Using diffusion of innovations theory to guide diabetes management program development: an illustrative example

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ABSTRACT

Background Optimal management of type 2 diabetes requires achievement of optimal glucose, blood pressure and lipid targets through promotion of prudent diet, regular physical activity and adherence to necessary medication. This may require the development of new programs for the coordination of required multidisciplinary services. Diffusion of innovations theory offers a conceptual framework that may facilitate the implementation of such programs.

Methods To illustrate this, we have re-examined the implementation experiences previously reported by the developers of an actual diabetes management pilot program in Montreal, with an eye toward identifying potentially important process factors that could effectively increase adoption and sustainability.

Results Physician participation in the program appeared to be influenced by perceived advantages of participation, compatibility of the program with own perspective and perceived barriers to participation. Organizational features that may have influenced participation included the extent of the program’s integration within the existing health care system.

Conclusion A thorough consideration of process factors that impact system and team integration must equally include a focus on ensuring ongoing partnerships among the producers of the model, governments, nongovernmental organizations, private industry, user professionals and patients. This can only be achieved when a knowledge transfer action plan is developed to guide program development, implementation and sustainability.

Keywords knowledge translation, knowledge transfer, cardiovascular disease prevention, multidisciplinary programs, type 2 diabetes

Introduction

Over 140 million people worldwide were estimated to have type 2 diabetes in the year 2000 and this prevalence is projected to rise to over 280 million by the year 2025.¹ There is, therefore, an urgent need to implement diabetes management strategies for the prevention of diabetes-related complications including blindness (retinopathy), kidney disease (nephropathy), amputation (neuropathy and peripheral vascular disease) and heart disease (myocardial infarction, heart failure).²–⁵ Adherence to diabetes care guidelines, as published by the American and Canadian Diabetes Associations and the International Diabetes Federation, is a key to achieving such prevention. These guidelines generally emphasize a multidisciplinary approach (physicians, dieticians, nurses and exercise specialists) toward achievement of target levels of glucose, blood pressure, lipid levels, body weight and physical activity.

Guideline adherence may be challenging for physicians not practicing within a multidisciplinary framework. This necessitates the development of diabetes management programs that permit access to comprehensive, multidisciplinary care. Development of such programs is a subject of diabetes translation research, which seeks to transform what is currently known about prevention and treatment into good clinical practice. Diffusion of innovations theory (DIT) may offer a useful conceptual framework for diabetes translation research. DIT provides an understanding of the complexities inherent in the process of adopting novel technologies, ideas and practices.⁶–¹¹ This theory suggests that the adoption of an innovation involves interaction between (1) the
individuals adopting the innovation and (2) the innovation itself. According to Rogers,12,13 there are five process factors that may influence the rate of adoption: (1) the adopter's perception of the relative advantage of the innovation; (2) the compatibility of the innovation with existing structures; (3) the perceived degree of difficulty involved in adopting the innovation; (4) the testability of the innovation, in the absence of significant resources; and (5) the visibility of outcomes resulting from adoption of the innovation.

Recently, some authors have expanded on the DIT by suggesting that the focus be given equally to the environment (e.g. organization) that supports providers as well as patients. This requires paying particular attention to process factors that have more to do with: (a) the structure of the multidisciplinary team approach as it relates to the contextual influences; and (b) level and extent of program integration across existing health care structures.6–11 Using the actual reported experiences of a specific diabetes management pilot project,14 we have endeavored to describe and underscore the utility of DIT in identifying and targeting possible challenges to the successful adoption and sustainability of an innovative diabetes management strategy. The term diabetes hereafter refers exclusively to type 2 diabetes.

An overview of the Côte-des-Neiges Diabetes Pilot Project (CN-Diabetes)

The Côte-des-Neiges (CN) area (a population of over 160 000) includes 12 polyclinics, over 50 solo medical practices, three acute care hospitals and one community health centre (Centre Local de Services Communautaires, CLSC), all providing care in a silo-type fashion. In 1999, the two-year CN-Diabetes Pilot Project (CN-Diabetes) was launched as a model of diabetes care in which a community health centre-based multidisciplinary team attempted to coordinate diabetes care in conjunction with individual physicians working at clinics within the CN area of Montreal (Quebec, Canada).14

As described by Nasmith et al.,14 the multidisciplinary diabetes management team of CN-Diabetes (a coordinator, a community organizer, two nurses, a dietician, a foot care technician, a social worker and an exercise consultant) was physically based at CLSC CN, but linked with physicians at other clinics in CN through internet, telephone contact and visits to clinics by team members. CN-Diabetes involved a partnership among academics and clinicians from both English and French universities in Montreal (Department of Family Medicine at McGill University; Groupe de Recherche Interdisciplinaire en Santé, from the University of Montreal), the CLSC and a regional authority for public health in central Montreal (Direction de la Santé Publique de Montréal centre). Health care services in Canada are funded through government programs administered at the level of provincial governments. CN-Diabetes, however, was funded as a research project through a federal agency, Health Canada.

