

Time to Evaluate Diabetes and Guide Health Research and Policy Innovation: The Diabetes Evaluation Framework (DEFINE)

Jann Paquette-Warren

Mariam Naqshbandi Hayward

Jordan W. Tompkins

Stewart B. Harris

The University of Western Ontario
London, Ontario

Abstract: Many investments have been made to help address the rising prevalence and associated costs of diabetes, but there has been minimal evaluation to assess their value. A comprehensive literature review and five expert committee meetings were conducted to iteratively conceptualize and develop a Diabetes Evaluation Framework (DEFINE). Building on existing frameworks, DEFINE provides an evidence-based approach for evaluating diabetes. The framework is focused on guiding evaluation, building robust evidence, and fostering knowledge translation. DEFINE promotes comprehensive evaluation of initiatives targeting diabetes prevention and management, and will facilitate policy innovations to reduce the burden of diabetes.

Keywords: chronic disease, complex interventions, diabetes, evaluation, health services research, quality improvement

Résumé : Plusieurs investissements ont été déployés pour lutter contre la prévalence croissante du diabète et ses coûts afférents, mais peu d'efforts pour évaluer leurs bénéfices. Une recension exhaustive de la littérature et cinq réunions d'un comité d'experts ont eu lieu pour concevoir et développer de façon itérative un cadre d'évaluation du diabète. Baptisé DEFINE, ce cadre basé sur des modèles existants s'avère une méthode fondée sur des données probantes pour évaluer le diabète. Le cadre vise à orienter l'évaluation, établir des données probantes, et faciliter le transfert de connaissances. DEFINE vise la promotion de l'évaluation comprehensive des

Corresponding author: Jann Paquette-Warren, Program Coordinator, Centre for Studies in Family Medicine, The University of Western Ontario, Schulich School of Medicine & Dentistry, Western Centre for Public Health and Family Medicine, 1151 Richmond St, London, Ontario, Canada, N6A 3K7; Jann.Paquette-Warren@schulich.uwo.ca

initiatives ciblant la prévention et la gestion du diabète et facilite les innovations politiques aidant à réduire le fardeau du diabète.

Mots clés : *maladies chroniques, interventions complexes, diabète, évaluation, recherche sur les services de santé, amélioration de la qualité*

Recent projections by the World Health Organization suggest that in 2030 chronic diseases will be the leading cause of death globally accounting for approximately three quarters of all deaths ([World Health Organization, 2008](#)). Chronic diseases are among the most preventable of all health problems, yet a recent report for Canada estimates that 4.2 million Canadians will develop diabetes by 2020, one of the most common of chronic diseases ([Canadian Diabetes Association, 2011](#)). The Public Health Agency of Canada estimated that 58% of total healthcare spending in Canada in 2010, totalling \$190 billion,¹ was attributable to chronic diseases, including \$68 billion in direct healthcare costs and \$122 billion in indirect socioeconomic costs related to decreased productivity ([Public Health Agency of Canada, 2011b](#)). Specific to diabetes, the cost to the healthcare system and economy was \$11.7 billion in 2010 and was projected to increase to \$16 billion by 2020, not including out-of-pocket costs for patients (e.g., medications, devices, supplies, various programs/services) ([Canadian Diabetes Association, 2011](#)). However, given the fact that one million people are estimated to have undiagnosed diabetes ([Canadian Diabetes Association, 2011](#)) and the challenges in estimating both direct and indirect healthcare costs, it is suspected that the real economic burden of diabetes is greater.

To help address the growing diabetes burden, government investment has been significant over the past decade. In 1999, the federal Public Health Agency of Canada pledged \$115 million over five years to develop a Canadian Diabetes Strategy ([Public Health Agency of Canada, 2011a](#); [Public Health Agency of Canada, 2012](#)), which was renewed at \$18 million per year starting in 2005. This was followed by provincial and territorial initiatives, such as the \$741 million in 2008 for a four-year Ontario Diabetes Strategy ([Ministry of Health and Long-Term Care, 2008](#)) and the \$2.5 million in the first year of a four-year Comprehensive Diabetes Strategy for New Brunswick in 2011, which was expanded to \$4.7 million in 2014 ([Canadian Diabetes Association, 2014](#)). To date, no substantive evidence exists to demonstrate whether government investments have helped to manage the increasing prevalence and burden of diabetes ([Office of the Auditor General of Canada, 2013](#); [Office of the Auditor General of Ontario, 2012](#)).

The diabetes-specific investments highlighted above have paralleled existing government funding (e.g., \$335 million for health-promotion programs) ([Office of the Auditor General of Canada, 2013](#)) and extensive primary healthcare reform strategies to improve healthcare delivery and the health of the population (e.g., new funding formulas with salary support for team-based care, financial bonuses for chronic disease prevention and surveillance, and support for widespread use of electronic medical records ([Glazier, Kopp, Schultz, Kiran, & Henry, 2012](#);

Hutchison, Levesque, Strumpf, & Coyle, 2011). Unfortunately, the implementation of reform strategies resulted in substantial turmoil and confusion both at the operational level of clinics and at the policy planning level. Therefore, notwithstanding the shortage of evidence to support quality improvement initiatives in healthcare, governments and other agencies have funded and launched initiatives to support transitions to the new healthcare strategies (Jones & Piterman, 2008; Schouten, Hulscher, van Everdingen, Huijsman, & Grol, 2008). Comprehensive evaluation of these complex initiatives to determine their impact on intended intermediate and long-term outcomes rarely occurs and should be prioritized (Crabtree et al., 2011; Craig et al., 2013; Dubois et al., 2011; Glazier et al., 2012; Schouten et al., 2008; Tricco et al., 2012; Zimmerman et al., 2011).

RATIONALE FOR A COMPREHENSIVE DIABETES EVALUATION FRAMEWORK

To date, no single framework exists to systematically guide the comprehensive evaluation of diabetes prevention and management strategies (Borgermans et al., 2008). With the increasing pandemic of diabetes, rising costs of managing patients with diabetes, and new fiscal restraints, such a framework is needed to assess the value of investments and guide future spending. A framework to help guide the comprehensive and systematic evaluation of programs is critical to understand the multitude of mechanisms and processes underlying care and to provide healthcare decision makers and stakeholders with appropriate information about the state of their healthcare system (Dubois et al., 2011; Nasmith et al., 2010). Otherwise, previously endorsed chronic disease management initiatives that have been unable to demonstrate a positive health and economic impact may be at risk of losing their funding. A growing consensus in the literature reflects the urgent need for standardized and rigorous comprehensive evaluation (Borgermans et al., 2008; Crabtree et al., 2011).

AIM

Our aim was to develop a diabetes evaluation framework to guide the comprehensive evaluation of initiatives targeting diabetes prevention and management, and to facilitate policy innovations to reduce the financial burden of diabetes. The purpose of this article is to describe the development of the *Diabetes Evaluation Framework (DEFINE)*, present an overview of the framework, and discuss its potential impact on diabetes prevention and management.

