Designing for diffusion: How can we increase uptake of cancer communication innovations?

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A B S T R A C T

Objective: The best innovations in cancer communication do not necessarily achieve uptake by researchers, public health and clinical practitioners, and policy makers. This paper describes design activities that can be applied and combined for the purpose of spreading effective cancer communication innovations.
Methods: A previously developed Push–Pull-Infrastructure Model is used to organize and highlight the types of activities that can be deployed during the design phase of innovations. Scientific literature about the diffusion of innovations, knowledge utilization, marketing, public health, and our experiences in working to spread effective practices, programs, and policies are used for this purpose.
Results: Attempts to broaden the reach, quicken the uptake, and facilitate the use of cancer communication innovations can apply design activities to increase the likelihood of diffusion. Some simple design activities hold considerable promise for improving dissemination and subsequent diffusion.
Conclusion: Augmenting current dissemination practices with evidence-based concepts from diffusion science, marketing science, and knowledge utilization hold promise for improving results by eliciting greater market pull.
Practice implications: Inventors and change agencies seeking to spread cancer communication innovations can experience more success by explicit consideration of design activities that reflect an expanded version of the Push–Pull-Infrastructure Model.

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1. Introduction

Designing for diffusion means taking additional steps early in the process of creating an innovation to increase its chances of being noticed, positively perceived, accessed and tried, adopted and implemented and, thus, successfully crossing the research-to-practice chasm. Maximizing the application and impact of cancer communication research is a major emphasis for CECCRs. In 2002, the U.S. National Cancer Institute (NCI) co-hosted the conference *Designing for Dissemination*, which convened researchers, practitioners, and intermediary funders and policy agency representatives to consider the topic [1]. Dissemination was defined to mean active intervention for the purpose of broadly communicating a special class of innovation: the evidence-based practice, program or policy. Dissemination was contrasted with diffusion, understood by conference participants to mean a passive process by which an innovation may spread among the members of a social system. NCI and other federal offices and institutes hosted other similar conferences [2,3], and published books and guides about dissemination and diffusion. NCI developed a web-based inventory of evidence-based innovations in cancer control and cancer communication for others to adopt [4], began offering research dissemination supplemental awards to spread effective practices [4], and led an inter-agency program funding research about dissemination and implementation [5]. All in all, NCI has been a leader both nationally and internationally in drawing attention and devoting resources to the importance of spreading the products of research (research dissemination) and conducting research about the process of spread (dissemination or diffusion research) [6].

The NCI emphasis on both the spread of effective innovations and funding the study of diffusion has roots in the U.S. government dating back to 1843 when Congress appropriated $30,000 to demonstrate Samuel Morse's telegraph system, a success that led to commercial growth of the telegraph across the U.S. [7] U.S. government agencies have long seen a role for themselves in

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accelerating the adoption of effective innovations, whether in sponsoring large-scale field demonstrations of innovations with developmental costs that are too high for single companies [8], creating clearinghouses of information for dissemination [9], improving search capacities for retrieval of scientific data across many databases in parallel [10], or portraying sets of effective programs from which potential adopters are encouraged to pick and choose [11]. In cancer communication, these efforts have included helping establish phone-based tobacco quitlines in every state [12], helping states apply evidence-based communication interventions like small media and client reminders to promote colorectal cancer screening (CDC), and forming partnerships with minority serving community agencies to adopt evidence-based cancer control programs to help eliminate health disparities [13,14].

Outside of cancer communication, an exemplary example of how an intermediary can encourage choice by community-based organizations of evidence-based programs is the Centers for Disease Control and Prevention's effort in HIV prevention, the Diffusion of Effective Behavioral Interventions (DEBI) project. This centrally-coordinated federal partnership with state health departments concerns a cluster of 18 evidence-based HIV prevention interventions which are communicated to potential adopters in community-based organizations both in terms of their underlying principles and their manifest components, and which is comprehensively supported throughout the process of organizational implementation through the provision of trainers, capacity-building assistance, marketing assistance, behavioral scientists, and evaluation consultants [15].

We would like to encourage critical reflection of these worthy programmatic efforts. For while much has been done to further our collective understanding of issues related to dissemination, diffusion, and the follow-through of implementation, there seems to us an opportunity to improve current research about diffusion and dissemination by clarifying the historical roots and meanings of these terms, identifying commensurate and complementary research traditions that can augment diffusion and dissemination conceptually and practically, and provide examples of formative stage design activities that take worthy evidence-based concepts from social science and apply them to cancer communication innovations. In doing so, we purposely use the term *diffusion* rather than *dissemination*.

1.1. Dissemination, then diffusion

Is there really a difference between dissemination and diffusion? Do we lose anything by using the terms synonymously? Dissemination is the more active term when we consider human agency, as in trying to disseminate. Historically, dissemination has referred to activities by proponents or intermediaries to inform others of an innovation. Information about an innovation is disseminated – sent out, transmitted, advertised – in what is usually a one-to-many process using mass or specialty media channels. This is active dissemination. Even more common is providing access to information, but relying on potential users to find the information themselves, as in the creation of a website for others to locate and use. This is passive dissemination. The key to understanding dissemination is to understand its product: information *about an innovation*.

In contrast, diffusion is a social process that may or may not occur after the dissemination of information about a new practice, program, or policy has occurred. Because of the newness of innovations, many people are initially uncertain about them. They engage in social communication to resolve their uncertainty. Diffusion happens because of one-to-one or group communication among members of a social system such as a network of pediatricians, journalists in a newsroom or who work for competing media companies but cover the same news beat, or the nursing staff in a hospital system. While the initial dissemination of information is necessary so that individuals can learn of an innovation, information alone is usually insufficient to precipitate interest, attitude formation, and behavior change (i.e., adoption of the innovation). What is typically required to bridge this knowledge–attitude–practice gap is *social influence*, especially in those cases when potential adopters perceive that the innovation in question is important and are accustomed to seeking the opinions of others before making important decisions.

