

Evaluating the Process and Outcomes of a Knowledge Translation Approach to Supporting Use of the Diabetes Population Risk Tool (DPoRT) in Public Health Practice

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Abstract: *To support the use of the Diabetes Population Risk Tool (DPoRT) in public health settings, a knowledge brokering (KB) team used and evaluated the Population Health Planning Knowledge-to-Action model. Participants (n = 24) were from four health-related organizations. Data sources included document reviews, surveys, focus groups, interviews, and observational notes. Site-specific data were analyzed and then triangulated across sites using an evaluation matrix. The KB team facilitated DPoRT use through planned and iterative strategies. Outcomes included changes in skill, knowledge, and organizational practices. The Population Health Planning Knowledge-to-Action model and team-based KB strategy supported DPoRT use in public health settings.*

Keywords: *diabetes, diabetes population risk tool, evaluation, knowledge broker, knowledge to action, knowledge translation, partnership, public health, risk tool*

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Résumé : *Pour appuyer l'utilisation de l'outil Diabetes Population Risk Tool (DPoRT) dans les milieux de santé publique, une équipe de courtage de connaissances (KB) a utilisé et évalué le modèle Population Health Planning Knowledge-to-Action. Les sources de données comprenaient des documents, des sondages, des groupes de discussion, des entrevues et des notes d'observation. L'équipe de KB a facilité l'utilisation de DPoRT. Les résultats comprenaient les changements dans les compétences, les connaissances et les pratiques organisationnelles. Le modèle Population Health Planning Knowledge-to-Action et la stratégie KB basée sur l'équipe ont appuyé l'utilisation de DPoRT.*

Mots clés : *diabète, diabetes population risk tool, évaluation, courtier du savoir, connaissances à la pratique, application des connaissances, partenariat, santé publique, outil pour évaluer le risque*

BACKGROUND

Diabetes prevention is a strategic priority for all levels of government in Canada (Canada, 2013). However, decision-makers are challenged with determining the types, intensity, and targets of preventive actions needed to effectively reduce the growing rates of diabetes. The Diabetes Population Risk Tool (DPoRT) was developed to respond to the need for tools that can be used by health analysts, planners, and decision-makers to enhance public health reporting of diabetes and inform strategies for diabetes prevention (Manuel, Rosella, Hennessy, Sanmartin, & Wilson, 2012). Specifically, DPoRT estimates the future risk of type 2 diabetes and quantifies the impact of prevention strategies by applying data routinely collected in population surveys to a validated risk-prediction algorithm (Rosella, Lebenbaum, Li, Wang, & Manuel, 2014; Rosella, Manuel, Burchill, & Stukel, 2011). For example, DPoRT can be used to forecast the number of future diabetes cases, and the accompanying health-care costs, which could be prevented through the implementation of a particular prevention program (e.g., a primary-care-based diabetes prevention program; see Hillmer et al., 2017). To enhance public health decision-making related to diabetes prevention, we sought to build capacity for and facilitate the use of DPoRT in public health settings. Recognizing that established knowledge translation (KT) approaches did not directly apply when integrating a health planning tool such as DPoRT into practice, we employed a novel KT approach and evaluated both the process and outcomes of our strategy.

Since DPoRT is a unique analytical tool, evidence to inform how best to put it into action, including training users and decision-makers on how to use the tool, was limited. In response, we developed the Population Health Planning Knowledge-to-Action (KtoA) model, which specifically informs the translation of population health risk tools into practice (Peirson & Rosella, 2015). Critically, the Population Health Planning KtoA model describes important differences in both knowledge creation (i.e., tool creation path) and application (i.e., action cycle)

phases of KT for population risk tools. While a full description of these differences is provided elsewhere (Peirson & Rosella, 2015), the key factors necessitating this novel KT approach included the explicit need for capacity-building (conceptual and technical) to support tool use, and the fact that the knowledge-creation process may require further tool development and validation to respond to user needs. In light of these key differences, and the need for significant technical expertise to support effective KT, we employed a knowledge brokering (KB) team to facilitate and evaluate this novel KT approach.

Knowledge brokers are informed and solution-oriented individuals who work collaboratively with stakeholders to facilitate KT through knowledge management, linkage, exchange, and capacity-building activities (Bornbaum, Kornos, Peirson, & Rosella, 2015). Recognizing that not all KT needs can be easily addressed by one individual, we employed a KB team (Waqar et al., 2013), as opposed to an individual knowledge broker, to provide a multi-faceted resource to knowledge users. Collectively, the DPoRT KB team was grounded with the knowledge and skills to support various aspects of DPoRT use and application, from technical training and tool adaptations to knowledge product creation. Specifically, the KB team worked with partners to identify how DPoRT could respond to strategic directions related to diabetes prevention, customize tool outputs, assess the barriers to and leverage the facilitators of DPoRT use, enable the capacity to independently use DPoRT and resulting knowledge products, and conduct monitoring and evaluation.

It is well recognized that KT processes need to be studied in a systematic, transparent, and evidence-informed manner to guide practice (Bhattacharyya, Estey, & Zwarenstein, 2011; Donnelly, Letts, Klinger, & Shulha, 2014; Graham & Logan, 2004; Straus et al., 2010; Urban & Trochim, 2009). Yet there are few published evaluations of the process and outcomes of KT initiatives (Donnelly et al., 2014; Gagliardi, Berta, Kothari, Boyko, & Urquhart, 2016; Lafrenière, Menuz, Hurlimann, & Godard, 2013), despite suggestions in the literature that KT- and utilization-focused evaluations are quite similar in nature (Bowen, 2012). Accordingly, we present the description and evaluation of a novel KT approach to support the use of a health planning tool (i.e., DPoRT) in public health practice. Specifically, we aimed to: (1) describe and evaluate the Population Health Planning KtoA model in practice, and (2) identify the strategies that facilitated uptake of and overcame the barriers to DPoRT use, including the core elements needed for sustained use.

