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Moving Research Knowledge into Dental Hygiene Practice

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Dental hygiene, as an emerging profession, needs to increase the number of intervention studies that identify improvements in oral health outcomes for clients. Historically, dental hygiene studies have typically been atheoretical, but the use of theoretical frameworks to guide these studies will increase their meaningfulness. Rogers' theory of diffusion of innovations has been used to study research utilization across many disciplines, and may offer insights to the study of research use in dental hygiene. Research use is an important component of evidence-based practice (EBP), and diffusion of research knowledge is an important process in implementing EBP. The purpose of this paper is to use diffusion of innovations theory to examine knowledge movement in dental hygiene, specifically through the example of the preventive practice of oral cancer screening by dental hygienists, considered as an innovation. Diffusion is considered to be the process by which an innovation moves through communication channels over time among a social network. We suggest diffusion theory holds promise for the study of knowledge movement in dental hygiene, but there are limitations including access to and understanding research studies as innovations. Nevertheless, using a theoretical framework such as Rogers' diffusion of innovations will strengthen the quality of intervention research in dental hygiene, and subsequently, health outcomes for clients.

Keywords: Diffusion of innovations, evidence-based practice, research utilization, theoretical frameworks, dental hygienists

Background

Dental hygienists, as oral health practitioners, strive to provide health care services that will result in optimal oral health outcomes for their clients. Using an evidence-based practice approach is intended to contribute to maximizing such outcomes.¹ Research utilization is an important component of evidence-based practice (EBP), and diffusion of research knowledge is an important process in implementing EBP. Moving knowledge from research into dental hygiene practice presents challenges that can be better understood and addressed by examining the social and professional contexts in which dental hygienists practice. It is important that we conduct studies about how research knowledge moves into practice in dental hygiene, in order that future efforts to promote EBP are consistent with empirical findings about successful knowledge movement in dental hygiene practice. The use of a theoretical framework, such as Rogers' theory of diffusion of innovations, provides a mechanism for studying knowledge movement, or diffusion, among practitioners.²

Evidence-based practice (EBP) is defined as an "... approach that integrates the best external evidence with individual clinical expertise and patients' choice."³ Despite the active promotion of the concept of practice based on current research evidence by professional dental hygiene organizations in Canada and the United States studies show variation among

practitioner behaviour. For example, a number of studies of dental Hygienists' practices with regard to oral cancer screening (OCS) found that, in many cases, practitioners' knowledge was not consistent with current scientific findings, and when knowledge was current, practices were not necessarily consistent with that knowledge.⁴⁻⁶ Putting the knowledge obtained from research into practice operationalizes evidence-based practice, but from this example it is apparent that this process is much more complex than existing models for EBP suggest, with their focus on individual actions in seeking new knowledge.⁷⁻¹⁰ In this paper we use Rogers' theory of diffusion as a framework for examining, via existing literature, the complexities associated with diffusion of OCS into practice.

Rogers' Theory of Diffusion of Innovations

Rogers' theory of diffusion of innovations² may hold some promise for developing an understanding of knowledge transfer in dental hygiene, and has already been used to study the information-seeking behaviours among dental hygienists. Rogers defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system.² A wealth of studies, mostly descriptive and correlational, have described the spread of change as innovations have diffused through given populations.¹¹ Many of these studies have examined relationships between the attributes of the innovation, the communication channels used to spread knowledge of the innovation, characteristics of the social system of potential adopters, and the time it takes for implementation of the innovation to occur.

There is a rich tradition of diffusion research occurring across many disciplines, and this theoretical framework has been used to study diffusion, for example, in medicine,^{2,11,12} nursing,¹³ dentistry,¹⁴ and dental hygiene.^{15,16} Covington studied uptake of fluoride guidelines among practicing dental hygienists in northern British Columbia¹⁵, and Finley-Zarse and her colleagues used diffusion of innovations as the theoretical framework to describe the demographics of adopter categories in her study of computer-based information gathering behaviours among US dental hygiene educators and practitioners¹⁶

Rogers has defined an innovation as an idea, object, or practice that individuals perceive as new.² It may have been in existence for some time, but may not have been adopted by all members of a social system yet. For the purpose of this paper, we will consider the example of the preventive practice of oral cancer screenings by dental hygienists to be the innovation under consideration. Although the terms 'screening' and 'examination' are sometimes used interchangeably in the literature, we have used the terms 'screening' and 'oral cancer screening (OCS)', consistent with Wilkins' definitions, where a screening implies the potential for referral for further in-depth examination.¹⁷ Implicit in this definition is the assumption that an examination would lead to a diagnosis, whereas a screening would lead to a referral for diagnostic purposes.