Just as information is the key to understanding the essence of dissemination, social influence is the key to understanding the essence of diffusion. This understanding, we agree with others [16], is more important now than ever before. Seen this way, diffusion is a very active change process, not on the part of proponents and intermediaries as with dissemination, but on the part of potential and actual adopters of innovations. They influence each other in predictable ways to passively ignore, actively reject, and sometimes, seek evaluative information about innovations and adopt them partly on the basis of social influence via advice, social modeling, and imitation. Implementation and sustained use of an innovation may then follow.

Dissemination, involving as it does the initial steps of creating and providing access to information is all about the source or sponsor of innovation. It is a source perspective about the supply of information. Diffusion, following on information dissemination, is all about the activation of influence among potential adopters – people observing and talking among themselves – as they consider the pros and cons of an effective practice, program, or policy and then make a decision to adopt or reject. For those innovations that people perceive to be important to their work or lives, diffusion occurs when people engage with each other about the topic in response to the receipt of information, and then make the decision to adopt [17].

In this paper we argue that what commonly passes as dissemination does a rather incomplete job of putting to use time-tested ideas from the diffusion of innovation literature, from marketing science, and from research about knowledge utilization. We argue that misspecification about what can be done to broadly spread a worthy innovation can be corrected by revisiting the range of applicable concepts from these research and practice traditions. In this way, a more inclusive portfolio of design activities can be considered to enhance the odds of dissemination, diffusion, and implementation success. We do this with special reference to innovations in cancer communication, inclusive of research results, new methods and tools, and interventions that are intended to improve patient and community health. Being prepared with process knowledge about how best to encourage the consideration and adoption of effective innovations is important now since the evidence base about community and health system cancer prevention and care is building [18].

1.2. Knowledge to practice research traditions

The challenge of putting scientifically derived knowledge to practical use has been characterized as a theory–practice gap, a failure of practitioners to take up worthy practices, an inability to bring innovations to market, and as a lag between invention and diffusion. Several knowledge-to-action theories have been created to account for these gaps and lags [19]. These differences in perspectives are associated with different paradigmatic orientations [20]. The work of education and policy researchers and psychologists including Carol H. Weiss, Ronald G. Havelock, Edward M. Glaser, and Robert K. Yin coalesced in the 1980s as a field of *knowledge utilization* that emphasized how the evaluative results of large federal programs affected policy decisions.

Sociologists and international development scholars including Everett M. Rogers, Elihu Katz, James S. Coleman, Gerald R. Zaltman, and James G. March defined a paradigm labeled the *diffusion of innovations*, emphasizing how micro-level processes can culminate in societal-level change, and vice versa how existing social structures, policies and normative expectations affect the range of individual attitudes and behaviors. Organizational scientists including Eugene Mansfield, Dorothy Leonard, and Donald J. Teece defined a field of *technology transfer*, emphasizing one-to-one rather than one-to-many movement of innovations within and across organizations. *Marketing* scientists such as Frank M. Bass and Vijay Mahajan applied and extended diffusion concepts to the realm of consumer purchase decisions and, especially in the work of Philip Kotler, the founder of the *social marketing* tradition.

Beginning in the mid-1980s, *evidence-based medicine* emerged through prominent publications by Jonathan Lomas, David L. Sackett, Anthony D. Oxman, and others, often focusing on the improvement of healthcare delivery by strategies to encourage implementation of clinical guideline recommendations and thus reduce unwarranted variance in practices and procedures. More recently, the paradigm of evidence-based medicine influenced the rise of *evidence-based public health* [21], another domain of knowledge–practice research that brought complex issues of community involvement and university–community partnerships to the fore. Evidence-based public health is an approach to health promotion and disease prevention that attempts to wed local values, resources, and interests with technical expertise and formal guidance. While research about the diffusion of innovations constitutes the largest of these paradigms in terms of number of publications, these literatures are differentially active, with evidence-based medicine, evidence-based public health, and increasingly the study of organizational implementation constituting hot topics.

These intertwined histories and continually evolving paradigms about the relationships between knowledge and practice represent a dialectic between the provision of new knowledge and the context-bound exigencies of practice; between, in essence, source "push" (dissemination activity) and receiver "pull" (conditions associated with successful diffusion). While each of these research traditions recognizes the importance of understanding the user context as prelude to action or intervention – and none more so than marketing science – most of these paradigms are weighted toward a source perspective on social change. Knowledge is generated, innovations are created, technologies are produced, evidence is weighed, and information is disseminated. Belief in the importance of results leads predictably to the imperative that communication – especially in the form of one-way transmission or dissemination – must occur so that the logical consequences of practice change and patient and public benefit can accrue.

We have known for some time the deficiencies with these disseminative orientations to improvement [22]. Best intentions, hand-offs, publications and publicity and the distribution of brochures and the debut of websites and our many public presentations are centralized attempts to transmit information from source to receiver. We push information, hoping against the evidence of these paradigms that someone, somewhere, will find the fruits of our well-intended hard work ripe for consumption.

What lessons have been learned from the knowledge utilization, marketing science, and diffusion of innovation paradigms about how we process information that is disseminated to us? Here is a representative, if not exhaustive, list of observations and best practices from these traditions that can guide dissemination and diffusion efforts in cancer communication.

1. Disseminated information about an innovation is most often a necessary but not sufficient condition for diffusion to subsequently occur.