METHODS

A comprehensive search of published and grey literature was used to identify existing evaluation frameworks. A search of Pubmed for English-language literature published before January 31, 2012 using keywords *performance*, *measurement*,

surveillance, evaluation, framework, national, global, quality of primary health care, and diabetes was completed. We also conducted a review of grey literature published before January 31, 2012, focusing on government and health organization websites. Articles and sources were considered relevant if they focused at the national level on system performance assessment and/or evaluation frameworks (countries that fit this criteria included Australia, Canada, Denmark, Israel, Norway, Republic Srpska of Bosnia and Herzegovina, the United Kingdom, and the United States).

Through a series of five face-to-face Advisory Council expert committee meetings held between 2009 and 2012, drafts of the framework were presented to experts in diabetes, family medicine, policy, evaluation, medicine, and research. Each meeting included a presentation of the most recent iteration of DEFINE including definitions, conceptual theory, components, and a discussion period to refine and expand the draft framework. Evaluation frameworks are political in nature; thus our overarching goal through this iterative process was to ensure that there were key stakeholder representation and sound methodological processes, in hopes of moving forward with a usable, adaptable, and relevant diabetes evaluation framework capable of bringing about positive change in our healthcare system.

FINDINGS

Existing Diabetes Evaluation Frameworks

In search of existing evaluation frameworks, it became clear that *surveillance systems, performance measurement strategies, and evaluation framework* are terms that are being used interchangeably in the literature, particularly the grey literature. As noted by Bowen (2012), performance measurement is typically limited by the availability of quantitative outcome measure data and relies on simple designs that fail to assess the impact of influential factors inherent in complex systems such as healthcare. Evaluation research is broader and aimed at asking the hard questions about the causal relationships between programs and outcomes, using a variety of mixed methods (Blalock, 1999). Keeping in mind these definitions and misconceptions, below is a summary of results related to existing evaluation frameworks as described in the literature.

General health-related national system-level performance measurement and national evaluation frameworks exist and provide the wider context for disease-specific frameworks to be tailored and positioned (Canadian Institute for Health Information, 2011a; Hogg, Rowan, Russell, Geneau, & Muldoon, 2008; McLoughlin, Leatherman, Fletcher, & Owen, 2001; World Health Organization, 2010). Specific to diabetes, national surveillance systems, performance measurement frameworks, or national evaluation frameworks were identified in Australia (e.g., National System for Monitoring Diabetes; Australian Institute of Health and Welfare, 2011), Canada (e.g., National Diabetes Surveillance System [NDSS]; Public

Health Agency of Canada, 2009), Denmark (e.g., The National Indicator Project; Mainz, Krog, Bjornshave, & Bartels, 2004), Sweden (The Swedish National Diabetes Register; Gudbjornsdottir, Cederholm, Nilsson, Eliasson, & Steering Committee of the Swedish National Diabetes Register, 2003), the United Kingdom (e.g., Diabetes National Service Framework, Quality and Outcomes Framework in the UK, National Diabetes Audit; National Health Service, 2007; National Health Service, 2012; National Institute for Health and Clinical Excellence, 2012), and the USA (e.g., National Quality Report, National Diabetes Education Program Evaluation Framework, Diabetes Quality Improvement Project; Fleming et al., 2001; Gallivan, Greenberg, and Brown, 2008).

The current strategies to assess diabetes care and outcomes described in the literature are focused on capturing clinical data with an emphasis on surveillance and building electronic infrastructure in the healthcare system (Khan, Mincemoyer, & Gabbay, 2009). The challenges related to the availability of high-quality data to assess diabetes care remain, and they are typically related to the need to balance rigour, cost, and feasibility of obtaining administrative versus self-reported versus chart audit data. Some countries have clearly articulated national targets, but the processes for measurement are poorly developed; in other countries, the processes for data gathering are well established, but the quality of the data is not reliable. Furthermore, the search for a set of indicators that are meaningful at a national level for the purpose of improvement in diabetes prevention and management continues. Building on existing frameworks are the Organization for Economic Co-operation and Development (OECD) Healthcare Quality Indicators Project for Diabetes for an overarching system for global surveillance (Kelley, Arispe, & Holmes, 2006; OECD, 2011) and the International Diabetes Federation (2013). These are important to help identify key diabetes indicators for surveillance, but they do not encompass indicators related to the system or environment (e.g., continuum of care, care utilization, resource utilization) that play an important role in diabetes prevention and management and are critical to informing stakeholders about system performance and improvement nationally, regionally, or locally (Chaudoir, Dugan, & Barr, 2013). As indicated by Blalock (1999), because of the limited scope of surveillance data and performance measures, performance monitoring alone does not provide enough information to make trustworthy inferences about the impact of programs on outcomes.

In Canada, the focus has been on building an infrastructure through the NDSS for high-quality surveillance data using administrative data to help with planning of effective policies and initiatives (Khan et al., 2009; Public Health Agency of Canada, 2011a). Many provinces and territories have contributed to NDSS and built on it with their own strategies to expand surveillance of their diabetes population and care utilization. The data are collected retrospectively, making them useful for a variety of important epidemiologic studies that are relevant to clinical management, but retrospective data limit opportunities for impact on improving quality care (Khan et al., 2009). The Health Indicators Framework of the Canadian Institute for Health Information (CIHI) for system performance

includes numerous levels and dimensions to help identify critical multilevel indicators related to chronic care and quality of care, but it does not emphasize the relationships between the levels or the causal linkages between programs and outcomes ([Canadian Institute for Health Information, 2011b](#)). Likewise, a conceptual framework for primary care has been developed to consider structural and organizational features that impact performance, but it doesn't take into account the entire system ([Hogg et al., 2008](#)). In summary, the current Canadian performance measurement and conceptual frameworks, as well as the diabetes surveillance system, provide a great foundation to build on. However, there needs to be more focus on linking investments or program activities to outcomes, and clearer applicability and utility by acknowledging the important role of stakeholders in determining relevant and meaningful evaluation goals, designs, and knowledge translation activities specific to diabetes.

The Diabetes Evaluation Framework (DEFINE)

To move beyond surveillance and performance measurement alone, DEFINE has three main goals: (a) to guide the comprehensive and systematic evaluation of initiatives, programs, and models that aim to improve diabetes prevention and management; (b) to build a robust body of evidence regarding health outcomes, quality of care, and the impact of these initiatives on patients with diabetes; and (c) to outline knowledge translation to inform stakeholders as they refine policies and fund initiatives to help address the increasing prevalence of diabetes and associated costs ([Figure 1](#)). The scope of DEFINE is broad and system-focused, covering the organization of healthcare; healthcare delivery; environmental (non-medical) factors; and the patient; and includes prevention, identification, and management of diabetes and associated complications ([Figure 2](#)). Embedded within the framework are key performance indicators that are inclusive of, but not limited to, clinical processes and outcomes. Furthermore, the framework encapsulates the six dimensions of quality—safety, efficiency, effectiveness, accessibility/timeliness, responsiveness/patient-centredness, and equity ([World Health Organization, 2006](#))—and builds on the concepts embedded in the Chronic Care Model ([Wagner, et al., 2001](#)), the Expanded Chronic Care Model ([Barr et al., 2003](#)), the Ontario Chronic Disease Prevention and Management Framework ([Ministry of Health and Long-Term Care, 2007](#)), and the Health Indicators Framework ([Canadian Institute for Health Information, 2011a](#)). To reach its goals, DEFINE includes five steps: (a) work with stakeholders to identify evaluation goals, (b) select multilevel indicators and associated measurement tools, (c) synthesize the knowledge, (d) develop a dissemination plan with stakeholders, and (e) participate in knowledge exchange.

