Conference Report

A theory-aided dissemination strategy for emerging technologies in cervical cancer screening

Multidisciplinary research groups involved in the development and evaluation of emerging healthcare technologies can maximize the clinical impact of their findings by adopting theory-guided strategies to support the dissemination and adoption of clinically beneficial advances in medicine. In this overview, we will report on our efforts to apply models of knowledge dissemination to the implementation to a novel cervical screening project in Nigeria. By measuring the public health impact of emerging clinical technologies in this program, we hope to refine not only the devices involved, but also an adaptable strategy for dissemination in other regions.

In the medical field, the failure to translate efficacious interventions into routine practice can result in lives lost unnecessarily. Each year, billions of U.S. tax dollars are spent on biomedical research with relatively little resultant information as to the best strategies for translating evidence-based medicine into practice [2]. Relying on the passive diffusion of innovations from laboratories to clinics can delay the adoption of practices which may be more clinically effective, more cost effective, or both. Because developing countries and under-served areas of developed countries are more insulated from the leading edge of biomedical research, it is particularly important to actively navigate barriers to the adoption of healthcare innovations in these regions.

A recent meta-analysis demonstrated that when innovative technologies are left to passively diffuse into routine medical practice, just 14% of innovations will be incorporated into routine medical practice and this small proportion will need an average of 17 years to diffuse [3]. In general, the scientific tradition of dissemination has been to establish an intervention’s efficacy under tightly controlled conditions and then later its effectiveness under more generalizable conditions. Even in small populations, the translation of efficacious research into evaluative programs can be problematic [2]. Recognizing this, in 2002, the National Cancer Institute’s Designing for Dissemination Conference called for a change by focusing on dissemination from the initial planning stages of an intervention to the final reporting [4]. In particular, innovative technologies should be designed so that it can be delivered in ways that are practical and cost-effective in the real world [4,1].

Theories of dissemination

Scholarly theories of knowledge dissemination are critical to the design of innovative technologies that can be adopted in practical and cost-effective ways in the real world [4,1]. There are two leading models of knowledge dissemination. Rogers’ Model of Diffusion is one of the earliest and most frequently cited models of dissemination (while the NCI Dissemination conference was careful to distinguish passive processes of diffusion from the intentional process of dissemination, Rogers’ use of the term diffusion is more consistent with the NCI Dissemination Conference’s definition of dissemination). Dissemination refers to “the active promotion and support of a program to encourage its widespread adoption, involving the adaptation, evaluation, and implementation of an intervention” [2,4,5]. Rogers lists five characteristics which increase an innovation’s likelihood of successful dissemination: (1) whether the innovation is relatively better than existing technologies, (2) whether the innovation is simple to adapt, i.e., complexity, (3) the ease of trying the innovation and discarding it if it does not work, triability, (4) its compatibility with the potential adopters’ existing needs, values, and past experiences, and (5) the observability of the innovation’s positive results. Provided all of the innovations’ characteristics align favorably for dissemination, Rogers’ posits that four key elements must be in place (see Fig. 1): (1) the innovation itself, (2) the passage of time, (3) communication channels, and (4) the potential adopters’ social system. Finally, the dissemination process itself is influenced by three key mediators: (1) communication of information about the technological innovation between the resource system (or the system which originated the innovation, i.e., the inventors) and the user system (or the organizational system of people and infrastructure which may potentially adopt the innovation, i.e., the potential adopters), (2) early and sustained linkage between the technology’s developers and its
potential adopters so that potential barriers arising from the real-world setting can be identified and addressed on an a priori basis, and (3) appropriate environmental support [1].

Orleans et al.’s Push-Pull Model, which was later adapted by the 2002 Dissemination Conference, provides other useful concepts [6]: The Resource System (the research team that created the technological innovation) is juxtaposed with the User System (the potential adopters). The dynamic between the two components is characterized as Push-Pull: the researchers will push the technology out into the world by demonstrating, publishing, and communicating, while the need for evidence-based medicine among the potential adopters will pull the innovation into their world. Orleans et al. highlight the importance of environmental capacities. ‘Capacities’ refers to the user system’s training and infrastructure needed for successful dissemination and sustained implementation of the new technological innovation. A synthesis of these two models can be used to guide biomedical researchers in developing tailored design strategies for adoption (see Fig. 2).