2. Evidence about effectiveness is just one of a set of perceived attributes that can affect adoption decisions.
3. Being perceived as credible, relevant, and salient depends on the degree to which we can tap into the beliefs and norms of target adopters.
4. Segmentation of intended audience members on the basis of demographic, psychographic, situational, and behavioral commonalities allows for the design of dissemination products that in turn are perceived as more relevant by intended audience members.
5. Message tailoring that finely differentiates among the individuals within an audience segment further boosts the perceived relevance of a message by intended target audience members.
6. Dissemination products that are designed on the basis of a close understanding of intended target audience members – potential adopters – and their beliefs, wants, and practices have a greater likelihood of being positively perceived.
7. The early involvement of partners who will distribute, provide access to, and refer potential adopters to an innovation increases the reach achieved in dissemination.
8. Confirming the prior positive adoption decisions by individuals during the subsequent stages of innovation implementation and routinization slows the rate of innovation discontinuance.
9. Most individuals are highly attuned to social norms concerning the use of an innovation; when they perceive that the norms of their immediate reference group – both real and mediated social models – support adoption, they adopt.
10. Decisions about innovations often are made partly on the basis of desirable status or image; the innovation is a means to achieve status or image.
11. Social influence is not evenly nor randomly distributed; a small group of influential persons are looked to by large numbers of others for cues to action and inaction.
12. Establishing a decentralized support system for implementers to share tacit solutions to implementation problems improves implementation quality, especially for complex innovations that can be easily adapted, customized or partially implemented.

1.3. Rebalancing push with pull

The history of dissemination practice and research concerning evidence-based and externally valid cancer communication, public health and medical innovations has far more instances of push than pull. It is a history characterized by trying to do *more*: more messages, more channels, more support and outreach staff, more control and process monitoring, more partnerships and meetings and coordinated action. That is push; systematic efforts to reach out to potential adopters, and supportive efforts directed at actual adopters to support high-quality implementation [23]. Doing more in the pursuit of worthy public health and healthcare objectives is all to the good. Doing more in intervention work gives researchers a lot to study and implementers a lot to do. Multiple study arms are contrasted and assessed for each unique contribution to observed effects; training workshops are augmented with multimedia packets, decision-support tools, on-site meetings, and online prompts, reminders and technical assistance.

Of course, the doing of more is also unrealistic outside of funded studies. What we really need as a collective is evidence about the doing of *less*: minimum "good enough" interventions that not only achieve acceptable thresholds of desired outcomes, but outperform push-based strategies through greater efficiency and by reaching and benefiting more people at a lower cost per contact [24]. How is this possible? By eliciting pull. We need campaigns, interventions, and policies – innovations in public health and

healthcare – with built-in process multiplier effects that naturally do what we have tried hard to induce at high cost: target audience attention, learning, attitude and behavior change, and maintenance of that which has been newly routinized. To believe, as some excellent behavioral scientists do, that diffusion does not occur spontaneously [25] is to misconstrue the history of diffusion scholarship. Diffusion can, in fact, occur with little or no coordinated or centralized effort. Imitation due to a desire for normative congruity or status conferral is a much more important driver of most adoption decisions than are carefully reasoned judgments about innovation results [26]. Our social interactions function to spread innovation; we influence each other on the basis of proximity, collaboration [27], talking and listening and trying and modeling the behaviors that we see [28]. Whereas push concerns what inventors such as cancer communication researchers or their intermediary proxies such as federal agency staff do, pull factors are what figure prominently in the minds of potential adopters. It is push-led strategies when pursued on their own that erect tall barriers, require many resources, and thus face long odds in achieving dissemination or diffusion. A push-only dissemination effort can drive up costs by always advocating the best and newest (and most expensive) solution to health problems [29]. If there is a gold standard for dissemination, it is to base our efforts in the achievement of pull. The best dissemination effort would play out like naturalistic diffusion. It would appear to "just happen".

Pull refers to what our potential adopters want. For cancer communication, these adopters may be individuals like clients, patients or providers or organizations like insurers or health systems. It is their preexisting dispositions, preferences, perceptions, capacities, and behaviors as they relate to the innovation in question. Social marketing scholars and practitioners have led in specifying and collecting data about pull because of the centrality of the consumer in the marketing transactional paradigm. Consumer preferences, psychographic associations, distribution channels, and places for product delivery play prominently in a perspective about pull. To know what will diffuse throughout a segment of a population, one needs to know what members of that segment value and prefer, what they already pay attention to and do, and what their opinions are about early versions of the innovation in question. Yet there is also more to pull than consumer psychology and prototype feedback.

We advocate a broad orientation to what constitutes pull. Effective dissemination does not affect change at any cost; it elicits or triggers pull—whether intended to do so or not. In designing for diffusion, the triggering of pull should be the *basis* for dissemination push activities. In a review of how tobacco-cessation interventions spread into practice, pull was found to be a more important factor than either push strategies or a strengthening of delivery capacity [30]. Especially at large scale, the elicitation of pull is a precondition for operating the efficient change effort. The more that a dissemination strategy is able to elicit market pull, the more success it may encounter.

2. A market oriented Push–Pull-Infrastructure Model

Achieving spread can be conceptualized as depending on three categories of factors: knowledge push, practice pull, and infrastructure for linking the two together (see Fig. 1) [31]. Knowledge is conceptualized as moving in relation to push factors from the knowledge production/supply side, and pull factors from the knowledge use/demand side. These factors are not mutually exclusive; indeed, it is the integration of practitioner needs and wants (pull) with research-generated knowledge (push) that results in value-added utilization [32]. For example, creating an online discussion board for women with breast cancer is a push activity; formatively testing the discussion board format, content,
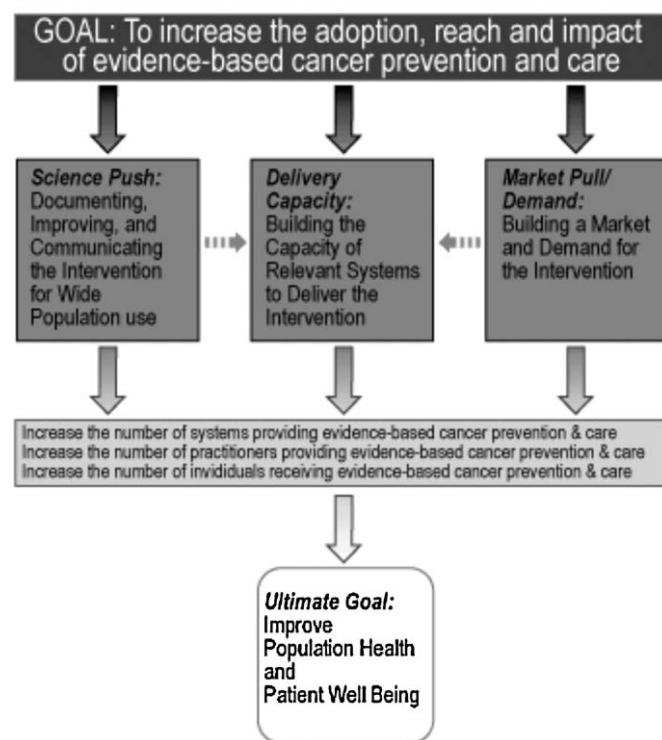