METHODS

The evaluation was conducted using a multiple case-study approach (Yin, 2009) through a mixed methods research design (Creswell & Plano Clark, 2007). We performed a utilization-focused evaluation (Patton, 2002), which contends that an evaluation should be judged by its utility to its intended users. Thus our evaluation was planned and conducted in alignment with our partners and according to the Population Health Planning KtoA model in an effort to enhance utilization,

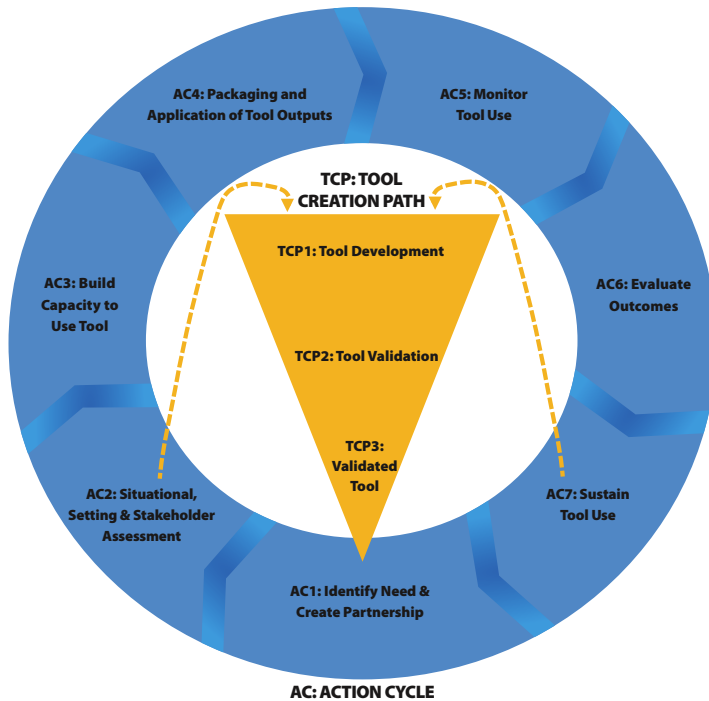


Figure 1. The Population Health Planning Knowledge-to-Action Model (Reprinted with permission from Wolters Kluwer Health, Inc. License Number: 3965941502853)

tool performance, and decision-making. Findings were based on the analysis of quantitative and qualitative data collected throughout 22 months of the KT approach (September 2013–June 2015).

The KB team included a researcher who led the development of DPoRT (L. Rosella), an epidemiologist (M. Lebenbaum), and two research coordinators with graduate-level training and expertise in implementation science and evaluation (C. Bornbaum, K. Kornas). All KB team members were proficient in using DPoRT and worked on a full-time basis to facilitate planned and iterative actions guided by the Population Health Planning KtoA model (Peirson & Rosella, 2015) (see Figure 1).

Ethics approval

The Public Health Ontario (PHO) Ethics Review Board approved this study, and all participants consented to participating in it.

Sample

Units of analyses included four partner sites in two provinces: two public health units, one provincial health organization, and one provincial

knowledge-dissemination team through which we connected with the regional health authorities (RHAs). Organizational, geographic, and population demographic characteristics of each site are described in the study protocol (Rosella, Peirson et al., 2014).

Ontario

Peel Public Health (PPH) participants included the Medical Officer of Health (MOH), a manager, a supervisor, and two epidemiologists. Of note, PPH served as the pilot site for this KT approach (June 2012–August 2013), during which the KB team provided two DPoRT training workshops, facilitated a validation exercise, answered questions, discussed applications of DPoRT, and collaboratively applied DPoRT outputs to a report and conference presentation. Lessons learned through the pilot phase informed subsequent KB activities.

Simcoe Muskoka District Health Unit (SMDHU) participants included the MOH, a manager, and an epidemiologist. Two additional staff also participated in the DPoRT training workshop.

Manitoba

Manitoba Health, Seniors and Active Living was formerly known as Manitoba Health, Healthy Living and Seniors (MHLS) during the study period. Participants from MHLS included a director and several epidemiologists and analysts ($n = 8$).

Our primary participant from The Need To Know (NTK) team was the co-director of that team, who facilitated regular interactions with members of the team including representatives from all five RHAs. Through this collaboration we also connected with the Director of Public Health and MOH from the Northern RHA (NRHA).

Data collection

Data collection and analysis were guided by an evaluation matrix (see Table 1). Questions in the matrix were operationalized based on the Population Health Planning KtoA model and matched with data sources and indicators. Indicators were identified from the Ottawa Model of Research Use framework (Graham & Logan, 2004), the Partnership Synergy framework (Lasker, Weiss, & Miller, 2001), Lavis's framework for knowledge transfer (Lavis, Robertson, Woodside, McLeod, & Abelson, 2003), and the Assessing Applicability and Transferability of Evidence Tool (National Collaborating Centre of Methods and Tools, 2007). Data-collection procedures are described briefly below; additional details are provided in the study protocol (Rosella, Peirson, et al., 2014).

Quantitative data sources

Post-workshop training survey: The KB team developed and administered a survey to participants immediately following the DPoRT training workshops at PPH, SMDHU, and MHLS, in order to assess the design and delivery of the workshop and participants' level of comfort with using DPoRT independently. Surveys were

Table 1. Evaluation Matrix of the Population Health Planning Knowledge-to-Action Process^a