Participating physicians were asked to complete registration forms for their patients with diabetes and indicate completion of diabetes care activities on a clinical care flow sheet at each clinic visit. Although printed flow sheets were also provided, physicians were encouraged to complete on-line forms, and each participating physician received a new computer and training sessions (physicians and their clerical staff) on how to use the system. Software provided through CN-Diabetes was used to monitor services provided and flag the need for further interventions.

Nurses from the multidisciplinary CN-Diabetes team were expected to (a) act as liaisons between the family physicians and their patients through e-mail, fax or telephone and (b) make frequent visits to physicians’ offices to offer feedback on patients being followed through the project. To encourage adherence to diabetes clinical practice guidelines, physicians were offered continuing medical education sessions seminars and were provided with CD ROM-based educational tools.

The CN-Diabetes multidisciplinary team monitored patient progress through follow-up at the CLSC, with a formal assessment of progress on diabetes-related health behaviors (e.g. diet and physical activity). To promote healthy lifestyle changes and better control of diabetes, CN-Diabetes offered patients diabetes education in either group format or individual sessions, which focused on making appropriate dietary choices and engaging in regular physical activity. CN-Diabetes established links within the community by offering group exercise sessions and walking groups.

Nasmith et al.14 reported that 44 family physicians from 10 family practices (group/solo) participated in CN-Diabetes. Over a one-year period, 322 patients were referred to the program. After a two-year period of funding by Health Canada, CN-Diabetes was unable to secure long-term funding from the Quebec Ministry of Health and the program was discontinued. The assessment of the pilot project published by Nasmith et al.14 includes qualitative self-reports from a number of stakeholders including family physicians, members of the provider group, project managers and decision-makers (members of the steering committee and advisory board). As discussed below, using this published information, we have identified process factors advanced by DIT that may have affected adoption of the
CN-Diabetes strategy by physicians and patients during and following the actual pilot project period.

**Examination of CN-Diabetes using DIT**

CN-Diabetes offered an innovative, integrated, multidisciplinary approach to the management of diabetes within a community. In CN-Diabetes, the potential adopters of the innovation were physicians and patients. We begin our descriptive inquiry into Roger’s five process factors, and end our analysis by considering the overarching organization in which CN-Diabetes was implemented.

1. **Relative advantage.** The CN-Diabetes developers of the program first conducted a needs assessment, which involved gathering information about the provision of diabetes treatment from patients, family physicians and health care providers working within the CN region. Stakeholders recognized the need for coordinated diabetes care. Through CN-Diabetes, family physicians who felt isolated from allied health professionals were successfully brought into a system of care through which there was better access to allied health care (e.g., dietary and exercise counseling, training in self-monitoring of glucose levels) and consultative services (e.g., telephone advice from an endocrinologist). Both physicians and their patients expressed appreciation for access to services that otherwise may not have been easily accessible.

   2. **Compatibility.** The CN-Diabetes multidisciplinary team operated within an existing CLSC (community health centre) and attempted to work with the existing group and solo practices within the CN area. The program therefore built upon an existing structure.

   3. **Degree of perceived difficulty.** CN-Diabetes endeavored to reduce providers’ perceived degree of difficulty in adopting the program by offering training sessions to all physicians (and their clerical staff) on how to use the diabetes-specific software. Nonetheless, many failed to use this computer system, preferring to use the printed clinical care flow sheet in each patient’s file. Reported barriers in using the computer system included time constraints and difficulties with use of the software provided. Because collaboration among all members of the team relied heavily on the adoption of the diabetes-specific software, limited use of this system by physicians may have hindered the process of communication.

   4. **Testability.** The clinical flow chart and computer-assisted tracking of patients were integrated into CN-Diabetes as quality improvement strategies. These strategies also had the potential to demonstrate the benefits of the program by indicating, for example, completion of recommended interventions (e.g., annual ophthalmological assessment). However, as described above, physicians did not consistently complete the on-line clinical care forms. Frequent contact with nurses and the project coordinator served as reminders for project goals, but this did not necessarily ensure adherence to quality improvement strategies. More funding and staff may have been needed for optimal use of the CN-Diabetes software system within group and solo practices.

