group support. Mailed generic print materials are easy to distribute, which should lead to high long-term system maintenance. However, individual maintenance is suspect due to inability to respond to individual issues in repeated mailings and thus a medium overall rating. Tailored materials are more personally relevant, but must be more carefully managed and distributed to patients using a tailoring algorithm. As a result, they are more costly, leading to higher individual, but lower system level maintenance. Health policy decisions, once made, are resistant to change, leading to a high probability of maintenance.

4. Discussion

This article illustrates use of a new framework for considering the strengths and limitations of chronic illness intervention modalities. The various RE-AIM dimensions provide a comprehensive set of criteria for evaluating interventions that should be of relevance to researchers, funders, and program planners [3,5]. Two strengths of this approach that make it particularly appropriate for public health and population-based applications are its emphasis on external validity (Reach and Adoption) as well as internal validity (Efficacy and Implementation); and its consideration of both individual level and system level outcomes.

Decision makers may wish to place greater emphasis on some RE-AIM dimensions than others. Some administrators may be concerned primarily with efficacy, others with reaching the largest number of patients, and still others with selecting programs likely to be consistently implemented or maintained. Thus, it is of interest to consider the “profile” of different interventions across the five RE-AIM categories (Fig. 1). This figure visually contrasts the strengths and weaknesses of hospital-based group sessions with health policies. A similar graphical approach can be used to help decide upon creative ways in which different modalities can be combined to produce effective, multi-component intervention packages.

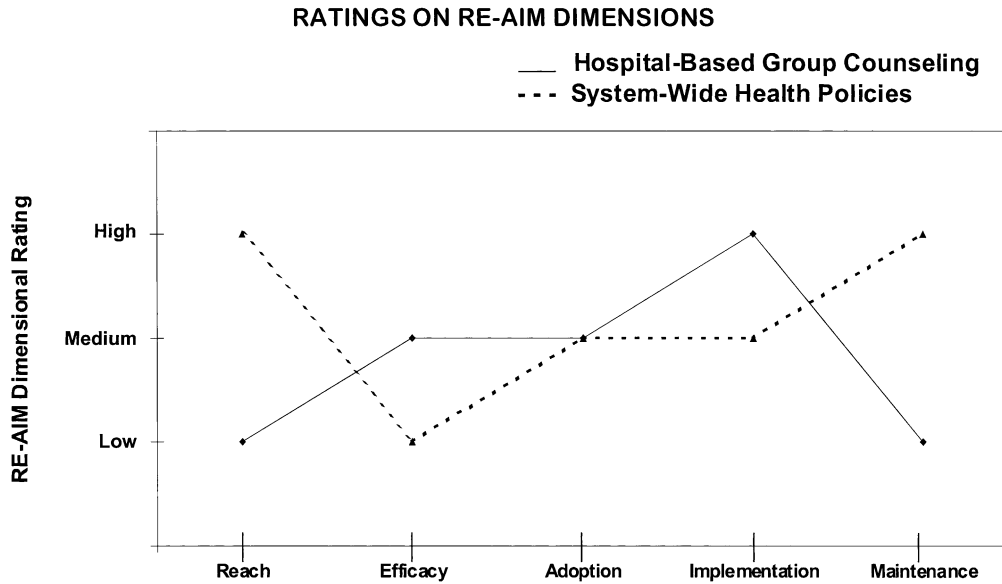


Fig. 1. Display of two different intervention programs on various RE-AIM dimensions.

Although RE-AIM profiles are informative, it may be particularly useful in policy analysis to combine the ratings across dimensions to produce an overall “Public Health Impact” score. A multiplicative formula could be used to combine the dimensions, extending the reasoning of $\text{Reach} \times \text{Efficacy} = \text{Impact}$ [9] to include all of the RE-AIM dimensions. The implications of such an exercise are quite interesting; an intervention modality that is low in two or more categories (e.g. Reach or Implementation) would result in a moderate to low public health impact, even if it produced high ratings on other dimensions, such as Efficacy. This could help explain why many innovations that produce impressive outcomes in efficacy studies [10] are not widely adopted — they do not meet the real-world concerns of either individuals or health care systems.

The ratings in Table 3 were made by referring to evidence-based reviews where available [13–15], but ultimately were consensus ratings among the authors. Given the much greater amount of research on some dimensions (e.g. efficacy) than others (e.g. adoption), our confidence in these ratings varies across dimensions. We categorized these modalities on their status as of the year 2000. We expect that the ratings will vary over time. For example, 5 years ago many of

the interactive technologies would not even have appeared on the ratings, but they will have much higher Reach ratings in the next 5 years [30,31]. It is also interesting to compare our ratings to related ratings made by Green et al. [7], approximately two decades earlier. Over this interval, the relative efficacy ratings of most modalities have remained similar, but several new, information technology modalities have been included that received relatively high ratings on implementation and maintenance.

There is still much to be learned about the RE-AIM model, but it is useful for directing attention to important public health issues often neglected when evaluating and selecting chronic illness programs. In particular, issues of Reach, Implementation, and Adoption are seldom reported in medical journals or considered in selecting programs. As Table 3 reveals, many of the most widely used chronic illness interventions do poorly on these ratings related to social justice. For example, traditional group-based education in a healthcare setting has numerous barriers and low reach. If we are to come close to eliminating health disparities or producing effective population-based chronic illness interventions [6,30], much greater attention will need to be paid to Reach and Adoption dimensions in the future.

4.1. Research recommendations

At least three areas of further research could increase the utility of RE-AIM or other comprehensive approaches for evaluating chronic illness interventions. First, it would be valuable to derive RE-AIM ratings for well-known interventions (e.g. the influential Diabetes Control and Complications Trial [32]; medical office-based smoking cessation [33]) using a formal process for obtaining expert consensus, and to conduct evidence-based literature reviews on specific RE-AIM dimensions. Second, various strategies for combining RE-AIM dimensional ratings into Public Health Impact scores should be evaluated. We have discussed a multiplicative approach to combining scores because we believe that this better represents population-based effects than an additive model [3]. However, other formulae for combining scores should be considered, along with their effects on the relative valuations of intervention modalities. Most important, more outcome studies are needed that address translation and dissemination issues by providing comprehensive data across all or a majority of RE-AIM dimensions, rather than restricting reports primarily to efficacy results.

5. Implications for practice and policy

The purpose of this article was to illustrate the use of the RE-AIM model as a heuristic framework with which chronic disease management strategies can be considered and compared. By providing a common metric for evaluating a wide range of interventions, the RE-AIM framework could be used to set priorities for research funding and reimbursement. By addressing both individual and system level impacts, RE-AIM could form the basis for a more sophisticated consideration of interventions from the perspectives of health care consumers, providers, payers, and the larger society. It should also help to facilitate translation of research into practice by directing research attention to important but seldom investigated issues such as implementation, reach, and adoption.

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