Fig. 1. Supply push, infrastructure, and demand pull are collectively important in achieving diffusion, but demand is most important. Adapted from Green and Glasgow [84].

and management with breast cancer survivors and incorporating that feedback into the redesigned discussion board embeds pull into the push activity. The American Cancer Society (ACS) observing a growing and unmet demand for online discussion forums is a pull approach to dissemination. Reaching an agreement with ACS to add a link on their website to the discussion board and encourage their thousands of worksite facilitators to mention the discussion board to employees with breast cancer ties the pull and push activity into the infrastructure of an existing distribution system.

This model implies that a sole emphasis on making information available and accessible (push) or only focusing on the stimulation of demand (pull) without then being able to satisfy that demand through an available distribution system (the infrastructure) is unlikely to effectively bridge research–practice gaps [33]. In this model, a key means for satisfying demand is setting up the conditions for existing distribution systems such as a healthcare or social services system, a professional association, or a network of businesses or community health outreach organizations to possess, deliver, and support the implementation and continued use of an innovation, often by partnering with stakeholders within the delivery system. Organizational capacity building, training, and technical assistance are all common parts of systemic capacity on behalf of an innovation, but so is policy agenda-setting, favorable practice environments, and "making the business case" for why an innovation is beneficial to an organized delivery system, its employees, and its clients [34].

While push factors, pull factors, and infrastructure are interrelated and each important, we believe that pull is the key to effective responses to dissemination. It follows that activities likely to generate pull must take on a higher priority when designing for diffusion in cancer communication research. Communication researchers have conceptualized pull somewhat narrowly, as a characteristic of channels or media. "Pull media" are

those in which media users control content and the timing of its delivery, including social media such as Twitter, Facebook, and YouTube. Pull media allow for self-actualization rather than mere identification with content, the satisfaction or gratification of need or want rather than arousal, and interactivity rather than one-to-many dissemination [35]. Social media have changed the nature of user engagement [36], though there are signs that increasing imposition by corporations that advertise on such sites may lead users to increasingly use such media in the comparatively dispassionate and less involving ways that we use traditional media [37].

We more broadly identify pull as consisting of several types:

1. *Understanding potential adopters:* Established market and consumer research objectives include preexisting dispositions, preferences, individual capacities, and behaviors. These are pull factors that, if known and applied when designing an innovation increase the likelihood that a target population of individuals or organizations will be attracted to it because they will recognize aspects of themselves in the innovation. It will address their concerns. It will be available through distribution channels they have access to and are comfortable using. It will build upon values and beliefs they already hold. Faced with such an innovation, the decision to adopt – even if it means quitting an existing practice – is made easy.

2. *Control and the invention process:* The degree to which potential adopters can influence what the innovation is, what features it will have, which population segments should be targeted in dissemination efforts and when, etcetera, are all essentially issues of control. Whether control is closely held by a few centralized sources or broadly invitational as in community-based planning processes, clarity about and responsibility for the many steps such as customer research, packaging, promotion, distribution, training, and technical assistance are vital. Successful marketing efforts depend on the management and control over resources. Planning for a decentralized change effort is especially challenging and especially promising since partners are more likely to feel ownership of the innovation and consider it their own when they have contributed to its invention. Choice of media for sharing information about cancer communication innovations and for encouraging adopters to adapt to best suit their needs is also an important consideration. Different media – especially social media – embed pull motivations. While these media will continue to rapidly evolve, the control over their content and when it is communicated is as much in the hands of distributed individual users as it is in the control of centralized change agencies.

3. *Sociological data about the social system:* Since diffusion often relies on advice-seeking, social modeling, and then imitation, insights into who influences whom within the targeted social system are useful in deciding with whom to first intervene so that others will naturally pay attention. Several options exist for determining which individuals or organizations are especially influential on matters of cancer communication within an audience segment, depending on how many people comprise the segment, how accessible they are to the researcher, and how likely it is that the segment is tied together through interpersonal communication.

4. *Formative evaluations of the innovation:* This includes target audience responses to prototype versions of an innovation, as well as opinions of technical experts who are not representative of a target population but who may be highly knowledgeable about it. Feedback is used to redesign the innovation and dissemination portrayals about it to heighten receptivity. Again, this is a well-understood form of consumer research. Depending on the innovation, receptivity is gauged via small samples of representative audience segment members through one-on-one usability testing, intercept interviews in which consumers are guided through a protocol of choices or preferences, or focus groups to assess how talking among consumers may shape their beliefs about the innovation. Experts are used at the prototype stage to identify more general problems with the innovation, based on what they know about the audience segment.

In all its forms, pull reflects the *motivations* [38] of potential adopters. While some of these motivations may be extrinsic in their reward to the individual or organization, the most important motivations are intrinsic: the potential adopter thinks and behaves certain ways because she wants to; she evaluates a prototype innovation in terms of its pros and cons in relation to what else she personally knows and experiences; she seeks the opinions of others and assigns credibility because she values them; she uses social media because she can be more creative, more specific and relevant in her communication, and more in control of her image and the timing and content of her communicative exchanges.