The comprehensive design and inclusive nature of DEFINE and its built-in flexibility allow for its application irrespective of the type of diabetes initiative or research question of interest because it permits users to determine and select the most appropriate indicators, tools, and methodologies for their respective context and evaluation goals. As such, DEFINE is well positioned to (a) facilitate the

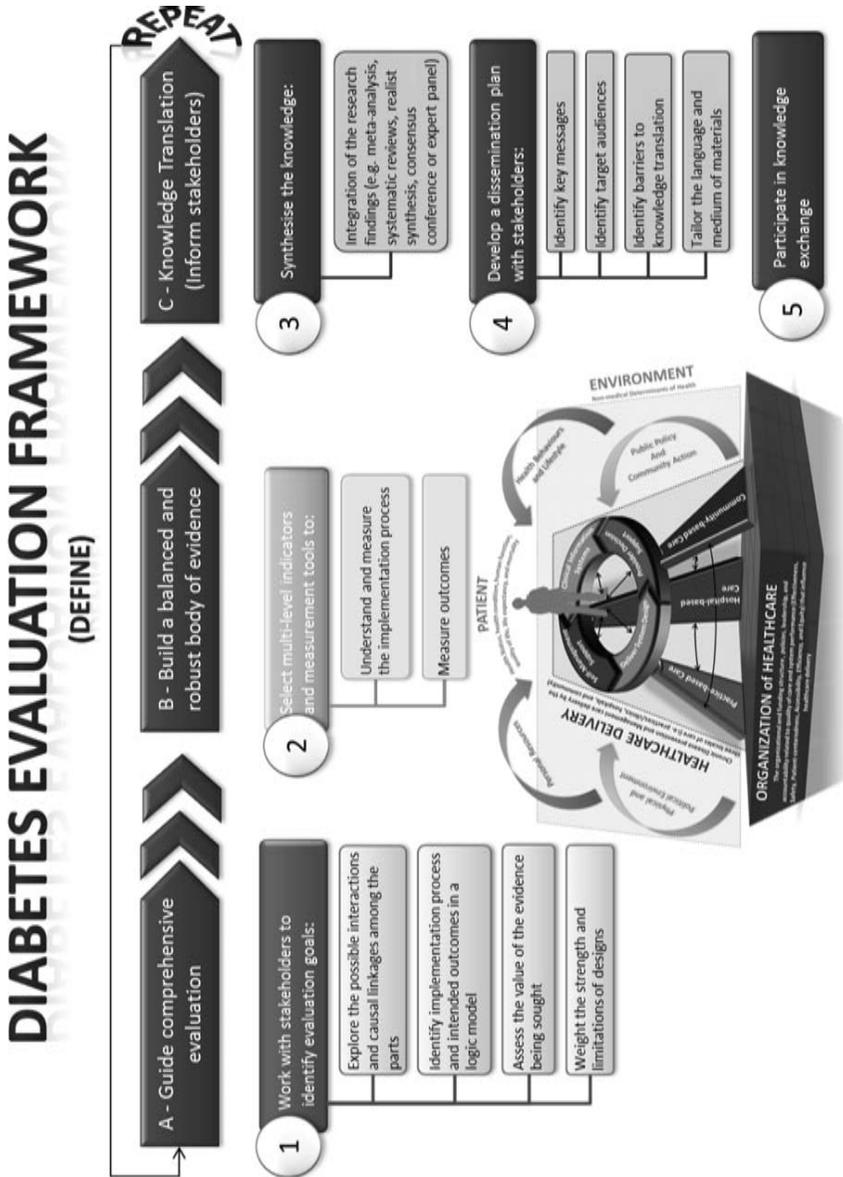


Figure 1. Schematic of the Diabetes Evaluation Framework (DEFINE)

identification of care gaps, (b) enhance transparency and inclusive decision making for greater accountability, (c) encourage examination of policy and economic implications, and (d) provide direction for future funding/program planning related to diabetes care and associated complications. Overcoming the limitations of existing frameworks, the systematic approach of DEFINE with multilevel