Future research should draw upon theory to guide the development and implementation of a dissemination strategy. For implementation, attention should be given to the key mediators which are expected to impact the process by which innovations are adopted. An important preliminary step is the identification of traditional communication networks and the most efficient styles of communication. Training personnel will assess the baseline competency of all healthcare providers and identify their infrastructure needs throughout the training process. Few research reports compare disseminative strategies or outline methodological issues in dissemination research. In 2002, the NCI’s Designing for Dissemination Conference summary report called for the increased support and publication of dissemination research. The first wave of research constituted of case reports detailing adoption efforts and lessons learned. The next wave of research should build on this body of research by testing theoretical frameworks, comparing dissemination approaches or highlighting outcome measurement issues.

Greenhalgh’s meta-analysis of dissemination studies from the health service, marketing, and industrial organizational sectors concluded that the most serious gap in the literature was the lack of focus on processes that speed dissemination and cement its implementation [10]. She recommended in-depth mixed methodology studies aimed at building up “a rich picture” of process and impact. Consistent with the NCI Designing for Dissemination 2002, Greenhalgh recommended that dissemination research be theory-driven and take special recognition of the reciprocal interaction between the potential adopter’s system and its cultural values and norms [10].

In Nigeria, we will administer semi-structured interviews and questionnaires to key stakeholders to detail the processes which facilitate or block the dissemination of the proposed technologies into mainstream practice. We will conduct focus groups and individual interviews with decision makers and use the resultant qualitative data to develop an heuristic evaluative tool for dissemination, based on Bartholomew et al.’s Intervention Mapping tool (see Fig. 3 [11]). In Fig. 3, we have filled in the intervention mapping boxes with the project’s

![Fig. 1. Rogers’ model of dissemination. Dissemination is the process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among the members of a social system. Three different innovations’ rates of dissemination are presented.](image1)

![Fig. 2. Modified Push-Pull Model of dissemination.](image2)
proposed program strategies, program and behavioral objectives, and resources.

Cervical cancer in low-resource settings

Eighty-three percent of cervical cancer incidence occurs in the developing world. In Nigeria, cervical cancer causes more cancer mortality among females than any other cancer [7]. Despite the need for effective cancer screening services in Nigeria, dissemination of cancer screening technologies should not be assumed straightforward. Past research has demonstrated that efforts to disseminate evidence-based medicine in Nigeria failed without taking into consideration societal and cultural norms and the compatibility of these norms with the effective intervention [8]. In order to increase the likelihood that cervical cancer screening will be disseminated into Nigeria, we will conduct a theory-driven case study which will assess systems-level and individual-level processes.

There are three distinct ethno-cultural geographic zones in Nigeria, referred to as the North, East, and West Zones. Within these zones, six cities have been chosen as sites for collaboration with the proposed P01, Enugu, Port Harcourt, Lagos, Ibadan, Jos, and Zaria (see Fig. 4 below). In order to explain the context for the methodological strategies proposed below, it is necessary to outline some of the salient cultural Nigerian values that would impact women’s likelihood of engaging in cervical cancer screening and participation in the proposed P01 trials.

Drawing upon our theoretical model (Fig. 1), we will assess communication among stakeholders in Nigerian society. In Nigerian culture, personal identity is understood to be inextricably linked with collective systems, as opposed to the autonomous and independent identity valued in Western culture. Nigerian women’s health decisions are constrained by their husbands’ needs and wishes, and in turn the husband–wife unit is constrained by their community’s religious and political

Fig. 3. Intervention mapping tool to evaluate dissemination of quantitative cytology. Adapted from Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Intervention Mapping: Designing theory- and evidence-based health promotion programs. Mountain View: Mayfield, 2001.
leaders. In the East zone, there is an additional layer of collective identity in that men belong to regional age groups that meet 1–3 times a year to make concerted and important decisions concerning community planning and goals (including collective decisions about adopting new medical practices and technologies). For men in the East, the decisions made by an age group tend to take precedence over those made by the religious and local political leaders. One relevant lesson learned was a Johns Hopkins study conducted in 1990 to introduce contraception into Nigerian culture [12]. This attempt failed initially due primarily to the researchers’ assumption that Nigerian women had the autonomy to visit health clinics for contraception without consultation from their husbands or community leaders. The high value that Nigerians place on fertility was not addressed in this study.