   5. **Visibility.** Physicians observed that patients participating in CN-Diabetes appeared to have more diabetes-related knowledge and were more willing to make lifestyle changes related, for example, to dietary patterns and physical activity. Patients considered the program to have improved their understanding of diabetes, their diet, as well as their use of medications. It is not clear whether the intended collaborative process between family physicians and the multidisciplinary team was clearly visible to patients.

Participation in CN-Diabetes was therefore perceived as conferring relative advantage compared to nonparticipation and the program was compatible with existing health care structures. However, there was some degree of perceived difficulty with use of the CN-Diabetes program software, which may have adversely impacted the testability of the program. Nonetheless, some benefits of program participation appeared to be visible to patients and physicians. While an awareness of Rogers’ five process factors can be used as a blueprint to think through the adoption process, it is important to point out that both physicians and allied health care professionals were brought together to work within a complex system of care: the creation of a multidisciplinary team was superimposed on existing health care structures such as the CLSC and solo/group clinic settings. A better understanding of barriers of the adoption process operating at the organizational level of analysis therefore requires that we also look at contextual influences that may have played a role in motivating the multidisciplinary team as well as the program’s integration across existing health care structures.

**Contextual influences**

The structure of the CD-Diabetes multidisciplinary team can be better appreciated from Dopson et al.’s analysis regarding the context of care as consisting of a layered set of influences. The outer layer is determined by government health policies, with health care issues that receive high priority being more likely to receive financial and human resources. In Canada, health care funds are managed by the provincial governments. Although the CN-Diabetes project was funded by Health Canada (federal agency), sustained funding was not obtained at the provincial level. A greater level of mobilization of community interest in the program...
may have led to community pressure for continued funding for the program. This would have required that the developers of CN-Diabetes work collaboratively with community nongovernmental organizations to bring about changes in attitudes and beliefs regarding prevention and treatment of diabetes. In the CN-Diabetes project, community involvement mainly consisted of engaging allied health care providers (e.g., pharmacists) to work with patients in improving control of their disease.

The inward layer of influence underscores the role that opinion leaders play in terms of exerting a powerful influence on the success of the program. Although the exact mechanism by which opinion leaders exert their influence has not yet been identified, their active support and involvement in the adoption process may be important factors. Dopson et al. distinguish the expert opinion leader from the peer opinion leader. The expert opinion leader is someone capable of explaining the evidence for the innovation and would be important in the early stages of planning. Although the expert opinion leader might still remain involved in the project, a peer opinion leader would be someone who has experienced the innovation and can therefore offer his or her colleagues support and encouragement. CN-Diabetes did not designate opinion leaders within the CN family physician community. Physicians participated in the project without necessarily offering each other support. Few attended continuing education sessions. A visible opinion leader may have enhanced credibility of the program and encouraged attendance at the educational sessions. Inter-organizational relationships, that is, between different health professional groups, are another inward-based influence that have the power to influence the adoption of an innovation. Such relationships were not described by Nasmith et al. in their report of the experiences of CN-Diabetes. Of particular interest would have been to know the nature of the relationship between the nurses and the family physicians. Nurses were expected to work with family physicians to encourage adherence to the diabetes guidelines and to provide feedback on their patients in the program. Nurses may have played a pivotal role in the adoption of the program’s goals, which makes knowing their perception about the CN-Diabetes project critical.

**Integration**

From a broader DIT framework, successful implementation of CN-Diabetes may have required both better horizontal integration of the values and interests of the stakeholders (family physicians, nurses and patients) with respect to the program and better vertical integration of expectations and responsibilities within the existing health systems structure of family physician offices and the local CLSC. Achieving such integration may necessitate a realignment of values, interests, power dependencies and expectations. Family physicians, nurses and patients acknowledged the importance of the CN-Diabetes intervention approach, but all three groups perceived the potential benefits of participation differently. For physicians, being part of the project alleviated the burden of identifying resources in the community. For nurses, it meant more time devoted to monitoring patients’ ongoing care. For patients, it meant control over their disease. As previously discussed, however, physicians and their delegates did not consistently use the tracking software and it is therefore unclear as to how often they responded to concerns raised through concurrent follow-up by the CN-Diabetes CLSC-based team. While lack of use of software was attributed to time constraints and technical difficulty, it is possible that physicians may not have perceived such tracking as being useful. In terms of patients’ control over their disease, they may have remained vulnerable and less in control than they may have wished to be, due to their dependence on available resources and proper tracking of their care. In terms of vertical integration, the implications for involvement in this project were clearly different for physicians in clinic settings and the provider group within the CLSC. What is known is that much of the planning behind CN-Diabetes involved the producers of the model and, to some extent, the provider group situated at the CLSC. Family physicians along with other stakeholders in the community were asked about problems and potential solutions to the care for patients; they provided no input, however, regarding the implementation process. Investment of funds was not required by family physicians. Nonetheless, clinics that had additional resources were better able to implement the quality improvement measures. Therefore, it would appear that decision-making was mainly the responsibility of the producers and decision-makers. Whether there truly was a shared understanding of what was involved in creating an integrated and coordinated system of diabetes care remains debatable.