KtoA Process	Evaluation Questions	Indicators	Data Source(s)
AC1: Identify Needs and Create Partnerships			
<ul style="list-style-type: none"> • Identify knowledge user(s) need(s) related to tool • Connect tool developers and decision-makers 	<ol style="list-style-type: none"> 1. Did the potential partner site demonstrate a need for the tool(s)? 	<ul style="list-style-type: none"> • Expressed commitment from knowledge users (e.g., written, verbal) 	<ul style="list-style-type: none"> • Observation (Obs) log • Document review
AC2: Situational, Setting, and Stakeholder Assessment			
<ul style="list-style-type: none"> • Assess capacity of setting and stakeholder to use tool • Assess and leverage barriers and facilitators to tool use 	<ol style="list-style-type: none"> 1. Did tool align with setting's goals/priorities? 2. What were the barriers and facilitators to tool use and application? 	<ul style="list-style-type: none"> • Alignment of tool to chronic disease prevention priorities • Types of barriers and facilitators: <ul style="list-style-type: none"> – Organizational acceptability; – Organizational capacity; – Available essential resources • # and types of modifications or alterations to the tools 	<ul style="list-style-type: none"> • Obs log • Semi-structured Interviews
AC3: Build Capacity to Use Tool			
<ul style="list-style-type: none"> • Assess whether the results of AC2 were used to inform capacity-building strategies to support use of tool 	<ol style="list-style-type: none"> 1. Did partners receive effective capacity-building support from the KB team? 	<ul style="list-style-type: none"> • # and types of capacity-building strategies • Perceived efficacy of capacity-building strategies on supporting tool use • Proficiency in using tool 	<ul style="list-style-type: none"> • Validation exercise • Post-training survey • After Action Review • Obs log • Interviews • Document review

KtoA Process	Evaluation Questions	Indicators	Data Source(s)
AC4: Packaging and Application of Tool Outputs			
<ul style="list-style-type: none"> Package tool outputs into tailored scenario-based policy and program options 	<ol style="list-style-type: none"> Did partners receive effective knowledge product support from the KB team? What KB team actions supported tool use? 	<ul style="list-style-type: none"> # and types of knowledge product support by KB team Perceived efficacy of knowledge product support # and type of knowledge products created 	<ul style="list-style-type: none"> Obs log Interviews Document review
AC5: Monitor Tool Use			
<ul style="list-style-type: none"> Check-in to assess tool use and resource sufficiency 	<ol style="list-style-type: none"> To what extent and how were periodic check-ins performed? 	<ul style="list-style-type: none"> Frequency and type of KB team / decision-maker initiated check-ins 	<ul style="list-style-type: none"> Obs log Interviews
AC6: Evaluate Process and Outcomes			
Evaluate User Experience	<ol style="list-style-type: none"> To what extent did partners perceive the tool and partnership to be useful? 	<ul style="list-style-type: none"> Types and intensity, and perceived efficacy of correspondence between KB team and partners 	<ul style="list-style-type: none"> Obs log Interviews Partnership Self-Assessment Tool (PSAT)
Evaluate Impact of Tools	<ol style="list-style-type: none"> To what extent did IKT approach influence change in knowledge, skills, practice, policy or programming? 	<ul style="list-style-type: none"> Partnership synergy score Perceived impact of KT approach on knowledge, skills, advocacy work, programs, policies, or actions 	
<ul style="list-style-type: none"> On prevention programming and health policy decision-making 			
AC7: Sustain Tool Use			
<ul style="list-style-type: none"> Determine if tool used in reporting, policy, program, or planning practices Assess if existing tool meets partner's needs 	<ol style="list-style-type: none"> How do partners plan to use tool in the future? What supports will be needed for sustained use? 	<ul style="list-style-type: none"> Intentions regarding future tool use and application Types and level of supports required to sustain tool use 	<ul style="list-style-type: none"> Semi-structured interviews

^aA detailed version of the evaluation matrix is available upon request through the corresponding author.

pilot-tested using the cognitive interviewing technique to assess user comprehension and clarity (Drennan, 2003). Participants were asked to assess the workshop content and structure, and their level of comfort with using DPoRT independently. Participants provided ratings from 1 (strongly disagree) to 4 (strongly agree). The training workshop was not provided to the NTK team, as this site did not have analytic staff available who could be trained in using DPoRT independently.

Partnership Self-Assessment Tool (PSAT): To assess partnership effectiveness, KB team members and participants at PPH and SMDHU each completed the PSAT (Center for the Advancement of Collaborative Strategies in Health, 2014a) at least six months following partnership commencement. Participants rated items from 1 (least positive response) to 5 (most positive response) (National Collaborating Centre for Methods and Tools, 2008). The PSAT was not completed by MHHLS or the NTK team, as these sites had fewer than five participants over a six-month period. Response rates for both SMDHU and PPH sites were 100%.

Knowledge product and document review: To assess the effectiveness of capacity-building activities and partners' DPoRT use, an analysis of knowledge products and DPoRT-related documents was performed for all sites. Documents selected for analysis were identified through examination of the observation log.

Qualitative data sources

After action review (AAR): Immediately following completion of the DPoRT training workshop at PPH, SMDHU, and MHHLS, participants were invited to participate in an AAR (Creswell & Miller, 2000) to identify factors that contributed to participant understanding and areas requiring additional support. AARs were audio recorded, transcribed verbatim, and reviewed for accuracy.

Observation log: Throughout the study period, the KB team maintained a record of the nature and sequence of events of the Action Cycle process at SMDHU, MHHLS, and the NTK team. An observation log was not maintained for PPH, since observations of the Action Cycle process that unfolded during the pilot phase were not recorded. To supplement log entries, email correspondence between the KB team members and participants from all four sites were reviewed; thus a portion of interactions that occurred between the KB team and PPH during the study period were captured. Observation log entries were recorded by a KB team member and verified for accuracy by an additional KB team member.

Semi-structured interviews: Interviews were conducted via telephone by the KB team following 15–18 months of facilitation in order to understand the effectiveness and impact of the Action Cycle process on DPoRT uptake. Interview participants included DPoRT users at PPH ($n = 4$), SMDHU ($n = 2$), the NTK team ($n = 2$), and MHHLS ($n = 1$). Interviews were audio recorded, transcribed verbatim, and verified for accuracy.