2.1. Is the time right to elicit pull?

How does pull – genuine end-user motivation – come to characterize the receptivity of individuals to our change efforts? We believe that conditions for pull can be identified and capitalized upon and, sometimes, engineered through contextual confluence.

When individuals newly sense a confluence or convergence of shared opinion, the time can be right for change. A perception of mutual reinforcement within a community, a professional network, or an organization can occur as a result of multiple reinforcing messages and actions especially when the sources of those messages and actions are different. What is important is the repetitive elicitation of prior frames that cue individuals how others think about a particular issue. Individuals will then be primed to interpret new information in light of those prior frames. The sources of change and motivation may be many, without close coordination of effort. Yet the effects on the individual or the organization can be mutually reinforcing. The result can be widespread appreciation of a normative shift, which leads individuals to change attitudes and behaviors, resulting in system-level change [39]. This complex process is exactly what many analysts refer to as naturalistic diffusion.

In the United States, arguably the greatest public health success has been the decrease in smoking of tobacco since the 1970s. The California experience, in particular, is illustrative of a multi-pronged dissemination system of mutually reinforcing messages, opportunities, regulations, incentives, and social pressure for normative, attitude, and behavior change [30,40]. This approach to change, while not a priori managed as a coordinated strategy, exhibits the holistic combination of centralized technical expertise, distribution and access, and decentralized participation and community incentives that private foundations have supported in communities as the "art" of dissemination has moved ahead of the "science" of dissemination [41]. The experience in California also demonstrates system interdependency; California and its residents, while early relative to others, were not alone in smoking behavior change. Federal efforts, mass media messages, and a broader normative readiness for change likely affected and were affected by what happened in California.

In the case of California and the shift there in both public norms and individual behavior, the change "just seemed" to occur when, in fact, the effect was the result of a complex interplay of reinforcing factors. Mass media are key to this type of cumulative effect, providing what Harold D. Lasswell referred to as a *correlational function* [42] for communities, in helping to suggest

which issues such as cancer prevention and screening are deserving of attention. When such an issue is also the topic of everyday discussion among residents, the resulting effect of *monopolization* of the total information environment can trigger behavioral change [43].

The California case is also notable in terms of timing. Change in California, just as in other states, did not occur randomly in time. In relation to smoking, California changed within a specific time frame and exhibited considerable over-time grouping with what happened in other states. Adoption decisions at national and state levels, just as with individuals, cluster together across time [44–46]. Cancer prevention and care intervention planners can either prepare for and then wait for windows of opportunity when the larger media or policy environment is attentive to or at least does not contradict the idea or importance of cancer prevention and care, or intervention planners can be more proactive by seeking to create a unified advocacy front of like-minded organizations to set the public, media and policy agendas for an issue or group of related and consonant issues, such as through the presentation of a call to action or national action plan [39]. Both are fundamental strategies in media advocacy [47,48].

3. Design activities

Researchers and intermediaries can take actions to increase the likelihood that cancer communication innovations found to improve outcomes will diffuse through populations. We divide these actions into four types of activities that can be conducted in a formative innovation design stage. Designers – researchers and intermediaries – do not have to attempt all of these types of activities. For enhancing dissemination and heightening the odds of subsequent diffusion, different of these concepts can be applied by mixing and matching those that make the most sense for the innovation in question and the resources available, just as previous dissemination research has done in borrowing constructs from related theories [49].

3.1. Designers must be listeners

How will a cancer communication innovation make life better, easier, more convenient or more efficient for the individuals or organizations that use it? How will it fit within their current routines or practices? How easy or difficult will it be for them to use? How interesting and engaging will it be? Too often, developers do not answer these questions in the design phases of intervention research, or worse yet, answer the questions from their own perspective and not the perspective of users. Health professionals and researchers are chronically guilty, for example, of assuming that all people are as motivated as we are by the promise of reduced risk or incremental improvements in health. A more consumer-oriented approach to developing cancer communication interventions demands that researchers clearly identify groups of potential adopters, learn as much as possible about them, actively engage them in substantive ways throughout the development process, shape the innovation around their needs and interests, and constantly adapt and improve the innovation based on user experiences [50].

As an example, CECCR researchers in St. Louis have spent more than a decade developing, testing, adapting and disseminating communication-based interventions to help eliminate breast cancer disparities in low-income African American women. This work began with extensive formative research to identify cultural values and beliefs associated with participation in cancer screening [51–53], continued with development, audience testing and modification of cancer communication messages that were based on these values and beliefs [54–58], and then efficacy testing in community-based practice settings to assess impact of the intervention on use of mammography [59].

When research evidence indicated the intervention was effective at increasing mammography, we worked closely with local breast cancer advocacy and support groups to determine how the intervention could be delivered outside a research context and to identify the best community venues for reaching African American women who were due for mammograms. As a result of this work, we jointly developed interactive touch-screen computer kiosks to deliver the intervention, and conducted usage and mapping studies to evaluate how and by whom the kiosks were used in different community settings [60–62]. These studies found that putting kiosks in Laundromats and libraries (vs. churches, health centers, social service agencies, beauty salons or health fairs) reached not only the greatest number of women but also the women who were most likely to need a mammogram. Because findings from the kiosk studies also indicated users had significant obstacles to getting to mammography facilities, we have recently entered into a partnership with the Missouri Breast and Cervical Cancer Control Program (BCCCP) to provide community navigation services to kiosk users who needed a mammogram. To help make this connection between kiosk users and BCCCP, we have installed cell phones in the kiosks so that a woman using the kiosk can make all arrangements to be screened while at the Laundromat, and BCCCP staff can provide informational and instrumental support to help her access free screening services.