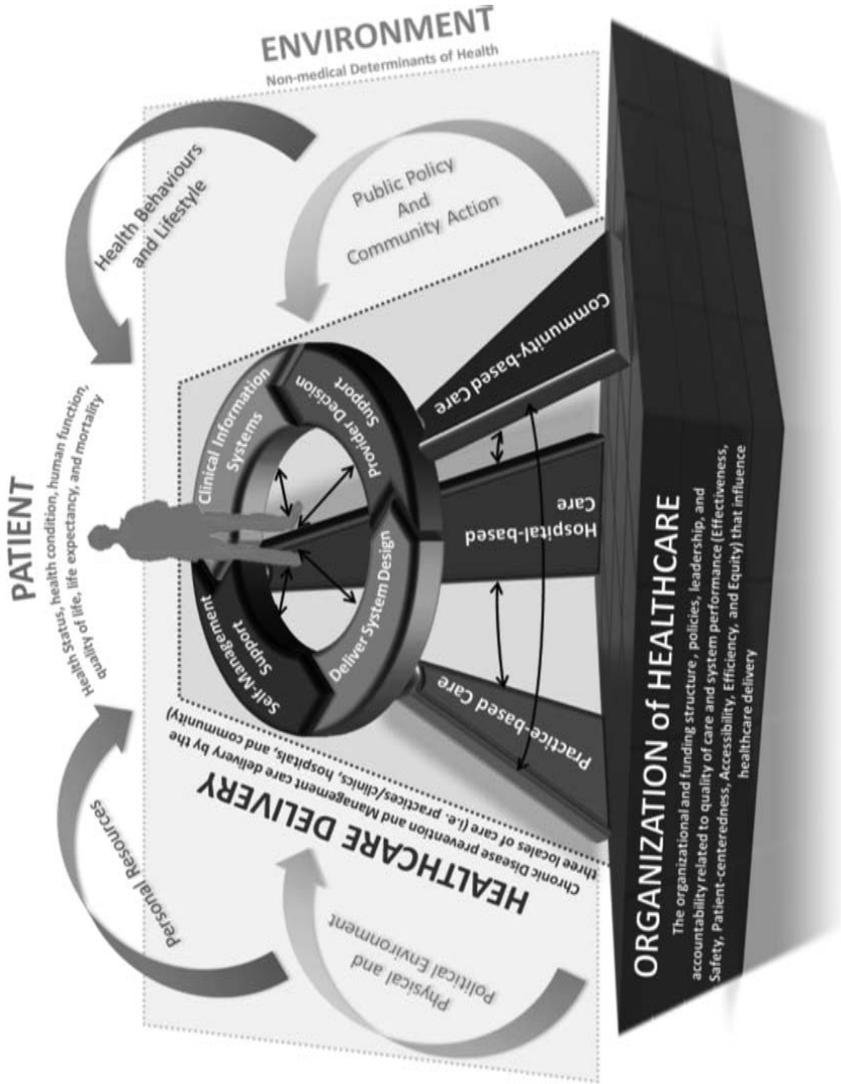


Figure 2. High-level Multilevel Indicator Schematic

common indicators promotes the capture of relevant and meaningful standards/benchmarks of diabetes care across the healthcare system and environmental context, and will greatly inform key stakeholders as they continue to strive to improve diabetes prevention and management in Canada. Below is a brief description of each component of the framework.

A. Guide Comprehensive Evaluation

The first step in applying the framework (Step 1) is to work with relevant stakeholders (e.g., program planners and implementers, decision-makers, experts,

participants, recipients) to identify evaluation goals that will ensure the selection of methodologies and measures yielding results that are relevant and applicable in terms of assessing impact and bringing about positive change (Bowen, 2012; Bryson, Patton, & Bowman, 2011; Craig et al., 2013; Creswell & Plano Clark, 2011; Dubois et al., 2011; Song, Sandelowski, & Happ, 2010).

A complete picture of the healthcare system and environmental context is required to understand the multitude of mechanisms and processes underlying care and patient health (Dubois et al., 2011; Hulscher, Laurant, & Grol, 2003). Therefore, a comprehensive (implementation/process and outcomes/summative) evaluation approach is necessary to examine not only the outcomes of interest, but also the interactions and causal linkages between the intervention/program and the outcomes (Blalock, 1999; Chen, 2005; Crabtree et al., 2011; Creswell & Plano Clark, 2011; Dehar, Casswell, & Duignan, 1993; Petrosino, 2000; Rush & Ogborne, 1991; Vingilis & Pederson, 2001). The involvement of relevant stakeholders in developing a logic model is critical to outlining mechanisms existing at multilevels of the healthcare system, the environment, and the patient that may be responsible for the results (Chen, 2005; Dubois et al., 2011; Gallivan et al., 2008; Hulscher et al., 2003; Zimmerman et al., 2011). Also, the logic model can highlight the value of evidence to stakeholders, help determine the most appropriate research design and analyses, and facilitate the selection of appropriate multilevel indicators (Chen, 2005; Craig et al., 2013; Dubois et al., 2011; McEwan & Bigelow, 1996).

B. Build a Balanced and Robust Body of Evidence: Components of DEFINE

As highlighted in Step 1, comprehensive evaluations incorporating multilevel indicators are critical. DEFINE includes four levels with multiple components (Figure 2): (a) Organization of Healthcare; (b) Healthcare Delivery (practice-based care, community-based care, hospital-based care); (c) Environment; and (d) Patient. Using the logic model developed in Step 1, Step 2 involves the careful selection of multilevel indicators and measurement tools to understand the implementation process, to measure outcomes that are relevant and applicable, and to discover the interactions and causal linkages between the initiative and outcomes. It is critical to capture data across all levels to have adequate information to assess the degree of success of initiatives (i.e., fidelity and quality of implementation, causal mechanisms, intended outcomes, unintended consequences, and contextual factors; Craig et al., 2013). Where possible, follow-up for interim or surrogate measures should be considered to assess sustainability and optimization (Craig et al., 2013).

Organization of Healthcare Level

The organization of healthcare level encompasses health policy grounded by the pillars, dimensions, and rights of quality (World Health Organization, 2006). This level includes indicators related to existing organizational and funding structures, fiscal measures, reform strategies, taxation, and local/regional/provincial/national support structures such as clinical practice guidelines. It is characterized by (a) leadership commitment to a chronic disease management approach and improved quality of services; (b) the existence of necessary resources such as

physical space, staffing and medical supplies; (c) accountability; and (d) a commitment to sustainability and spread of successful initiatives/strategies.

Healthcare Delivery Level

Directly shaped by the underpinning organization of healthcare are the three locales of healthcare delivery (practice-based care, hospital-based care, and community-based care) that each offer a unique and vital support structure for patients related to care utilization, care delivery, and care support. The circular nature of care delivery, indicated by the arrows between the locales of care in [Figure 2](#), suggests that using only one part of the system is insufficient to obtain and maintain overall health and wellness. To improve chronic disease prevention/management and successfully influence diabetes prevention, management, and clinical outcomes, one must recognize the integrated nature of the locales ([World Health Organization, 2006](#)). In DEFINE, the locales are bound by the organization of healthcare and by the mechanisms of care delivery that take into consideration the four aspects of the chronic care model: self-management support, delivery system design, decision support, and information systems ([Barr et al., 2003](#); [Ministry of Health and Long-Term Care, 2007](#); [Wagner et al., 2001](#)).

I. SELF-MANAGEMENT SUPPORT

This component of healthcare delivery is oriented to the role of healthcare providers in enhancing patients' knowledge, skills, and involvement in their own care. This includes a structured adoption and use of a patient-centred approach, self-management measures and indicators including health behaviours, quality of life, collaborative care, problem solving and goal setting, shared decision making, and appropriate use of resources.

II. DELIVERY SYSTEM DESIGN

Delivery system design is oriented to maintaining or restoring the health of individuals and groups, and incorporates changes to the organization of practice (e.g., patient flow) that impact the provision of accessible and safe care and encourage productive patient interactions. For example, it includes better organization of health information and its timely availability, a reduction in duplication of services, and better healthcare planning. Furthermore, it encompasses adherence to evidence-based practice guidelines, principles related to patient-centred care, proactive care/planned visits, and population-level health promotion/disease prevention/disease detection. Lastly, this component includes enhanced team structure and function for service alignment/coordination, ease of patient navigation, continuity of care, and more commitment to quality improvement and to the establishment of partnerships with community members and other stakeholders to enable and empower patients and advocate for healthy public policy.

III. PROVIDER DECISION SUPPORT

Provider decision support is oriented to improving the knowledge and skills of providers and administrators. It includes embedding evidence-based guidelines ([Canadian Diabetes Association Clinical Practice Guidelines Expert Committee,](#)

2013) into daily practice, enhancing the relationships among providers and administrators from different locales of care, and using clinical care and client management tools (e.g., flow sheets, registry, and patient assessment/disease severity tools) that link indicators with recommendations for treatment or health behaviour change strategies. Also, it comprises routine feedback reports (mechanisms) regarding measurements, evaluation, and performance.