Data analysis

Site-specific data sources were first analyzed independently and subsequently triangulated according to the evaluation matrix (Onwuegbuzie & Teddlie, 2003)

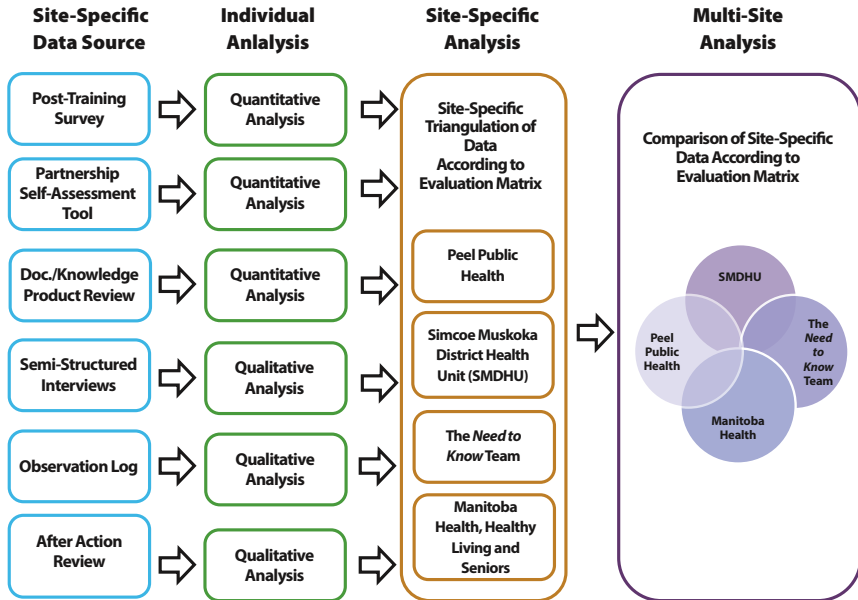


Figure 2. Integrated Data Analysis Strategy

to create in-depth, context-sensitive descriptions of each site (Patton, 1980) (see Figure 2).

Quantitative analysis

Quantitative data from the post-training survey and PSAT were analyzed using SAS 9.3. Items in the post-training survey were coded as 1 (strongly disagree) to 5 (strongly agree), and means and frequencies for each item were calculated. Partnership synergy constructs from the PSAT were coded and calculated according to the tool's manual (National Collaborating Centre for Methods and Tools, 2008). Frequencies were calculated to quantify the types of knowledge products generated by the KB team, DPoRT users, and a combination of both.

Qualitative analysis

Qualitative data from the observation logs, semi-structured interviews, and AARs were analyzed using descriptive and iterative methods (Yin, 2009). A deductive approach was used to explore the data for themes related to indicators identified a priori in the evaluation matrix, complemented by an inductive approach to identify emergent themes.

NVivo 9 was used to organize and code the data. First, a coding manual (Crabtree & Miller, 1999) was developed to abstract and synthesize the data through a priori construction of a preliminary list of codes structured according to indicators. The preliminary manual was reviewed and discussed with the research team. A primary and secondary rater independently applied the

preliminary coding manual to one randomly selected interview transcript. The coding manual was modified to capture themes that emerged inductively from the data; revisions were agreed upon by coders before the remaining documents were coded. The previously coded document was reviewed to ensure consistency with the revised coding manual. All remaining qualitative data were analyzed independently by one coder and verified by a second coder. Coding agreement was achieved through discussion (Harry, Sturges, & Klingner, 2005).

Data integration

Data integration was guided by a fully mixed concurrent equal status design (Leech & Onwuegbuzie, 2009) such that quantitative and qualitative data were given equal weight and mixed concurrently during data collection, analysis, and interpretation (Leech & Onwuegbuzie, 2009). Site-specific analyses were conducted according to the convergence model variant of mixed methods triangulation design (Creswell & Plano Clark, 2007). First, each data source was analyzed independently according to the procedures described above. Where data from multiple sources addressed the same evaluation question, findings were triangulated (Onwuegbuzie & Teddlie, 2003). Finally, findings from all sites were merged and aggregated into a larger unit of analysis for cross-case comparison and synthesis (Stake, 2005; Yin, 2009).

RESULTS

While the KT and evaluation activities were performed largely simultaneously (i.e., process evaluation data were used to tailor and enhance the KT strategy), to enhance clarity we present a summary of our KT strategy first and then describe the evaluation results. All findings are presented below according to the seven corresponding Action Cycle (AC) stages in the Population Health Planning KtoA model (Figure 1).

AC1: Identify need and create partnerships

KT activities. The KT approach began with the identification of relevant needs and the cultivation of partnerships with decision-makers who agreed to joint engagement in the use of DPoRT and its outputs. Partnerships commenced through the joint application for a Canadian Institutes of Health Research (CIHR) KtoA grant (KAL-129895).

Evaluation findings. Partners identified how DPoRT aligned with organizational strategic priorities and could optimize the use of existing health data to enhance diabetes surveillance and inform prevention and resource planning. For example,

We have found that the [Canadian Community Health Survey] has been underutilized for health systems planning and we believe that DPoRT may provide an optimal method to apply this data source in a novel way. (Director)

AC2: Situation, setting, and stakeholder assessment

KT activities. The KB team identified facilitators and barriers to DPoRT use in discussion with partners, and used the information to customize site-specific capacity-building strategies (described below in AC3) and develop tool adaptations.

Evaluation findings. Facilitators and barriers to DPoRT use and application are summarized in [Table 2](#) and expanded on below.

DPoRT use was encouraged by an organizational champion at all sites, and its uptake was enhanced by the perceived alignment between tool applications and organizational perspectives:

The most effective [factor] is having [the MOH] be there to really sort of keep us involved in it.... DPoRT is just a really great example of the population thinking that we were already doing, but I think it is the first example ... that is actually able to quantify that sort of abstract population level thinking ... in a way that would make it clear for people. (Epidemiologist)

On the other hand, the perceived misalignment of the tool with organizational priorities was a barrier in one setting:

I can see us being able to make more use of data from CDPoRT [a chronic disease population risk tool], just because of the nature of our program being integrated chronic disease prevention. (Manager)

The ability to discern applications for DPoRT and leverage opportunities where staff could apply DPoRT outputs was a perceived facilitator of DPoRT use:

Once the program area sees the value [of DPoRT] and sees it as a potential way for them to help them make decisions ... I think then we will start getting more and more requests to use [DPoRT] to evaluate the types of things we are thinking about. (Epidemiologist)