Of known oral diseases & conditions, oral cancer is the only one that can and does frequently lead to death, and often leads to severe disfigurement. Dental hygienists can contribute to reducing morbidity and mortality associated with these cancers.⁴ Although relatively widely known for some time, this practice has not yet been adopted consistently into regular dental hygiene practice. Syme, Drury, & Horowitz studied behaviours of Maryland dental hygienists related to assessment of patients' risk for oral cancer, and found while the majority probed for present tobacco use, fewer probed for past tobacco use and still fewer probed for present or past alcohol use.⁶ Those who provided more comprehensive screenings were more likely to feel adequately prepared to provide tobacco cessation education. Horowitz, Siriphant, Canto, and Child found that dental hygienists perceived a lack of time and lack of expectation on the part of their employer dentists to conduct oral cancer exams.⁵ They identified discomfort and uncertainty about their skills for providing comprehensive oral cancer examinations. Forrest, Horowitz, and Shmuley noted inconsistency between knowledge and practitioner behaviour with regard to oral cancer screening.¹⁸ Clovis, Horowitz, and Poel studied Canadian dental hygienists in Nova Scotia and British Columbia and found inconsistency between knowledge, and the application of that knowledge, in providing oral cancer examinations.⁴ It is believed by many that evidence-based practice will contribute to reducing variation among practitioners, as they come to embrace the most current evidence for practice. The challenge is to identify ways to move knowledge from research into practice in a more timely manner than is currently occurring. The purpose of this examination of Rogers'

diffusion of innovations theory is to consider whether it may provide a useful framework for studying interventions to actively diffuse knowledge from research such that it results in implementation in practice. If we are to characterize OCS or any other findings from research as an innovation, we need to describe it in terms of each of the elements in the diffusion process.

Attributes. This theory contends that the rate of diffusion is related to 5 attributes of the innovation, the first element in Rogers' definition, as perceived by potential adopters. These 5 attributes are relative advantage, compatibility with existing values, complexity, trialability, and observability. If an innovation has a greater relative advantage than the idea it is replacing, it will be taken up more rapidly. If an innovation is more compatible with existing values, beliefs, past history, and needs of the potential adopters, it is more likely to be taken up sooner. If an innovation has low complexity, is easy to understand and use, it is more likely to be taken up early than if it is very complex and difficult to understand and use. If an innovation is trialable, that is - it can be tried in a small way by a potential user such that they can see its advantages and achieve success, it is more likely to be adopted. If an innovation is observable and can be noticed by others and observed by those considering adoption, it is more likely to diffuse rapidly. Between 49% and 87% of the variance in adoption rates can be explained by these 5 variables.¹²

When considered against the attributes, OCS has mixed results. In terms of relative advantage, OCS does not replace an existing practice; rather it is in addition to (an adjunct to) existing intra- and extra-oral examination processes. This may not be perceived as an advantage by practitioners, rather some may consider it to take more time than is available. Clovis et al pointed out that "The single most critical intervention influencing survival is early detection,"⁴ consistent with the notion of greater relative advantage. Investigators found a rather complex interplay of factors, including confidence in skills and knowledge, perceived time constraints, and unclear influence of practice and professional context for supporting routine OCS by hygienists, suggesting that the advantage of early detection may be moderated by other influences.

OCS can readily be seen to be compatible with dental hygiene's existing values of disease prevention and health promotion. It also aligns well with professional models of practice, rather than occupational models.¹⁹ A challenge for dental hygienists is that historically, this was not a role for dental hygiene practitioners, but rather was assumed by dentistry. Clovis et al recently found 20% of dental hygienists still believed it was the dentists' role to provide this screening.⁴ The continued movement from an occupational culture to a professional culture may positively improve this acceptance of dental Hygienists' responsibility over time. As this is an additional service and does not meet a specific identified need of practitioners, nor does it have a fee associated with it, routine incorporation of OCS is not straightforward.