IV. CLINICAL INFORMATION SYSTEMS

The clinical information systems component is oriented to tracking, measuring, evaluating, and sharing health information to provide timely, accurate, and comprehensive information about individual patients or groups of patients. This is characterized by the tracking of population-level data, the existence of patient registries, and the advanced use of EMRs (e.g., patient tracking, embedded CPGs/system reminders, severity indicators with recommendations for treatment, and performance feedback), all leading to better access to health information for proactive and coordinated care and improved collaborative treatment plans.

Environment Level

Building on the importance of the environment as a determinant of health and a key component in the Expanded Chronic Care Model (Barr et al., 2003), DEFINE extends beyond the traditional healthcare system to focus on the important role of prepared and proactive community partners, as well as informed and activated communities. Communities are included for the role they play in the management of the nonmedical determinants of health including socioeconomic, living, and working conditions, as well as the political and physical environment. This level has three components: (a) Supportive Political and Physical Environment, (b) Community Action, and (c) Public Policy. The linkages between the multilevel healthcare system and the broader environment play an important role in the management of chronic illness to promote health and prevent chronic diseases such as diabetes (Public Health Agency of Canada, 2011a).

I. SUPPORTIVE PHYSICAL AND POLITICAL ENVIRONMENT

Integral to a supportive physical and political environment is the political/leadership commitment to establishing healthy and equitable socioeconomic, living, and working conditions and the existence of accessible systems or structures (e.g., housing, transportation, justice, employment) that are stable, secure, safe, and patient-centred (i.e., stimulating, satisfying, and enjoyable). This component includes the efficient use of systems or structures that are cost-effective and the existence of relationships/partnerships among structures for continuity of care related to patient transitions from one healthcare provider to the next or from one locale of care to another (e.g., linkages among community members/stakeholders and leaders/providers in healthcare).

II. COMMUNITY ACTION

This component encompasses the community's role in being knowledgeable about and responsible for the identification of risk behaviours and environmental (living

and working) conditions that impact community members' health. It includes a community's mobilization and public participation in activities to manage non-medical factors that influence health. A critical element in this component is the existence of relationships/partnerships among community members/stakeholders (e.g., municipalities, advocacy groups, recreation centres, service clubs) and leaders/providers in healthcare, research, education, and other relevant realms to identify patient needs and build adequate knowledge and skills.

III. PUBLIC POLICY

The existence of organizational and governmental policies and legislation that foster greater equity related to safer and healthier goods, services, and environments (e.g., dietary guidelines, reduced pricing for whole-wheat products and fruits) is the basis of this component. It captures the community advocacy efforts to develop new organizational and governmental policies and legislation in non-healthcare areas (housing, transportation and food distribution, education, justice, employment) that may enhance the health of the community.

Patient Level

At the centre of DEFINE is the patient as an informed and active partner (enabled and empowered) in the management of medical and nonmedical determinants of health including health status, health condition, health function, human biology, health behaviours and lifestyle, and personal resources (e.g., education, literacy, skills, confidence in self-management, social support, culture, income, employment, social status, coping skills). Patients play an important role in (a) recognizing their own health status; (b) making appropriate use of services; (c) working with their care team to establish an appropriate treatment plan by identifying personal barriers, challenges, and preferences; (d) adhering to treatment plans by attending planned visits/referral appointments/scheduled tests and/or taking medications; (e) participating in educational activities; and (f) making appropriate use of community structures and other support systems. This level is characterized by patient satisfaction with accessibility, effectiveness, patient-centredness, interaction with their care team, living conditions, treatment plan, community action, community structures and systems, and public policies.

C. Knowledge Translation to Inform Stakeholders

The third goal of DEFINE is to inform stakeholders through knowledge translation and exchange activities that link results to policy issues and guide policy development. Knowledge translation is "a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically sound application of knowledge to improve the health of Canadians, provide more effective health services and products, and strengthen the healthcare system" ([Canadian Institutes of Health Research, 2010](#), p. 2). To accomplish this goal, Step 3 involves knowledge synthesis to integrate individual research findings through scientifically sound synthesis methods including meta-analysis, systematic reviews, Cochrane reviews, realist synthesis, narrative synthesis, and results from a consensus conference or expert

panel (Canadian Institutes of Health Research, 2010). Step 4 is to develop a dissemination activity plan in collaboration with stakeholders (e.g., communities, providers, patients, and policy experts). The goal of all dissemination and knowledge translation materials is to identify key messages for different target audiences (e.g., government and organizational leaders, policy experts, diabetes researchers, clinician scientists, and end-users such as community stakeholders and patients) and to tailor the language and medium used in dissemination materials to be easily assimilated by the different audiences. Finally, Step 5 includes both integrated and program-end knowledge translation to align the knowledge to action cycle (Straus & Holroyd-Leduc, 2008). Its goal is to develop policy briefs and recommendations with policy partners in a way that overcomes barriers to knowledge translation and ensures the topics and content are relevant to policy (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012). Program-end meetings are an optimal approach to bringing together all key stakeholders for the exchange of evaluation results and experiences. Finally, but only after internal dissemination activities, external dissemination can include scholarly publications and conference presentations, with or without media engagement, that can facilitate exchange efforts between researchers and the end users of the research. Knowledge translation is essential to meeting the overall objective of the DEFINE framework: ensuring ethically sound application of knowledge to improve the healthcare system for better diabetes care and outcomes and to contribute to decreasing the burden of diabetes.

DISCUSSION

With the increasing pandemic of diabetes and its associated healthcare costs, substantial investments to implement initiatives and refine policies have been made by key stakeholders as they continue to strive to improve diabetes prevention and management and reduce the burden of diabetes in Canada. Therefore, a major research focus should be placed on evaluation of strategies and initiatives to determine their utility and benefits. Conducting comprehensive and systematic evaluations will increase our understanding of initiatives, programs, or models and determine which investments in healthcare should be continued or redirected, and where new investments are needed.

DEFINE was designed to guide the evaluation of diabetes prevention and management; however, it can be employed to evaluate a variety of chronic illnesses with appropriate adaptation. DEFINE will help to determine if organizations, programs, quality improvement initiatives, and other interventions have resulted in better process or clinical outcomes, healthier patients, more satisfied providers, and more cost-effective expenditure of healthcare and community resources. Specifically, DEFINE is designed to consider all aspects of the health systems across the continuum of care, the relationship among the locales of care delivery, and the linkages among the patient, the healthcare system, and the broad environmental context. Given the current patterns of ongoing healthcare reform,

a cultural shift is required and the broad system focus of DEFINE uniquely ensures outcome-oriented health policy and serves as a guide for program planning and evaluation.