3.2. Control, invention, and implementation

Studies of the creation and implementation of interventions suggest that involvement – the sharing of control – is positively related to adoption, implementation, and sustainability of change [63]. Making changes to innovations is more norm than exception [64], especially with wider availability of technology so that more and more adopters can participate in intervention development themselves [65]. Involvement can be encouraged and sought during two phases: the initial time period during which an intervention is first created or significantly adapted for practice application, and then later, when implementers seek to find a best fit between their work context in a public health or healthcare organization and the intervention itself, through adaptation decisions. Both time periods represent creative opportunities for practitioner or distribution partners, or intervention implementers.

Partnerships between cancer communication researchers and delivery system partners such as community groups or professional associations can produce innovations that are more likely market-ready than innovations that researchers alone produce. Partnerships or collaborative relationships that involve non-researchers from the very beginning in exploration of the variety of means for reaching a target audience and then providing a service or product to them that will fit the parameters of an existing distribution system accessed by the target population share the definitional control over the innovation's form and function. There are good reasons to invite others into the creation of an innovation: partnerships can produce innovations that are wanted, regularly used, and are more likely to sustain. Sharing control often means that others come to see researchers as genuinely interested in helping improve conditions for clients. As a result of partnering with researchers, practitioners can come to feel strong ownership over and responsibility for an innovation. Nowhere is the importance of research–practitioner partnerships more important than in communities. For many researchers, however, sharing control over the definition of what an innovation will be is very difficult, and sometimes their attempts at involvement are not intended as, or need not be, full partnerships.

Clarity at the outset about the role and extent of involvement that researchers seek from partners is important so that community partners understand what is expected of them in the partnership process.

Partnerships with communities for topics such as cancer prevention and control often revolve around issues of *organizational process*, the convening of a decision making group such as a community coalition, and how it functions as a goal-directed group in deciding upon and implementing specific cancer prevention projects. Organizational process consists of the group functions of *inclusion* (who is at the meeting table), *participation* (the extent to which those at the table contribute their ideas), and *decision making* (the style of facilitation and procedures of voting) as especially important since how the conveners, staff, and leaders of a group plan for and structure these aspects of group process can make or break an attempt at partnering with a community. So as a design stage set of activities inviting partners early into an exploration of how to serve a certain target population better for a topic, such as cancer prevention, can produce key dividends; however, constant attention to group process issues is necessary when community groups are involved.

Activities during the design stage can also heighten pull from potential adopters by creating innovations that invite adaptations by implementers. Adaptations are a normal means of improving the fit between organizational context and a practice or program from afar. Indeed, what goes on in adopting organizations can make all the difference in the likelihood of observing positive and intended outcomes as a result of organizational adoption of an innovation. Theorists of classic diffusion, in focusing on individuals as the units of adoption, did not doubt that an individual who adopted would implement, too, even if the observed outcomes of use were often unanticipated and sometimes undesirable. But in organizations, the choosers of innovations in cancer prevention and cancer care are often not users. Thus a very considerable degree of attention in contemporary dissemination science rightly concerns the sub-process of implementation.

Historically, what it is that organizational implementers do with innovations has been viewed as a dichotomy. Either they put the innovation into practice as is, or they change it in the belief that the new iteration will better fit their current workplace or client conditions. For decades in discussions of how to best diffuse or "scale-up" effective educational programs, researchers have kept to this framing of the translational problem. Adherents of program fidelity believe that working to insure that adopters make as few modifications as possible is key to retaining the success of the original program. If the program is changed, how does one know if it is still effective? On the other hand, adherents of the program adaptation perspective counter that it is only through allowing adopters to change a program to suit their needs that the likelihood of sustainability is increased. If adopters do not feel ownership of the program, how can we insure its persistence in practice? Currently, the same debate is alive and well in disease prevention circles.

There is great incentive, often well-intended, at the individual or single organizational level to customize, to partly adopt, and to combine intervention components from multiple sources to create a best fit in the user context. For every adopting organization, truth be told, is unique. Adaptations, additions, and subtractions to an adopted intervention are more often observed than not. Yet this perspective on adaptation perspective is incomplete, for more than an intervention can be altered to achieve a best fit between a program and one's work context. The context, too, can change. If one only changes an adopted program and not the work environment – or vice versa – technical, delivery system, and performance criteria misalignments are more likely to characterize implementation. Over-time and incremental adjustments to both

an innovation and a work environment characterize successful cases of one-to-many diffusion and one-to-one technology transfer. "Mutual adaptation" of both a new program and of its user environment implies that an awful lot of the action of successful diffusion occurs neither with the change agency nor with the end-user such as a patient or resident of a community, but in intermediary organizations such as a public health clinic. How practitioners interpret the purpose and promise of a new program will interact with how they choose to make accommodation for it in the workplace. The meanings we make of a new intervention will contribute to what changes in the workplace we deem useful to best exploit it.

Though practitioners often pick and choose which components of a given intervention they will implement, there is some evidence that they should be encouraged to customize by making additions to, rather than just modifying, an intervention. Adding local supplemental components to a proven intervention is less likely to dilute its effectiveness than is modification that includes the deletion of or alteration to core components [66].

Another key to successful implementation is to communicate *why* an innovation works, not just what it is or *that* it works. For many cancer communication innovations, specific mechanisms of effect may not have been directly tested, but sometimes can be inferred from findings. "Guided adaptation" through explicating both the underlying causal components of a program as well as examples for operationalizing those causal components in practice, and clarifying to implementers which aspects of a demonstrated program are central to its observed effect and which components are peripheral and more likely changeable without deleterious effects is a sensible approach to implementation that can recast adaptation as a property of implementation process and fidelity as a property of outcomes. Conceptualized this way, adaptation and fidelity can be positively, not negatively, related. This perspective also encourages pursuit of the very real possibility that new iterations of the practice or program can out-perform the original test that demonstrated external validity. The pursuit of process adaptations to achieve outcome fidelity should be especially likely when both conceptual knowledge and examples are codified so that they are explicit rather than remaining tacit for subsequent implementers. Implementation of innovations is more consistent and positive when knowledge about them is clearly communicated.