Innovations that are of low complexity are more likely to diffuse rapidly, and some would suggest OCS is low complexity. Prout et al suggest that screening can be taught to nurses and other primary health practitioners in one hour, and they can successfully use the technique to identify and refer lesions, using a standardized form.²⁰ However, Clovis et al found that even though nearly half of dental hygienists surveyed felt their knowledge of OCS was current, fewer still were likely to provide this screening, even when they knew it was necessary.⁴ Despite the fact that OCS can be a "death-defying act" requiring only a few minutes of time,²¹ one explanation for this reluctance to perform a seemingly low complexity screening may be that OCS is associated with the higher complexity skill of interpretation and judgement.

Communication channels. The second element in Rogers' definition is the use of communication channels, and diffusion research has found that different communication channels are more useful at different times in diffusing different kinds of knowledge among potential adopters. There are 3 main types of knowledge about innovations: awareness knowledge - that the innovation exists; how-to knowledge - subjective evaluation knowledge of how to incorporate the innovation into practice; and principles knowledge - functioning principles underlying how the innovation works. Mass media channels are best for communication of awareness knowledge, and interpersonal channels are best for communicating information about "how to" knowledge, in particular subjective evaluation knowledge about the innovation. Awareness knowledge can be communicated from outside the social system, but diffusion studies have shown that, other than the most innovative of potential adopters, most do not evaluate their potential decisions to adopt on the basis of scientific studies.¹⁰ Most people within a social system prefer to receive subjective evaluation information, "how to" knowledge, about an innovation from a near-peer within their social system, and this transfer of knowledge occurs primarily through social interaction.

Dental Hygienists' awareness and principles knowledge are most likely to have been acquired during basic education and continuing education. Their decision to incorporate OCS, which according to diffusion studies would typically be based on subjective evaluation of near peers, is more complex. Studies have shown that dental hygienists request more continuing education (CE) about oral cancer and performing OCS, yet CE has not translated into changed practice behaviours,^{4,6} and preliminary studies of knowledge sources show high use of experiential sources (personal experience, knowledge from clients)²² and interpersonal sources.^{17,23}

Dental Hygienists' comfort with principles knowledge, reflecting the underlying principles of how OCS works, may be influenced by differences among guidelines regarding OCS. The Canadian Task Force on Periodic Health Examination (CTFPHE), the American Cancer Society (ACS), and the US Preventive Services Task Force guidelines demonstrate a lack of consensus regarding screening, with ACS recommending routine screening every 3 years for those between the ages of 20 and 40, and annually for those 40 and over.⁴ The CTFPHE does not include a recommendation for OCS, but Clovis points out it is critical to note that this stems from a lack of evidence rather than evidence of no benefit.

Time. The decision to adopt an innovation does not occur simultaneously with first knowledge of the innovation; rather it is a process that occurs through a series of 5 steps over time. The first step is knowledge of the existence of the innovation, followed by persuasion or forming a favourable or unfavourable attitude toward it. The third step is the decision step, when the potential adopter makes a decision to adopt or reject the innovation. If the decision is to adopt, the fourth step is implementation, which can and frequently involves reinvention of the innovation to fit the local context. The fifth step is confirmation, when the adopter seeks reinforcement or possibly support to confirm that the decision is right and functional. The length of time for the innovation-decision period can vary, and can take years from awareness to adoption and confirmation.²

There are no studies that have looked at time related to diffusion of research innovations within dental hygiene.

Social system. Other factors that influence the spread of adoption are characteristics of the individuals within the social system, frequently referred to as adopter characteristics. These characteristics are generally described in terms of the individual's innovativeness, or how early they are to adopt new ideas. Various studies have found that these groups approximate a normal frequency distribution.² See Figure 1 for an illustration of the frequency distribution of adopter categories. The first group, the smallest at about 2.5% of the total population, and found 2 standard deviations above the mean, are innovators. These are active information seekers who have wide external networks, travelling further to communicate with others and seek information (Rogers calls them cosmopolite), and a high degree of exposure to mass media. They are able to cope with some uncertainty and do not depend on subjective evaluations of others within their social system. The next group, between 1 and 2 standard deviations above the mean, or 13.5% of the population, are early adopters. They are more connected to the local social system than innovators, and have a high degree of local opinion leadership. They have some network connections outside of the local system to find out about innovations, communicate readily with each other, and have a short innovation-decision time period. They can and do report on the innovation if asked. Some have suggested that there may be great advantage to the intentional use of opinion leaders to aid in strategic diffusions (see Figure 1).^{24,25}

Figure 1. Distribution of Adopter Categories on the Basis of Innovativeness.