DEFINE is inclusive yet flexible in its application, and the various components of DEFINE may be relevant to some research questions but not others. Inclusivity fosters comprehensiveness, and flexibility inspires innovation to determine the set of indicators that are most likely to be effective in demonstrating improved performance and identifying opportunities for improvement. Therefore, as the framework is applied and the body of research builds, so will this framework. Because DEFINE builds on the evidence in the field of diabetes surveillance, performance measurement, and existing evaluation frameworks, as well as general health and chronic disease models and frameworks, it carries forward lessons-learned and synthesizes this information to position this framework as a standardized tool for diabetes.

As discussed throughout this article, comprehensive evaluation of diabetes care (prevention and management) is a necessary first step toward building an evidence base to inform and enable policy makers, government, and other stakeholders with sufficient information to make accountable decisions about our healthcare (Borgermans et al., 2008). In a time of resource spending constraints, public demand for more accountability, and insufficient number of healthcare providers to manage the growing population of patients with diabetes, fostering an evidence base for policy makers grounded in a conceptual framework assists in the prioritization of healthcare initiatives, and plays an integral role in the design, management and provision of healthcare services (Garcia-Altes, Zonco, Borrell, Plasencia, & Barcelona Group on the Performance of Health Care Services, 2006; Garcia-Altes et al., 2007).

Reported here is the first step in creating a national diabetes evaluation strategy that is appropriate and flexible enough to be applied by different users and in different settings. This framework will help to build the necessary information and capacity to raise the quality of diabetes care in Canada and to prevent and delay diabetes and related complications. Next steps in the development of DEFINE will include (a) a Modified Delphi process to assess the construct and content validity of the conceptual basis of DEFINE and its embedded indicators and related measurement tools, (b) an assessment of the utility and feasibility of DEFINE through a retrospective case study of an initiative that targeted diabetes prevention and management in Canada, and (c) the application of DEFINE in a prospective case study.

CONCLUDING THOUGHTS

In the midst of the diabetes pandemic and escalating healthcare costs, DEFINE is well positioned to facilitate the identification of care gaps, guide needs assessments and quality improvement initiatives, and ultimately provide direction for future funding and program planning related to diabetes care and associated complications. The ultimate goal of DEFINE is to support the enhancement of diabetes

care as a model for chronic disease with greater functionality and accountability in Canada's healthcare system.

ACKNOWLEDGEMENTS

Funding for the Diabetes Evaluation Framework (DEFINE) has been generously provided by the National Diabetes Management Strategy (NDMS; <http://www.tndms.ca/>). Special acknowledgement is made to TNDMS Advisory Council for their input and feedback. The authors acknowledge the editorial assistance of Marie Tyler, research assistant at the Centre for Studies in Family Medicine, the University of Western Ontario, London, Ontario.

NOTE

1 All sums are expressed in Canadian dollars unless otherwise indicated.

REFERENCES

- Australian Institute of Health and Welfare. (2011). Diabetes indicators in Australia. Retrieved from www.aihw.gov.au/diabetes-indicators/
- Barr, V. J., Robinson, S., Marin-Link, B., Underhill, L., Dotts, A., Ravensdale, D., & Salivaras, S. (2003). The expanded chronic care model: An integration of concepts and strategies from population health promotion and the chronic care model. *Hospital Quarterly*, 7(1), 73–82.
- Blalock, A. B. (1999). Evaluation research and the performance management movement: From estrangement to useful integration? *Evaluation*, 5(2), 117–149. <http://dx.doi.org/10.1177/13563899922208887>
- Borgermans, L. A., Goderis, G., Ouwens, M., Wens, J., Heyrman, J., & Grol, R. P. (2008). Diversity in diabetes care programmes and views on high quality diabetes care: Are we in need of a standardized framework? *International Journal of Integrated Care*, 8, 1–15. Retrieved from <http://www.ijic.org/index.php/ijic/article/view/URN%3ANBN%3ANL%3AUI%3A10-1-100478/471>
- Bowen, S. (2012). *A guide to evaluation in health research*. Canadian Institutes of Health Research. Retrieved from http://www.cihr-irsc.gc.ca/e/documents/kt_lm_guide_evhr-en.pdf
- Bryson, J. M., Patton, M. Q., & Bowman, R. A. (2011). Working with evaluation stakeholders: A rationale, step-wise approach and toolkit. *Evaluation and Program Planning*, 34(1), 1–12. <http://dx.doi.org/10.1016/j.evalprogplan.2010.07.001>
- Canadian Diabetes Association. (2011). *Diabetes: Canada at the tipping point*. Toronto, ON: Author. Retrieved from http://www.diabetes.ca/documents/get-involved/WEB_Eng_CDA_Report_.pdf
- Canadian Diabetes Association. (2014). *New Brunswick Department of Health budget expands investment in diabetes strategy*. Toronto, ON: Author. Retrieved from <http://www.diabetes.ca/newsroom/search-news/new-brunswick-department-of-health-budget-expands>

- Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. (2013). Canadian Diabetes Association 2013 clinical practice guidelines for the prevention and management of diabetes in Canada. *Canadian Journal of Diabetes*, 37((supp 1): S1–S212). Retrieved from <http://guidelines.diabetes.ca/forcitation>
- Canadian Institute for Health Information. (2011a). *Health indicators 2011*. Ottawa, ON: Author. Retrieved from https://secure.cihi.ca/free_products/health_indicators_2011_en.pdf
- Canadian Institute for Health Information. (2011b). *Learning from the best: Benchmarking Canada's health system*. Ottawa, ON: Author. Retrieved from https://secure.cihi.ca/free_products/learning_from_thebest_en.pdf
- Canadian Institutes of Health Research. (2010). A guide to knowledge synthesis: A knowledge synthesis chapter. Ottawa, ON: Author. Retrieved from <http://www.cihr-irsc.gc.ca/e/41382.html>
- Chaudoir, S. R., Dugan, A. G., & Barr, C. H. I. (2013). Measuring factors affecting implementation of health innovations: A systematic review of structural, organizational, provider, patient, and innovation level measures. *Implementation Science; IS*, 8(22), 1–20. Retrieved from <http://www.implementationscience.com/content/pdf/1748-5908-8-22.pdf>. <http://dx.doi.org/10.1186/1748-5908-8-22>
- Chen, H. (2005). *Practical program evaluation: Assessing and improving planning, implementation, and effectiveness*. Thousand Oaks, CA: Sage.
- Crabtree, B. F., Chase, S. M., Wise, C. G., Schiff, G. D., Schmidt, L. A., Goyzueta, J. R., . . . , & Jaen, C. R. (2011). Evaluation of patient centered medical home practice transformation initiatives. *Medical Care*, 49(1), 10–16. <http://dx.doi.org/10.1097/MLR.0b013e3181f80766>
- Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2013). Developing and evaluating complex interventions: The new medical research council guidance. *International Journal of Nursing Studies*, 50(5), 587–592. <http://dx.doi.org/10.1016/j.ijnurstu.2012.09.010>
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Los Angeles, CA: Sage.
- Dehar, M. A., Casswell, S., & Duignan, P. (1993). Formative and process evaluation of health promotion and disease prevention programs. *Evaluation Review*, 17(2), 204–220. <http://dx.doi.org/10.1177/0193841X9301700205>
- Dubois, N., Lloyd, S., Houle, J., Mercier, C., Brousselle, A., & Rey, L. (2011). Discussion: Practice-based evaluation as a response to address intervention complexity. *Canadian Journal of Program Evaluation*, 26(3), 105–113. Retrieved from <http://search.proquest.com/docview/1038939197?accountid=15115>
- Fleming, B. B., Greenfield, S., Engelgau, M. M., Pogach, L. M., Clauser, S. B., & Parrott, M. A. (2001). The diabetes quality improvement project: Moving science into health policy to gain an edge on the diabetes epidemic. *Diabetes Care*, 24(10), 1815–1820. <http://dx.doi.org/10.2337/diacare.24.10.1815>
- Gallivan, J., Greenberg, R., & Brown, C. (2008). The national diabetes education program evaluation framework: How to design an evaluation of a multifaceted public health education program. *Preventing Chronic Disease*, 5(4), 1–8. Retrieved from http://www.cdc.gov/pcd/issues/2008/oct/07_0191.htm