Three sites (i.e., PPH, SMDHU, MHLS) intended to use DPoRT independently. These sites allocated analytic staff to work with the tool and had access to the statistical software and data needed to run DPoRT. Notably, at all sites, individuals with decision-making authority (e.g., MOHs, managers, directors) participated in the KT approach and requested and applied DPoRT outputs:

Having the epi[demiologist] be able to access the tool, and run the data, and provide the data to us was critical. (Manager)

DPoRT's initial format and functionality were a barrier to use at all sites. Partners suggested several tool adaptations to facilitate ease of use and expand applications, including the need to simplify syntax (e.g., develop macros), expand the types of tool outputs (e.g., enable projections of diabetes prevalence and new intervention scenarios), validate the tool's risk-prediction algorithm for specific populations (e.g., First Nations), and expand applications of the tool for broader

Table 2. Assessment of Facilitators and Barriers to DPoRT Use and Application at Each Partner Site

Factor	Manitoba		
	Ontario PPH Public Health Unit (pilot site)	SMDHU Public Health Unit	MHLS Provincial Health Organization
Organizational acceptability or leverage			
Partners' support for the use and application of DPoRT in site	[F] Tool use/application supported by all users, championed by MOH; DPoRT integrated into operational work plan of staff	[F] Tool use/application supported by all users, championed by MOH; DPoRT integrated into operational work plan of staff	[F] Tool use/application supported by the NTK Team members, championed by director; setting did not intend to have analytical staff use DPoRT independently
Initial format and functionality of DPoRT relative to partner needs	[B] Tool adaptations required to meet setting's needs	[B] Tool adaptations required to meet setting's needs	[B] Tool adaptations required to meet setting's needs
Available essential resources			
Staff with analytic capacity to support DPoRT use	[F] Available analytic capacity (4 epidemiologists)	[F] Available analytic capacity (1 epidemiologist)	[F] Available analytic capacity (8 epidemiologists/ analysts)
Staff members trained in using statistical software	[F] Analytic staff proficient with statistical software	[F] Analytic staff proficient with statistical software	[F] Analytic staff proficient with statistical software
Individuals or groups with decision-making authority to support DPoRT application	[F] Individuals at setting with decision-making authority available	[F] Individuals at setting with decision-making authority available	[F] Individuals at setting with decision-making authority available
Access to a population data set with variables for DPoRT use	[F] Access to appropriate population data set	[F] Access to appropriate population data set	[F] Access to appropriate population data set

Access to statistical software for DPoRT use	[F] Access to statistical software	[F] Access to statistical software	[F] Access to statistical software	Not applicable
Organizational expertise and capacity				
Degree that setting accepts potential evidence-based challenges directed at its perspective	[F] No indication of setting resistance	[F] No indication of setting resistance	[F] No indication of setting resistance	[F] No indication of setting resistance
Required approval processes related to DPoRT use	No evidence to answer whether approval processes were required	No evidence to answer whether approval processes were required	No evidence to answer whether approval processes were required	Not applicable
Degree of alignment of DPoRT with the setting's strategic plan, mission and local priorities, existing legislation or regulations, local programming	[F] DPoRT aligned with organizational strategic plan	[B] DPoRT not directly aligned with organizational strategic plan	[F] DPoRT aligned with organizational strategic plan	[F] DPoRT aligned with strategic plan of at least one Regional Health Authority
DPoRT overlap with or symbiotic with existing diabetes surveillance/prevention tools	[F] DPoRT symbiotic with existing tools	[F] DPoRT symbiotic with existing tools	No evidence to assess if DPoRT symbiotic with existing tools.	No evidence to assess if DPoRT symbiotic with existing tools.

[F] = identified as a facilitator; [B] = identified as a barrier

chronic diseases. The KB team responded by providing tool customizations and technical enhancements, which were available to users across settings and ultimately improved user-friendliness and increased the relevance of outputs to partners' needs:

We have made a number of suggestions [to enhance DPoRT's functionality], all of which have been taken up.... [The KB team] take[s] suggestions [well], so that's been the most helpful thing—openness to make changes as we go along, and appreciating that ease of use is very important. (MOH)

AC3: Build capacity to use tool

KT activities. The KB team used information and learning gathered from situation and stakeholder assessments to facilitate several planned and iterative capacity-building strategies that were tailored to partners' needs, and focused on building partnerships and enabling DPoRT use and application (see [Table 3](#)).

Evaluation findings. The KB team effectively incorporated participant feedback to improve the process and content of training workshops (e.g., additional time was allocated to teaching intervention scenarios after participants requested more hands-on learning opportunities). All participant sites strongly agreed that the workshop activities contributed to their understanding of DPoRT, suggesting that the training workshop was an effective strategy to build capacity for DPoRT use (see [Table 4](#)).

KB team interactions with partners were perceived positively across all sites, with the KB team's "flexibility" and "responsiveness to requests" described commonly by partners. Overall, the KB team was reported to be an effective resource for maintaining partnerships and facilitating the understanding and use of DPoRT:

Having somebody like [KB team member] there to support us was amazing, it was an integral part of my learning and ability to use it. (Epidemiologist)

Engaging in meetings with partners at the onset of the KT approach was perceived to be useful for establishing relationships and conveying the intent of DPoRT and the partnership. Partners from all sites noted a preference for these meetings to be conducted in-person:

There's just nothing more impressive than in-person contact ... to build capacity among a group or build a relationship. (Director)

Tailored capacity-building strategies to facilitate independent use were provided to analytic staff at three sites. Overall, participants from all three sites commented that the training workshop was effective at enhancing their understanding and use:

I didn't know what DPoRT was at all, so for me I learned a lot about both DPoRT and using the [software]. (Epidemiologist)

Table 3. Strategies Used to Build Capacity for Use and Application of DPoRT (AC3)