The next group, the early majority, are distributed about 1 standard deviation above the mean, and comprise about 34% of the population. This group adopts just before the average adopter and are well connected with their peers in a local network. They are not opinion leaders but watch opinion leaders' actions with the innovation. This group relies on personal familiarity, rather than science, to assist their decision to adopt.¹¹ As this group begins adopting the innovation, it is said to reach "critical mass," at which point the diffusion takes off and begins to spread with less external influence and more as a result of internal influences and information sharing. The next group, the late majority, distributed 1 standard deviation below the mean and making up approximately one-third of the population, are more conservative and adopt as a result of peer pressure, and after all uncertainty has been removed about the process. The final group, referred to as laggards, comprise approximately 16% of the population, and are the most localite and isolated with their smaller, locally-based social system networks. They may be resistors, or just ultra-cautious and wishing to stay with the "tried and true."¹¹

Finley-Zarse and her colleagues classified dental hygiene educators and practitioners by Rogers' adopter categories based on their frequency of use of computer-based information sources.¹⁶ They found statistically significant differences between educators and practitioners, with educators more likely to be classified as early adopters or early majority, and practitioners more likely to fall into late majority or laggard classifications.

So what do we know about the influences of the social system on dental Hygienists' uptake or adoption of research findings? There have been few studies of information-seeking practices and research utilization behaviours of dental hygienists. In an early study, Gravois and her colleagues found the main sources of information for practice were discussions with colleagues and browsing journals, books, and newsletters, while conducting or having someone else conduct a database search was used infrequently.^{26,27} Covington and Craig, using Rogers' diffusion theory to study diffusion of a clinical guideline related to fluoride, found the most frequently utilized information sources to be discussions with colleagues, journal articles, mailings from professional associations and the licensing body, textbooks, and CE courses.²³ They also found low usage of computerized information sources, but this study, conducted in 1996, was somewhat early relative to the diffusion of computers and their general use patterns. The findings of discussions with colleagues are consistent with literature on diffusion of innovations that suggests the importance of personal contact for sharing knowledge about an innovation.^{2,12}

More recently, Finley-Zarse et al, also using Rogers' theory of diffusion as the framework, found an increase in the use of computer-based information sources among dental hygienists, including the Internet and computer databases, possibly consistent with increased computer use by the North American population in general.¹⁶ Finley-Zarse et al examined information sources used by dental hygiene educators and practitioners, and found practitioners most frequently used, in descending order, CE courses, journals, asking a dentist, newsletters, and asking a dental hygiene colleague.

Ohrn et al studied research utilization among dental hygienists in Sweden, and found that reading research articles in professional journals was the most frequently reported research-related activity, followed by sharing research findings with colleagues.²⁸ Ohrn also found higher support for research use in public health settings, and suggested this may be related to the groups of dental hygienists working in such settings providing opportunity for collegial discussions, relating this to studies in nursing identifying the importance of interactivity for knowledge transfer.

Findings from a pilot study on research utilization in Alberta found that the top knowledge sources used by dental hygienists include: information learned about each patient/client as an individual; personal experience of dental hygiene patients/clients over time; and information obtained from attending inservices/conferences.²² The finding of the top 2 knowledge sources was very interesting, as previous studies had not asked questions about these 2 sources. The least likely source used was "information I get by searching PubMed," a step that is consistent with recommended approaches to EBP. Findings such as these point to the need for empirical examination of how knowledge from research moves into dental hygiene practice, rather than reliance upon prescriptions for how to practice in an evidence based manner, especially when these prescriptive directions have not been empirically derived.

Discussion

In this paper, we consider diffusion of knowledge from research, or research findings, to be consistent with operationalization of a culture of evidence-based practice. Some models of EBP focus on methods by which an individual can seek an answer to a clinical question,⁷⁻¹⁰ but these models do not address the social context in which research knowledge moves from one practitioner to another. Rogers' theory of diffusion takes this context and process of knowledge movement into consideration, and thus provides an excellent theoretical framework to study the movement of research knowledge into practice.