- Garcia-Altes, A., Borrell, C., Cote, L., Plaza, A., Benet, J., & Guarga, A. (2007). Measuring the performance of urban healthcare services: Results of an international experience. *Journal of Epidemiology and Community Health*, 61(9), 791–796. <http://dx.doi.org/10.1136/jech.2006.051789>
- Garcia-Altes, A., Zonco, L., Borrell, C., Plasencia, A., & Barcelona Group on the Performance of Health Care Services. (2006). Measuring the performance of health care services: A review of international experiences and their application to urban contexts. *Gaceta Sanitaria / S.E.S.P.A.S*, 20(4), 316–324.
- Glazier, R. H., Kopp, A., Schultz, S. E., Kiran, T., & Henry, D. A. (2012). All the right intentions but few of the desired results: Lessons on access to primary care from Ontario's patient enrolment models. *Healthcare Quarterly (Toronto, ON)*, 15(3), 17–21.
- Grimshaw, J. M., Eccles, M. P., Lavis, J. N., Hill, S. J., & Squires, J. E. (2012). Knowledge translation of research findings. *Implementation Science; IS*, 7(50), 1–17. <http://dx.doi.org/10.1186/1748-5908-7-50>
- Gudbjörnsdóttir, S., Cederholm, J., Nilsson, P. M., Eliasson, B., & Steering Committee of the Swedish National Diabetes Register. (2003). The national diabetes register in Sweden: An implementation of the St. Vincent Declaration for Quality Improvement in Diabetes Care. *Diabetes Care*, 26(4), 1270–1276. <http://dx.doi.org/10.2337/diacare.26.4.1270>
- Hogg, W., Rowan, M., Russell, G., Geneau, R., & Muldoon, L. (2008). Framework for primary care organizations: The importance of a structural domain. *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care / ISQua*, 20(5), 308–313. <http://dx.doi.org/10.1093/intqhc/mzm054>
- Hulscher, M. E., Laurant, M. G., & Grol, R. P. (2003). Process evaluation on quality improvement interventions. *Quality & Safety in Health Care*, 12(1), 40–46. <http://dx.doi.org/10.1136/qhc.12.1.40>
- Hutchison, B., Levesque, J. F., Strumpf, E., & Coyle, N. (2011). Primary health care in Canada: Systems in motion. *Milbank Quarterly*, 89(2), 256–288. <http://dx.doi.org/10.1111/j.1468-0009.2011.00628.x>
- International Diabetes Federation. (2013). *IDF diabetes atlas* (6th ed.). Retrieved from http://www.idf.org/sites/default/files/EN_6E_Atlas_Full_0.pdf
- Jones, K., & Piterman, L. (2008). The effectiveness of the breakthrough series methodology. *Australian Journal of Primary Health*, 14(1), 59–65. <http://dx.doi.org/10.1071/PY08008>
- Kelley, E. T., Arispe, I., & Holmes, J. (2006). Beyond the initial indicators: Lessons from the OECD health care quality indicators project and the US national healthcare quality report. *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care / ISQua*, 18 Suppl 1, 45–51. <http://dx.doi.org/10.1093/intqhc/mzl02>
- Khan, L., Mincemoyer, S., & Gabbay, R. A. (2009). Diabetes registries: Where we are and where are we headed? *Diabetes Technology & Therapeutics*, 11(4), 255–262. <http://dx.doi.org/10.1089/dia.2008.0057>
- Mainz, J., Krog, B. R., Bjornshave, B., & Bartels, P. (2004). Nationwide continuous quality improvement using clinical indicators: The Danish national indicator project. *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care / ISQua*, 16 Suppl 1, i45–50. <http://dx.doi.org/10.1093/intqhc/mzh031>

- McEwan, K. L., & Bigelow, D. A. (1996). Using a logic model to focus health services on population health goals. *Canadian Journal of Program Evaluation*, 11(2), 167–174. Retrieved from <http://search.proquest.com/docview/1011302333?accountid=15115>
- McLoughlin, V., Leatherman, S., Fletcher, M., & Owen, J. W. (2001). Improving performance using indicators. recent experiences in the United States, the United Kingdom, and Australia. *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care / ISQua*, 13(6), 455–462.
- Ministry of Health and Long-Term Care. (2007). *Preventing and managing chronic disease: Ontario's framework*. Toronto, ON: Author. Retrieved from http://www.health.gov.on.ca/en/pro/programs/cdpm/pdf/framework_full.pdf
- Ministry of Health and Long-Term Care. (2008, July 22). Ontario launches diabetes strategy. Retrieved from <http://news.ontario.ca/mohlhc/en/2008/07/ontario-launches-diabetes-strategy.html>
- Nasmith, L., Ballem, P., Baxter, R., Bergman, H., Colin-Thomé, D., Herbert, C. ... Zimmerman B. (2010). *Transforming care for Canadians with chronic health conditions: Put people first, expect the best, manage for results*. Canadian Academy of Health Sciences. Retrieved from <http://www.caahs-acss.ca/wp-content/uploads/2011/09/cdm-final-English.pdf>
- National Health Service. (2007). *Better metrics project*. Retrieved from http://webarchive.nationalarchives.gov.uk/20101110155218/http://www.cqc.org.uk/_db/_documents/Better_Metrics_full_report.pdf
- National Health Service. (2012). *National diabetes audit*. Retrieved from <http://www.hscic.gov.uk/nda>
- National Institute for Health and Clinical Excellence. (2012). *Quality and outcomes framework*. Retrieved from <http://www.nice.org.uk/Standards-and-Indicators/QOFIndicators>
- OECD. (2011). *Health at a glance 2011: OECD indicators*. OECD Publishing. doi:10.1787/health_glance-2011-en
- Office of the Auditor General of Canada. (2013). *2013 spring report of the Auditor General of Canada. Chapter 5: Promoting Diabetes Prevention and Control*. Ottawa, ON: Author. Retrieved from http://www.oag-bvg.gc.ca/internet/English/parl_oag_201304_05_e_38190.html
- Office of the Auditor General of Ontario. (2012). *2012 annual report, Office of the Auditor General of Ontario. Chapter 3: Reports on value-for-money audits and reviews. Section 3.03: Diabetes management strategy*. Toronto, ON: Queen's Printer for Ontario. Retrieved from http://www.auditor.on.ca/en/reports_en/en12/2012ar_en.pdf
- Petrosino, A. (2000). Answering the why question in evaluation: The causal-model approach. *Canadian Journal of Program Evaluation*, 15(1), 1–24.
- Public Health Agency of Canada. (2009). *Report from the national diabetes surveillance system: Diabetes in Canada, 2009*. Ottawa, ON: Chronic Disease Surveillance Division: Centre for Chronic Disease Prevention and Control. Retrieved from <http://www.phac-aspc.gc.ca/publicat/2009/ndssdic-snsddac-09/pdf/report-2009-eng.pdf>
- Public Health Agency of Canada. (2011a). *Diabetes in Canada: Facts and figures from a public health perspective*. Retrieved from <http://www.phac-aspc.gc.ca/cd-mc/pub>