Psychological and sociological activity by targeted adopters is augmented by a third way in which activity occurs. Potential adopters are very often active in relation to the innovations they adopt, and not only at the margins of innovations. They can be creators, inventors, and sources of change. They can be extremely active in testing, manipulating, jerry-rigging, and doing what it takes to create both through language and through action an innovation that precisely addresses the requirements of an acutely felt local problem.

The traditional diffusion perspective is one in which potential adopters actively listen to, read about, and observe others' responses to innovations, and discuss those innovations with others. People are neither passive nor atomized individuals. Except for the most venturesome and the most cautious, potential adopters think and act with reference to the social norms that characterize the networks or systems of which they are members. Thus for most people, their activity is of a social type that is normatively guided by prevailing attitudes and values. Their activity is with other adopters and potential adopters, defined more or less by their degree of innovativeness. The earliest adopters ("innovators" in Rogers' categorization) are highly active in scanning information environments, in seeking out new ideas from heterogenous sources, and in experimentation. Feeling few constraints on their behavior, they act nearly autonomously

toward the group, though they often exhibit ties to others outside the immediate group. But innovators comprise only a small proportion (2.5%) of the adopters in any social system. The vast majorities of others (early adopters, early majority, late majority, laggards) are less active in how they behave, their activity being more a response to how they perceive that others within the group view the innovation in question. The last to adopt also exhibit a lesser degree of social integration, though they are more commonly passive rejecters rather than active in relation to others. How can a cancer communication intervention designer use this knowledge?

3.3. Sociological data about the social system

A key advance of dissemination science over both classical diffusion studies and marketing approaches is to combine the ideas of a societal sector (or market segment, from marketing science) with that of its internal social structure (from diffusion literature). The objective in this design activity is to (1) decide on one or more societal sectors, and then (2) identify which organizations (and sometimes well-known individuals within them) are especially known and considered credible by their sector peers.

A *societal sector* is a collection of focal organizations operating in the same topical domain (such as Laundromats, community cancer centers, cancer survivor support groups, elementary schools, rural health clinics) sometimes in combination with proximity, as identified by the similarity of their services, products or functions, together with those organizations that critically influence the performance of the focal organizations [67]. To a marketing scientist, a societal sector is a market segment, though societal sectors and their members are "upstream" of the typical marketing or social marketing focus on individual consumers [68]. The advantages of planning to intervene across a societal sector are several. First, organizations rather than individuals are the units of adoption since organizational resources are required for providing many of the services such as disease prevention programs that may affect public health, or cancer care practices that affect the patient experience of healthcare systems. The units of a societal sector are members of that sector because they are engaged in the provision of the same type of service or activity. Since they are functionally similar, the organizations in a sector are represented by the same trade or professional associations and thus bridged via the same specialty publications and the same trade conferences. They are often subject to the same regulations and the same oversight agencies, and the same or common union policies. They often have the same set of suppliers and distributors. These conditions of homophilous organizations mean that efficient communication with the focal organizations and their clients is possible.

After a sector is decided upon for intervention, attention can turn to learning about the internal dynamics of the sector in terms of its *social structure*, or patterns relationships among system members. Specifically, this means using data-collection methods of survey research for asking who-to-whom sociometric questions (such as, "who do you look to for new ideas or advice concerning better ways of delivering breast cancer care?"), or informant based interviews that proceed into snowball sampling procedures, or direct observation, archival records, or self-nomination survey measures. While a triangulation of identification data-collection procedures has been suggested for formative research [69], most often this is impractical because of lack of time or resources. When the societal sector in question has many members, or has a membership that cannot be accessed by online questionnaire, approaching a small number of informants with broad knowledge of the sector in order to ask for their help in suggesting initial interviewees who are especially influential with their peers can work well to quickly generate further names for subsequent

rounds of interviews that, in snowball fashion, continue until resources are depleted or most of the newly mentioned names have already been mentioned. Alternatively, self-nomination survey measures (i.e., "My friends and co-workers routinely ask for my advice about new consumer products") are increasingly used by marketing firms to understand the attitudinal and behavioral characteristics of informal opinion leaders [70]. Sociometric questions can be asked that produce relational data that are especially useful at pre-test, to understand who influences whom, and thus which organizations and individuals to recruit into a opinion leader-based intervention so that they can be encouraged to discuss an innovation with their peers in the course of their normal discussions. Many studies have demonstrated the viability of identifying informal opinion leaders and then recruiting them to help in dissemination and diffusion [71].

Conceptualizing a societal sector and then assessing its structure for the formative purpose of intervention was effectively combined for the international problem of ineffective obstetrical practices. In thousands of hospitals, evidence-based birthing practices are under-used, while ineffective and harmful practices continue. Previous efforts at improving birth attendant performance in Mexico and Thailand by providing access to the latest information about evidence-based practices resulted in no change in what birth attendants do. Researchers tested sociometric identification and recruitment of informal opinion leaders to diffuse evidence-based birthing practices by randomly assigned 19 hospitals in Argentina and Uruguay to receive a multifaceted behavioral intervention involving opinion leaders, workshops, training, one-on-one academic detailing, reminders, and feedback, or enhanced standard of care. Desirable practices increased and undesirable practices decreased at the intervention hospitals as compared with control hospitals. At intervention hospitals where opinion leaders had been sociometrically identified by questionnaire and then contacted and recruited to help, the rate of use of prophylactic oxytocin during the third stage of labor increased from 2.1% to 83.6%. Opinion leading birth attendants were key to the 18-month intervention's success, and they were eager to help by talking with their work colleagues in positive terms about evidence-based birthing practices. Practice changes were sustained for at least 12 months after the end of the study [72].