**Building a knowledge transfer action plan**

As noted by Narayan et al., diabetes translation research needs to be concerned not only with the development of programs but also with the ‘sustainability of long-term implementation in real-world settings’. The two-year budget and time frame of CN-Diabetes may not have been sufficient to ensure long-term implementation of the program.
Additional funding may have permitted inclusion of a control group to distinguish the benefits associated with an integrated system of diabetes care. This may have facilitated attempts to secure long-term funding for the program. Other factors that may have improved both program effectiveness and likelihood of long-term implementation include mobilization of community action toward the formation of support groups for patients and the identification of a peer opinion leader among participating physicians. We outline below a knowledge transfer action plan that may be applied to diabetes care programs such as CN-Diabetes. The knowledge transfer action plan underscores DIT concepts.

The Who of the knowledge transfer action plan

1. Form and sustain strong partnerships among the developers of the program, government departments in health and social services, community organizations, regional health authorities, health providers, administrators and patients, who may serve as advocates for the program. These groups can identify available health services, targets for information/service delivery, private industry (who contribute in kind) and patients.¹⁶

2. Engage decision-makers early on in the project so as to place the factor of ‘timing’ in favor of the program findings.¹⁶

The What of the knowledge transfer action plan

3. Understand and clearly communicate the extent to which the distribution of the risks and benefits associated with the innovation maps onto the values, interests and power dependencies of the various stakeholders.²

4. Identify and involve both clinical and administrative champions¹⁴ as well as opinion leaders.¹⁷

The How of the knowledge transfer action plan

5. Identify potential barriers at the individual and organizational level before program implementation. Develop a plan to address identified barriers prior to the start of the program. Involve all stakeholders in the process of identifying barriers and possible solutions.

6. Hold working group meetings (bi-monthly and quarterly) with relevant stakeholders throughout the life course of the project. This will promote working relationships. Such meetings can inform stakeholders about the status of the program such as obstacles encountered and how they were dealt with based on the intended plan outlined in Step 5.

7. Ensure a process wherein stakeholders are receiving ongoing information regarding patient satisfaction, disease control indicators and adherence to quality improvement measures (e.g. attendance at educational sessions and clinic visits).

8. Bear in mind that stakeholders are not passive recipients of the program, but rather take an active role in recreating the goals and/or creating new knowledge through social interactions.¹⁸ Create forums where exchange of experiences with the program can take place. Document the views and opinions expressed.

Concluding remarks

Translating knowledge about treatment and prevention of diabetes-associated complications into sustained and effective programs will require more than another large-scale diabetes management program pilot project. DIT provides one useful framework for identifying and addressing features at both individual and the organizational levels that may facilitate or hinder program adoption. The CN-Diabetes Pilot Project offers lessons for future innovative programs that seek to provide comprehensive care for patients living with diabetes. Our descriptive inquiry into the program’s adoption process using DIT suggested that the providers’ perception of the model’s relative advantage, compatibility and degree of difficulty all played an important role in its adoption. Given that the model was superimposed on existing health care structures, certain determinants of the adoption process at the organizational level of analysis were also considered to be important, namely, the contextual influences within the system of care, and the level and the extent of the program integration into the existing health care system. Developing a knowledge transfer plan as part of any innovation will require careful consideration of who ought to be involved, what will be required to improve the transfer process of the information gathered and how should the process of dissemination take place. An eight-point generic knowledge transfer action plan, based on DIT, has been proposed as a useful starting point for the diffusion of any innovation program.

Given the projected rise in the prevalence of diabetes, there has never been a better time to pool resources together and move forward with a knowledge transfer action plan for an infrastructure that supports integrated and coordinated care for patients living with this disease. Suboptimal treatment for diabetes can lead to debilitating and potentially fatal complications. Failure to invest now in a sustainable coordinated and integrated system of care for diabetes may cost all stakeholders more in the future.
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Dr. D.C. was funded by the CIHR as a Postdoctoral Fellow. She currently works as a Knowledge transfer Consultant in private practice. K.D. holds an investigator award from the Fonds de Recherche en Santé du Québec and is an Assistant Professor of Medicine at McGill University. Her area of research and clinical practice is the prevention of cardiovascular complications in the context of diabetes and obesity.

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