lications/diabetes-diabete/facts-figures-faits-chiffres-2011/pdf/facts-figures-faits-chiffres-eng.pdf

- Public Health Agency of Canada. (2011b). *United Nations NCD Summit 2011. Chronic diseases: Most significant cause of death globally*. Retrieved from http://www.phac-aspc.gc.ca/media/nr-rp/2011/2011_0919-bg-di-eng.php
- Public Health Agency of Canada. (2012). *Canadian diabetes strategy*. Retrieved from http://www.phac-aspc.gc.ca/cd-mc/diabetes-diabete/strategy_funding-strategie_finance-eng.php
- Rush, B., & Ogborne, A. (1991). Program logic models: Expanding their role and structure for program planning and evaluation. *Canadian Journal of Program Evaluation*, 6(2), 93–106.
- Schouten, L. M., Hulscher, M. E., van Everdingen, J. J., Huijsman, R., & Grol, R. P. (2008). Evidence for the impact of quality improvement collaboratives: Systematic review. *BMJ (Clinical Research Ed.)*, 336(7659), 1491–1494. <http://dx.doi.org/10.1136/bmj.39570.749884.BE>
- Song, M. K., Sandelowski, M., & Happ, M. B. (2010). Current practices and emerging trends in conducting mixed methods intervention studies in health sciences. In A. Tashakkori & C. Teddlie (Eds.), *Mixed methods in social & behavioural research* (2nd ed., pp. 725–747). Thousand Oaks, CA: Sage.
- Straus, S. E., & Holroyd-Leduc, J. (2008). Knowledge-to-action cycle. *Evidence-Based Medicine*, 13(4), 98–100.
- Tricco, A. C., Ivers, N. M., Grimshaw, J. M., Moher, D., Turner, L., Galipeau, J., . . . , & Shojania, K. (2012). Effectiveness of quality improvement strategies on the management of diabetes: A systematic review and meta-analysis. *Lancet*, 379(9833), 2252–2261. [http://dx.doi.org/10.1016/S0140-6736\(12\)60480-2](http://dx.doi.org/10.1016/S0140-6736(12)60480-2)
- Vingilis, E., & Pederson, L. (2001). Using the right tools to answer the right questions: The importance of evaluative research techniques for health services evaluation research in the 21st century. *Canadian Journal of Program Evaluation*, 16(2), 1–26.
- Wagner, E. H., Austin, B. T., Davis, C., Hindmarsh, M., Schaefer, J., & Bonomi, A. (2001). Improving chronic illness care: Translating evidence into action. *Health Affairs (Project Hope)*, 20(6), 64–78. <http://dx.doi.org/10.1377/hlthaff.20.6.64>
- World Health Organization. (2006). *Quality of care: A process for making strategic choices in health systems*. Geneva, Switzerland: Author. Retrieved from http://www.who.int/management/quality/assurance/QualityCare_B.Def.pdf
- World Health Organization. (2008). *World health statistics 2008*. Geneva, Switzerland: Author. Retrieved from http://www.who.int/whosis/whostat/EN_WHS08_Full.pdf
- World Health Organization. (2010). *Monitoring and evaluation of health systems strengthening: An operational framework*. Geneva, Switzerland: Author. Retrieved from http://www.who.int/healthinfo/HSS_MandE_framework_Nov_2009.pdf
- Zimmerman, B. J., Dubois, N., Houle, J., Lloyd, S., Mercier, C., Brousselle, A., & Rey, L. (2011). Guest editors' remarks: How does complexity impact evaluation? / Un mot des rédacteurs invités: En quoi la complexité a-t-elle des répercussions sur l'évaluation? *Canadian Journal of Program Evaluation*, 26(3), v–xx.

AUTHOR INFORMATION

Jann Paquette-Warren, MSc, is a program coordinator on the Diabetes Team at the Centre for Studies in Family Medicine at the Schulich School of Medicine & Dentistry, The University of Western Ontario, London, Ontario, Canada. Her current research focus on evaluation and quality improvement in diabetes contributes to advancing research methodology (qualitative and mixed methods) and supporting innovation in health practice and policy in chronic disease management.

Mariam Naqshbandi Hayward, MSc, is a program coordinator on the Diabetes Team at the Centre for Studies in Family Medicine at the Schulich School of Medicine & Dentistry, The University of Western Ontario, London, Ontario, Canada. Mariam specializes in participatory research and evaluation with cross-cultural and multijurisdictional groups to advance chronic disease management. Her current research focus is on high-risk groups and Indigenous peoples.

Jordan Tompkins, MA, is a program coordinator on the Diabetes Team at the Centre for Studies in Family Medicine at the Schulich School of Medicine & Dentistry, The University of Western Ontario, London, Ontario, Canada. Jordan specializes in medical writing, and is involved in all facets of diabetes research and evaluation to improve chronic disease management and advance health practice and policy.

Dr. Stewart Harris, MD, MPH, FCFP, FACPM, is a professor at the Centre for Studies in Family Medicine at the Schulich School of Medicine & Dentistry, The University of Western Ontario, London, Ontario, Canada. He holds the Canadian Diabetes Association Chair in Diabetes Management (<http://tndms.ca>) as well as the Ian McWhinney Chair of Family Medicine Studies. He has appointments in the Division of Endocrinology & Metabolism, the Department of Family Medicine and the Department of Epidemiology and Biostatistics and is a research scientist at the Lawson Health Research Institute. The major focus of Dr. Harris's research is to develop and evaluate strategies to improve clinical outcomes for patients with type 2 diabetes. His current and previous research, as well as professional involvement as a clinician in diabetes care, provides a strong base to fulfill this research agenda, which encompasses diabetes research at three levels: primary care, population health, and First Nations.