Challenges to moving knowledge from research into dental hygiene practice

Recommended approaches to evidence-based dental hygiene practice begin by developing a question to address the clinical problem or issue, searching for systematic reviews or research studies that may contain answers to the question, critically appraising the quality and appropriateness of the information retrieved, applying appropriate results into practice, and evaluating the results of the practice change.^{7-10,29} However, this approach, a very linear and rational model, is prescriptive and simplistic, and does not acknowledge the complexity identified in studies of innovation diffusion and research utilization in other professions. These complexities include adequate skills for accessing and appraising evidence, access to evidence, the social context of practice, and authority over practice. It is also important to acknowledge that these models are not based on studies of how dental hygiene practitioners actually seek and incorporate new knowledge into practice. Such studies are necessary.

The findings of the dental hygiene information-seeking studies raise interesting questions about the current messages regarding EBP, oversimplified as "find it, critique it, do it," and their appropriateness given the inconsistency with dental Hygienists' demonstrated preferences for obtaining information for practice decisions.^{15,16,22,26,27} A challenge for practitioners occurs when they believe that they should practice according to the latest evidence in order to be a good practitioner, but encounter barriers when trying to follow the currently popular approach being promoted in dental hygiene journals and CE sessions. It may be that a form of cognitive dissonance occurs when they continue to practice as they have been, while believing they should aspire to EBP, yet are unable to follow the supposedly simple steps for doing so. Understanding how dental hygienists prefer to obtain their information for practice can help evidence-based practice proponents promote methods that are consistent with existing behaviours and reduce the potential for cognitive dissonance. Diffusion theory can provide a framework for such studies.

Skills for evidence-based practice

Inherent in the linear rational model is an assumption that the necessary reviews or research are readily accessible by practitioners, that practitioners have the skills for searching and for critical appraisal, and that once a practice revision was identified as necessary, dental hygiene practitioners would have the authority to implement the change in practice. A study of dental hygiene programs found that teaching the necessary skills for EBP varied across dental hygiene programs³⁰ and that teaching of these skills were more likely to be found in baccalaureate curricula than in entry-to-practice associate degree or diploma-level programs.³¹ Yet Chichester et al pointed out that often the application of this knowledge was not extended to making patient/client decisions at the chairside.³¹

Access to evidence

Access to research evidence, as per the EBP movement, poses a challenge for many dental hygienists. The EBP movement privileges quantitative methods, especially systematic reviews of randomized clinical trials. The type of research frequently conducted and published by dental hygienists, and found in dental hygiene journals, is more likely to be descriptive or correlational rather than experimental. This is partially connected to the politics of funding for research, ie, there is little funding available for dental hygienists and dental hygiene-related projects. Further, the limited access to graduate education and lack of doctoral programs means that there are few highly-qualified dental hygienist researchers with appropriate graduate education and research training to apply for funding, and to conduct and publish this research.

Practice and social context

A further challenge for dental hygienists is their relative isolation in their practice context - they may be the only dental hygienist working in the office, or other dental hygienist employees work on alternate days, making it difficult to achieve the social connections that facilitate information sharing. These influences make for a messy context in which to presuppose that the "find it, critique it, do it" model of EBP will just happen, even if the dental hygienist is completely sure what "it" is. These assumptions also are inconsistent with existing studies of information-seeking behaviours of dental hygienists.^{15,16,22,26,27} Diffusion theory takes these influences into consideration.

Authority over practice

Changing dental hygiene practice in accordance with findings from recent research, as in an evidence-based approach to practice, assumes that the dental hygienist would have the authority to implement changes within the practice setting.³² In the small-business setting of a dental office, there may be potential for conflict within the orientation for practice - is it to be a health service provider or a small business with a profit-driven orientation? While an uncomfortable thought, and one largely unacknowledged in the literature, the answer to this question could influence the choice of evidence to support decision-making in practice.

Dental offices can also be sites for interprofessional conflict^{33,34} given their hierarchical structure with the dentist as employer and member of a profession that may consider itself superior to dental hygiene. There is a historical tradition of patriarchy, with dentistry once having had control over dental hygiene education, practice regulations, and control of practice settings through legislated supervision requirements. Many of these controls have disappeared over the years with trends toward self-regulation in professional practice, but dentists remain the primary employers of dental hygienists in North America, and perceive their education as superior for making decisions for practice.³⁴ It remains to be seen whether this increasing autonomy leads to more timely uptake of research findings into dental hygiene practice.