Strategy ^a	Description	Ontario		Manitoba	
		PPH ^b (Public health unit, pilot site)	SMDHU (Public health unit)	MHLS (Provincial health organization)	NTK Team (Provincial KT conduit)
All sites team meeting (planned)	KB team hosted teleconference to orient partners to the knowledge translation project	<i>n</i> = 4	<i>n</i> = 3	<i>n</i> = 2	<i>n</i> = 2
Initial site meeting (planned)	Individual meetings to identify site-specific needs, facilitators, barriers, and interests relative to DPoRT	Onsite (Dec. 2013), <i>n</i> = 4	Onsite (Nov. 2013), <i>n</i> = 3	Teleconference (Dec. 2013), <i>n</i> = 2	Teleconference (Dec. 2013), <i>n</i> = 2
Newsletter (iterative)	KB team prepared newsletter to share site-specific updates and encourage collaboration	Disseminated via email to all site partners Yes	Disseminated via email to all site partners Yes	Disseminated via email to director	Disseminated via email to co-director Yes
Check-ins or re-minders (iterative)	KB-team initiated check-ins to support partnerships and inform capacity building supports	Yes	Yes	Yes	Yes
DPoRT training workshop (planned)	KB team instructed sites on population risk algorithm theory, DPoRT validation and analytic procedures, use of DPoRT risk projections and scenarios, and interpretation of DPoRT outputs	<i>n</i> = 4 (epidemiologists, manager, supervisor)	<i>n</i> = 4 (epidemiologist, research analyst, managers)	<i>n</i> = 8 (analysts, epidemiologists, director)	N/A
DPoRT manual (planned)	Included training workshop materials, DPoRT syntax, and suggested readings	Provided with STATA syntax	Provided with STATA syntax	Provided with SAS syntax	N/A
Validation exercise (planned)	Exercise disseminated to workshop participants; required use of DPoRT to answer site-specific questions on risk projections and intervention scenarios	<i>n</i> = 4 disseminated; <i>n</i> = 0 returned	<i>n</i> = 3 disseminated to analytic staff; <i>n</i> = 1 returned	<i>n</i> = 8 disseminated; <i>n</i> = 0 returned	N/A
Provide tool adaptations (iterative)	Adaptions to DPoRT's format and functionality provided in response to user feedback and requests	Yes	Yes	No	Yes
PowerPoint presentations (iterative)	Prepared by KB team to facilitate meetings and delivery of training workshop	Yes; <i>n</i> = 2	Yes; <i>n</i> = 3	Yes; <i>n</i> = 4	Yes; <i>n</i> = 4

(Continued)

Table 3. Continued

Strategy ^a	Description	Ontario		Manitoba	
		PPH ^b (Public health unit, pilot site)	SMDHU (Public health unit)	MHLS (Provincial health organization)	NTK Team (Provincial KT conduit)
Meeting handout(s) (iterative)	Prepared by KB team to facilitate meetings	Yes; n = 1	No	Yes; n = 1	Yes; n = 1
Engage in focused DPoRT discussions (iterative)	KB team facilitated discussions with users on DPoRT topics (e.g., specific tool adaptations)	Yes	Yes	Yes	Yes
Identify, obtain, or provide relevant information or resources (iterative)	KB team responded to requests for DPoRT outputs, prepared boilerplates, sent notice on relevant talks, and provided relevant publications	Yes	Yes	Yes	Yes
Answer technical or interpretive questions (iterative)	KB team answered questions about use of DPoRT syntax, tool functions, and interpretation of DPoRT outputs	Yes	Yes	No	Yes
Discuss DPoRT applications (iterative)	KB team discussed applications related to intervention scenarios, economic outputs, and communicating findings to decision-makers	Yes	Yes	No	Yes
Provide feedback on stakeholder-generated knowledge products (iterative)	KB team reviewed site-generated knowledge products upon request to ensure DPoRT results were correctly interpreted, and offered feedback	Yes	Yes	No	No
Peer-to-peer support (iterative)	DPoRT partners described engaging in informal collaborations within and across DPoRT sites to discuss calculations and check outputs	Yes	Yes	Yes	No

^aCapacity-building strategies are classified as “planned” if they were planned before commencing the KT approach, whereas strategies are classified as “iterative” if they were not planned before the KT approach but were deemed to be of potential benefit and consequently implemented.

^bCapacity building strategies provided to PPH during the pilot phase are not reflected in this table.

Table 4. Perceptions about the Design and Effectiveness of the DPoRT Training Workshop (Mean Scores)

	SMDHU March, 2014 (n = 3)	PPH April, 2014 (n = 3)	MHLS December, 2015 (n = 6)
Workshop Content			
I understand how to generate variables (e.g., recode levels, label and format values)	3.7	3.7	3.8
I understand how to generate descriptive statistics (e.g., means, population counts)	3.0	3.7	3.7
I understand how to apply DPoRT intervention scenarios (e.g., by type of intervention, targets, outcomes)	2.7	3.7	3.7
Workshop Structure			
An adequate amount of time was spent on each topic area	2.3	3.3	4.0
The total length of time provided for the training workshop was appropriate	2.3	3.3	4.0
The workshop activities contributed to my understanding of DPoRT	3.7	3.7	4.0
General Feedback			
I am comfortable with using DPoRT independently	2.7	3.0	3.7

Note. Participants provided ratings from 1 (strongly disagree) to 4 (strongly agree). The training workshop was not provided to the NTK Team.

Despite having been completed by only two of the three participant sites, the validation exercise, in combination with iterative support for technical and interpretive questions (e.g., using DPoRT syntax, interpreting risk projections) and verifying partner-generated DPoRT outputs upon request, was perceived by both sites to be effective for building applied skills:

I wouldn't know how to use [DPoRT] if it wasn't for the training and the email exchanges and phone conversations.... The validation exercise was very useful in terms of making sure that I was understanding [DPoRT], [and] was able to run it correctly. (Epidemiologist)

In addition, at two sites, iterative within- and between-site peer-to-peer exchanges were useful for building capacity:

A couple times [epidemiologists at partner site] contacted me.... They were developing a report and they sent me the report and they asked me to look it over and if I had any feedback on it—it was more of that kind of informal back and forth support. (Epidemiologist)

Table 5. Summary of Knowledge Products Generated with Packaged DPoRT Outputs

Type of Knowledge Product	SMDHU	PPH (pilot site)	MHLS	<i>The NTK Team</i>	Total ^a
PowerPoint presentation for members of the partner site	0	1	0	1	2
Report for members of the partner site	0	2	0	1	3
Conference presentation	0	1	0	0	1
Organizational website	1	0	0	0	1
Advocacy report	1	1	0	0	1
PowerPoint presentation for decision-makers	0	1	0	0	1
Knowledge Product Creator					
KB team	0	1	0	0	1
Partner site	1	1	0	0	2
KB team and partner site	1	4	0	2	6

Note. The identified knowledge products are based on the document review.