By studying the dissemination process in Nigeria, we can identify and overcome obstacles that arise when the same or similar technologies are used in underserved areas of the United States. There are low rates of cervical cancer screening among eligible women and historically higher rates of cervical cancer incidence and mortality in women with low socioeconomic status [7], or who live in areas of geographic disparities such as Appalachia [13,14], the Texas–Mexico border, and other rural areas. In response to these health disparities, the federal government created the National Breast and Cervical Cancer Early Detection Program in 1990 [15]. We will identify existing stakeholders’ decision to adopt this technology, analyze systems that would be affected by the change, and explore barriers to dissemination. The resulting methodology that will be developed can then be applied for future studies of dissemination with other technologies.

Pre-implementation phase: identifying current practices in Nigeria

Our team made two trips to Nigeria in 2006. The first 10-day trip was in late January, when we met with investigators at the University College Hospital in Ibadan, Nigeria and established research collaboration. We also held a meeting with physician-led teams from six sites: Ibadan, Lagos, Enugu, Port Harcourt, Zaria, and Jos. We met to determine the state of cervical cancer screening and diagnosis in Nigeria. There was a tremendous desire for equipment and training in screening, diagnosis, and treatment of both precancerous and cancerous lesions.

Identifying quality performance gaps

In July 2006, we returned to deliver equipment and teach core skills in colposcopy, LEEP excisions, cervical cytology, pathology, and the treatment of invasive cervix cancer. As the training progressed, it was apparent that practitioners had little confidence in skills they learned long ago, but never used. It became clear that more time was needed for example in skills such as focusing a colposcope, administering cryotherapy, and conducting loop excision procedures without burning the margins of the cervical specimens. During this trip, it quickly became apparent that the quality and education of the gynecology residents, nurses, nurse midwives, and nurse practitioners were superb, but that not having used learned skills would require a structured program and competence testing. In part of the course, we instituted an intensive training course where residents and nurses practiced LEEP on beef tongue (pictured in Fig. 3) and other basic skills until they could demonstrate competence. Based on this experience, we realized that there is a need for the delivery of standardized training of basic procedures that are done in the P01 trials, as well as a need to measure and confirm the competency of the study’s providers before they can conduct the study trials (Fig. 5).

Our observations were consistent with Lazcano-Ponce et al.’s report of the failed dissemination of a national cervical cancer screening program in Mexico from 1974 to 1999 [9]. Despite having sufficient infrastructure and resources to administer over 3.5 million Papanicolaou smears each year,
the national screening program had no effect on cervical cancer mortality, which remained unchanged at 16 women per 100,000 during the 25 year period. Lazcano-Ponce et al. examined data evaluating every level and facet of the cervical screening procedure, from Papanicolaou smear sampling quality, the validity of cytological reports, patient screening behaviors and nonadherence to follow-up, and finally the possible lack of infrastructure necessary for effective coverage of the eligible Mexican population. They concluded that the principal reasons for the ineffectiveness of the national cancer screening program were poor quality of Papanicolaou smear sampling and cytological diagnosis and low access to screening resources in rural areas [9]. As an example of the lack of quality control, Lazcano-Ponce cited an evaluative study which randomly sampled 6011 smears out of 31,398 negative Papanicolaou smear results: of these random slides, a strikingly high proportion, 64%, lacked endocervical cells. Similarly, poor concordance and low sensitivity rates (ranging from 0.46 to 0.90) were reported among the 16 national cervical cancer screening centers when 90 positive screened (CIN2 to invasive cancer) of cytology specimens were randomly distributed to each of the centers [9]. The authors strongly recommended that Mexico’s national cervical cancer screening program improves its internal quality control system regarding the sampling and reading of cervical smears.

In Nigeria, we have collaborated with faculty at the Department of Public Health and Promotion at the University of Ibadan and with the Department of Pathology at the University of Ibadan to conduct a case study among the key decision makers from the six study sites representing the three distinct cultural and geographic zones (North, East and West).

Conclusion

Our multidisciplinary research group will use a theory-guided strategy to support the dissemination of emerging technologies in North America and in Nigeria. Training, quality control, and a dissemination case study regarding quantitative cytology will be the focus of this strategy. We will develop training materials and tools to assess pre- and post-training competency. We will also conduct parallel case studies to understand the systems-level and provider-level processes that affect dissemination of healthcare technology in Nigeria and underserved areas of North America.

Conflict of interest statement

We declare that we have no conflict of interest.

References


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