Movement of knowledge from research into practice is consistent with, and results in, EBP. Diffusion of innovations theory, where the innovation is the knowledge from research, provides a framework for the study of movement of research knowledge, such as the use of OCS in dental hygiene practice.

Summary

While Rogers' theory of diffusion of innovations holds some promise to study knowledge transfer in dental hygiene, there are some limitations to consider. One challenge to the use of Rogers' theory of diffusion of innovations is whether the findings of the research should be considered the innovation, or whether a communication vehicle, such as a clinical practice guideline, should be considered the innovation. Studying diffusion of the research findings poses problems with both access to, and understanding of, the research study itself by practitioners. Research findings are typically found in research journals that have limited circulation among practitioners, other than innovators, and are often written describing statistical tests and interpretations that are less meaningful to practitioners than to other researchers. These issues have been raised in studies of EBP with physicians,^{35,36} yet some EBP messages to practitioners continue to promote actively seeking research studies.

Studying diffusion of translated research, such as a clinical practice guideline, holds more promise as it may be more accessible and understandable, but the use of clinical practice guidelines in dental hygiene, and in dentistry to an extent, is not yet common.²⁸ Use of practice guidelines is much more common in medicine and nursing, but not without limitations for success in uptake of recommendations.^{37,38} Since dental hygiene practice contexts differ considerably from medicine and nursing, it is not easy to determine which lessons would transfer most readily. Studies of intentional diffusion of practice guidelines could use Rogers' theory to exploit knowledge of local social networks and contribute to changing current decision-making culture. However, there would be challenges to overcome in identifying local opinion leaders and the extent of networks, and the literature on the use of opinion leaders is not conclusive.

Similar to many health professionals, dental hygienists obtain much of their information about new interventions from CE courses and journal and magazine publications from their professional organizations. However, these mechanisms are unlikely to communicate the subjective evaluation information from a near-peer that is most influential in diffusion within a network, especially for those who are not at the leading edge.

Dental hygiene clinical practice does not have a facilitation role for communication of new research findings such as a Clinical Nurse Specialist or Clinical Nurse Educator, as found in nursing. This is a role that has potential for increasing research use,³⁹ however given the small-business setting of clinical dental practices, development of such a role in this environment is unlikely. However, municipal, regional, or state or provincial health authority dental programs may well be ideal locations for a newly developed role such as this. In particular, such dental programs would not have the potential conflict inherent in the market model of private practice.

The culture of dental hygiene has been evolving from a technical occupational model to a research and theory-oriented professional model,⁴⁰ but this evolution has been constrained by restrictive practice legislation and traditions of patriarchy and gender bias. These influences have in turn led to inter-professional conflict between dentistry and dental hygiene. Dental hygienists practice as employees of dentists, so the hierarchical relationship and patriarchal traditions exert both subtle and overt influences on dental Hygienists' decision-making behaviours. The influence of these conditions needs to be studied to determine how they would constrain or facilitate any strategies for knowledge transfer and implementation of changes for successful EBP.

Evidence-based practice involves locating and obtaining the best evidence and integrating it with clinical expertise and patient preferences, which may lead to changes and improvements in practice and health outcomes. Some possible interventions for the diffusion of evidence for practice, such as practice guidelines and the use of opinion leaders and facilitators, have been discussed. Studies are needed to determine which interventions will be most effective for implementing changes to move knowledge from research into dental hygiene practice. In particular, intervention studies related to increasing oral cancer screening (OCS), which has life-saving implications, should be a priority for dental hygienist researchers.

There is a need to increase the number of intervention studies that seek to move knowledge from research more rapidly into practice. The use of a theoretical framework will improve the quality of these studies, and Rogers' theory of diffusion of innovations holds some promise for this purpose. In our example, diffusion theory enabled us to systematically examine the movement of knowledge about OCS in the practice context of dental hygiene, and to identify its strengths and limitations for future use. The knowledge gained from this exercise can be useful in the design of theoretically-driven clinical trials to test interventions.

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Notes

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