^aThe totals reflect that some knowledge products were co-created between sites.

AC4: Packaging and application of tool outputs

KT activities. The KB team worked with partners to support the co-creation of knowledge products by jointly identifying questions of interest, generating tool outputs, supporting the interpretation and application of tool outputs, reviewing partner-generated knowledge products (e.g., reports, presentations), and jointly developing and disseminating reports and presentations.

Evaluation findings. The extent to which knowledge products with DPoRT outputs were created and disseminated differed between sites (see Table 5). Notably, knowledge products were developed more often in collaboration with the KB team than independently. At the time of evaluation, no knowledge products had been created by MHLS; however, this site experienced a short time interval (i.e., three months) between the delivery of the training workshop and the completion of data collection for this study. Overall, partners perceived KB team knowledge product supports positively:

I sent [the KB team] the tables, the draft report, and [they] took a look at it and helped us with the interpretation.... that was really helpful for us. (Epidemiologist)

AC5: Monitor tool use

KT activities. The KB team used multiple strategies to monitor emergent barriers to DPoRT use, identify needs for capacity-building supports and tool

adaptations, and verify the accuracy of generated outputs. Specifically, check-ins were performed on an iterative basis, both in person and via email, to provide reminders on KT-related items (e.g., review newsletter content), and to gauge interest in focused discussions on DPoRT items (e.g., DPoRT syntax or applications).

Evaluation findings. One site noted that KB team check-ins were instrumental to maintaining the organization's interest in DPoRT:

The way you guys keep kind of nudging me from time to time ... Honestly, that keeps you guys on the radar, and reminds me that this is an important piece.... I appreciate ... regular check-ins. (Director)

However, there was an indication that check-ins could have been performed more frequently for one site, as one respondent expressed the desire for more frequent discussions regarding DPoRT outputs and adaptations:

I kind of felt that right after the training there was regular communication with [KB team member] around [developing macros for DPoRT] and it seemed like there was some ground kind of being made around some of those suggestions and then there seemed to be ... the communication wasn't quite as frequent after [that KB team member] left. (Epidemiologist)

As noted by the respondent, following 10 months of the KT approach, a KB team member who had been facilitating technical tool-related discussions left the team.

AC6: Evaluate outcomes

Following 22 months of the KT approach, partners reported changes in skills, knowledge, and practice, and/or used DPoRT in ways to inform decision-making. No sites reported specific changes in programs or policies. All sites reported that the partnership between the KB team and partners functioned effectively.

Self-reported skills. DPoRT users at two sites self-reported proficiency in using DPoRT independently:

I understand what each general section [of DPoRT syntax] is doing and where I would need to change something to get it to do what it needs to do. (Epidemiologist)

One site did not report changes in staff skills related to DPoRT use. Change in skill was not applicable for the site that did not seek training for staff to use DPoRT independently.

Self-reported knowledge. Partners from three sites reported that DPoRT helped reinforce an issue related to diabetes or provided new knowledge about the impact of diabetes risk factors or intervention approaches:

One of the things [DPoRT] did was it really refocused us back on BMI because we really didn't realize the difference that would make. We were really stuck on hypertension. (Director)

One site did not report a change in knowledge at their setting; however, there was consensus among participants that DPoRT aligned with the organization's current population health perspectives:

We have been looking at a population impact assessment concept.... We were kind of thinking along those lines and DPoRT was a nice tool to help start out that thinking with. (Manager)

Organizational practices. Two sites expressed intentions to train other analytic staff in DPoRT use. They also reported that DPoRT was integrated into organizational practices such that the tool was included in the work plan of analytic staff, and DPoRT outputs were incorporated into an annual organizational report on diabetes and routinely integrated in knowledge products for different audiences:

[MOH] is going to do a presentation to the [city council] in September and wanted me to prepare some data for him ... estimating the economic impact [of diabetes] using DPoRT. (Epidemiologist)

At one site, a participant reported discussing DPoRT applications with their RHA and inter-professional team to help determine how their region might target chronic disease. One site reported not currently using DPoRT at the time of the evaluation but stated its intentions to use the tool in the future for diabetes projection and intervention modelling.

Programs or policies. No sites reported specific changes to programs or policies as a result of the KT approach. However, one site described using DPoRT to inform policy dialogue and noted how DPoRT scenarios enhanced staff capacity to advocate for health interventions:

The impact is on providing data for advocacy and policy.... It's those "what if" questions.... They are very powerful. Instead of just vague utterances, you're able to say, "look, if you fix this, you will have that, and that amount of impact," and that's very important.... [DPoRT] enabled us to actually answer the question "what if?" That's a really important way of thinking. (MOH)

Partnership. The partnership between the KB team and partners was described positively by participants from all sites, with one MOH noting, "I wish all my partnerships were like this." Among the two sites that completed the PSAT, opportunities to improve the collaborative potential of the partnership were revealed in the areas of synergy, leadership effectiveness, efficiency, and financial resources (see [Table 6](#)). In general, the partnerships were perceived positively relative to the effectiveness of administration and management and the sufficiency of non-financial resources. Notably, partnership scores were higher for the site that participated in the pilot phase (i.e., PPH), suggesting that the duration of the partnership may have positively influenced its functioning.