A cancer communication intervention designer can also conceptualize policy makers and policy experts from a network perspective. Policy researchers have shown how certain super-networkers help move health innovations across jurisdictions, making accurate identification and recruitment of these bridging individuals very important [73,74], and even how cities and states influence each other [75–77], suggesting that there are better and worse places for designers to launch their innovations so that policy experts in other jurisdictions will notice and consider trying them.

3.4. Formative evaluations of the innovation

A major component of designing for diffusion is frequent and iterative testing of prototype versions of innovations with users. While such formative research has long been a recommended best practice in cancer communication [78], approaches to this work have become more systematic and new methods have been developed and refined. For example, the growing field of user-centered design has established a multi-step process for guiding development and testing of innovations [79]. This process begins by identifying users and understanding their needs, summarizing these in user profiles, and creating "personas" – archetypes of actual or potential users – that reflect distinctive characteristics of different types of users. How, why, when and where would each persona use the innovation? Answers to these questions help

create user scenarios and tasks for each persona that can be tested with actual users. Initially these tests examine user reactions to low-fidelity prototypes, and later to high fidelity prototypes that have incorporated findings and recommendations from earlier testing. Cognitive interview methods, including thought listing, paraphrase and think aloud tasks, are also useful in formative evaluations of cancer communication materials [80]. These techniques, derived from survey development research, are administered during or after exposure to cancer communication prototypes and can shed light on how audiences think about, understand and process the information therein.

Applied in CECCR activities, formative research has been instrumental in developing promising cancer communication tools. As reported elsewhere in this supplement, a video-based intervention build around breast cancer survivors' stories showed multiple positive effects related to use of mammography among low-income African American women [81,82]. The process of selecting survivors and stories to include in the final intervention was based on reactions of women in the target audience to hundreds of sample stories [83]. Audience members also evaluated the production quality of the videos, chose the narrator, and selected the name of the video (*Living Proof*). In new, ongoing cancer communication research, the video intervention has been adapted and expanded into a touch-screen tablet computer tool for clinical cancer care. Women newly diagnosed with breast cancer are given the tool to take home with them, where they can use it to access a library of hundreds of survivor stories about dozens of breast cancer related issues faced by newly diagnosed women. The structure and function of the system, the topics it addresses, and the organization of its content were all based on formative research with women diagnosed with breast cancer. Such user-driven design should be ongoing, extending beyond intervention development to actual implementation and use. In this study, the interactive tablet computer tool tracks what parts of the system are used, which topics and stories are viewed most, and when and for how long women use it. This information will be used to make improvement in the next version of the tool.

4. Discussion and conclusion

4.1. Discussion

The designers of health communication campaigns and those interventions created to improve healthcare and public health are on the cusp of a new shared understanding for why their efforts sometimes achieve impressive outcomes. Communication research has documented the importance of repeated and reinforcing messages sent through different communication channels. Social marketing efforts suggest the importance of comprehensive planning, management, product distribution, and follow-through. Scholars focused on community health highlight the importance of stakeholder engagement, collaborative decision-making and organizational capacity-building. Researchers who focus on the provision of disease prevention and medical care increasingly note the importance of practice-based research to achieve the translational potential of research-based practice. These general lessons, and others, can be collectively understood as components of a Push–Pull-Infrastructure Model for closing research–practice gaps.

4.2. Conclusion

Dissemination push activities on behalf of an innovation can, if designed on the basis of a close understanding of the societal segment targeted for adoption and implementation, elicit pull motivations among those individuals to learn about, assess, and try the innovation. Pull is represented in the preexisting dispositions, preferences, perceptions, capacities, and behaviors of potential adopters as they relate to an innovation. While push activity – the normal province of dissemination – is often necessary in communicating with potential adopters what a new practice or program is, it is often not sufficient in generating adequate intrinsic motivation in our targeted adopters to lead them to seek out evaluative opinions about an innovation from credible sources and then prompt them to a decision. Infrastructure, too, is often necessary so that a new practice or program can reach an intended audience and later provide the confirmatory messages that adoption was the right decision. The elicitation of pull is what will propel cancer communication research and practice forward in making a difference for cancer providers and their patients.

4.3. Practice implications

As researchers of innovations in cancer communication, we have come across many practitioners who are committed to providing the best care possible to their patients. For communication about cancer, this means taking action to try the sorts of design activities we reviewed. In all cases, we have found practitioners to be well-suited to these applied tasks.

First is the critical task of listening to public health and healthcare practitioners and their patients. What problems do they have? What challenges are high on their personal and unit-level work agendas? Which of their salient problems are also affordable and within the constraints of the community or organization to resolve? This process, commonplace among social marketers, is a type of needs assessment that identifies problems and potential solutions to those problems in order to prioritize a way forward.

The second type of design activity that practitioners can excel at identifying which other stakeholders and organizations are important for implementing and sustaining a solution to a selected problem. Partnerships, and especially early involvement in problem identification and the generation of solutions, are a well-established means by which cancer communication programs can be fielded beyond research trials. Partnering with others shares control of the innovation, and increases the likelihood that the innovation can be adapted in ways that are most compatible with the missions and operations of partner organizations while at the same time retaining the reasons why the innovation is effective practitioners can also use sociometric or other relational inquiry methods to learn about existing informal structure that ties together the societal sectors of potential adopters they hope to affect. Relational questions can be asked of highly positioned informants in the form of snowball samping; self-designating methods to learn about social influence can be embedded in a survey; or sociometric questions can be posed to respondents. In any case, the purpose is the same: to know who is best positioned to influence similar others.

Lastly, we know practitioners who are very good at taking prototype versions of innovations and asking potential adopters how they perceive them in terms of pros and cons, and assessing how usable a prototype is so that it can be improved prior to launch. Diffusion depends on the results to all four of these types of formative design data-collection activities.

Conflict of interest

None declared.

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