Table 6. Partnership Synergy Overall Mean Scores^a

	SMDHU <i>n</i> = 5	PPH <i>n</i> = 7 (pilot site)
Synergy	3.6	3.9
Leadership effectiveness	3.8	4.5
Efficiency	3.8	4.6
Effectiveness of administration and management	4.2	4.2
Sufficiency of non-financial resources	4.2	4.3
Sufficiency of financial and other capital resources	3.8	4.1

Note. MHLS and the NTK Team did not qualify to complete the PSAT because they had fewer than five participants.

*Participants rated items from 1 (least positive response) to 5 (most positive response) (National Collaborating Centre for Methods and Tools, 2008).

AC7: Sustain tool use

KT activities. Throughout the KT approach, partners proposed several tool adaptations to respond to their evolving needs, including developing new outputs to supplement incidence (e.g., prevalence and costs), validating the tool for target groups of interest (e.g., on-reserve First Nations people), expanding the software platforms for DPoRT use (e.g., SPSS, Stata, SAS), enabling broader chronic disease end-points vs. disease-specific outputs, enhancing the user-friendliness of intervention scenarios by simplifying the syntax, and developing new scenarios using new data sources. The KB team responded to each of the requests, though given time restrictions, some tool adaptations were not completed by the time of evaluation (e.g., developing new scenarios for analysis).

Evaluation findings. The KB team examined the types and level of supports that partners anticipated needing in order to sustain DPoRT use. Partners noted that support from senior decision-makers was important, with one decision-maker noting that

If I wasn't here [the project would not continue] ... that's how easy things happen at the regional level, if the few key people [are not present] ... if it was more of a provincial initiative, it would have more support to keep going. (Director)

All partners reported that DPoRT's utility needed to be clearly demonstrated to ensure the long-term sustainability of the tool, with one noting,

You've got to prove its utility... We've got to be able to ... see some nice combination of direct and indirect benefits or insights that come from having this that [we] didn't have before. (Director)

Partners also expressed the need for supplemental supports or resources from the KB team (e.g., instruction manuals). In addition, partners described the need to expand training to others in their organization to support tool sustainability:

I've done some of the creating standard files and tried to start documenting the process.... We need to make sure that a few other people are able to run DPoRT at any given point in time. (Epidemiologist)

Finally, the KB team explored how partners planned to continue using DPoRT in the future. Three sites reported intentions to continue using DPoRT, whereas one site reported uncertainty about its role in facilitating DPoRT's future use.

Partners reported several specific intentions for future uses and applications of DPoRT, including updating and informing annual reporting (e.g., reports, presentations, website); informing program interventions and economic impacts in public health unit reports; supporting reports to external stakeholders (e.g., municipal/regional councils); generating data for "rapid review" evidence syntheses; evaluating the potential impact of interventions being considered by a program planning team; tracking health trends over time; informing program logic models; justifying population-based approaches to public health strategies; and informing operational planning. In addition, some partners anticipated using DPoRT collaboratively with other sites:

One of the things that we want to do in a public report is to ask some of those bigger questions.... Our hope is that based out of the larger public report that we can have some different conversations with the [regions] that can start to ask and answer some of their specific questions. So that's where that [DPoRT] intervention modeling will be of use for us. (Director)

DISCUSSION

The KB team facilitated and evaluated a novel KT approach in four health settings to support the use of DPoRT to inform diabetes prevention efforts. Our evaluation demonstrated that the Population Health Planning KtoA model can be used to facilitate KT of health planning tools and to guide the evaluation of the process and outcomes of such initiatives. Through the Population Health Planning Model's Action Cycle, the KB team and partners jointly identified barriers and leveraged facilitators to DPoRT use, delivered and assessed tailored strategies to build capacity for use, and performed monitoring and evaluation activities to assess emergent needs, outcomes, and sustainability within settings. After 22 months, all sites reported changes in skills, knowledge, and practice, and/or used DPoRT to inform decision-making. Our evaluation of the Population Health Planning KtoA Action Cycle responds to the need to test available models for designing and evaluating KT approaches (Gagliardi et al., 2016).

To our knowledge, this paper represents the first effort to empirically evaluate a theory-based integrated knowledge translation approach in a public health

setting. Utilization-focused evaluations provide a useful way to optimize KT efforts due to the complementary nature of both the underlying principles and the approach (Bowen, 2012). Both utilization-focused evaluations and KT approaches emphasize the value of using research or evaluation results through all phases of the process; promote responsive research and evaluation activities based on stakeholder-identified needs; support early and ongoing involvement of the intended users of the information; and view the evaluator, researcher, and intended users as collaborative partners in the process (Bowen, 2012). Through concurrent application of evaluation and KT activities, our utilization-focused evaluation served to inform and enhance our KT activities and ultimately contributed to the changes in knowledge, skill, and practice observed among our partner sites through the ongoing translation and use of research and evaluation data.

The duration of the KT approach relative to the time required to build partnerships and capacity may explain some of the differences observed across sites. For example, at the time when the partnership was formally initiated, the pilot site had greater capacity for DPoRT use compared to non-pilot sites, due to the training and supports received during the pilot phase. As a result, over the next 22 months of continued participation in the KT approach, a greater proportion of the pilot site's time was observed to be spent on the fourth Action Cycle stage of "discussing and packaging tool outputs"; this is reflected in the greater number of knowledge products co-developed with the pilot site. This is consistent with literature describing collaboration and relationships between researchers and knowledge users as important facilitators to evidence use (Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014).

Our findings build on what is known about facilitators and barriers to evidence use, but in the new context of health planning tools. Notably, organizational factors were perceived to be important to both facilitating DPoRT use and its sustainability (Davies & Edwards, 2009; Oliver et al., 2014). In particular, the involvement of an organizational champion was a salient facilitator, whereas the perceived utility of DPoRT relative to the needs of partners was a prominent barrier. A strength of our KT approach was that the KB team shared responsibility with partners in identifying and responding to emergent barriers, such as technical adaptations to better customize support. In addition, the use of the KB team ensured that a broader range of skills were available to partner sites. Our evaluation showed that use of a KB team was perceived as effective for supporting relationships and building capacity, adding to research demonstrating that KT strategies are strengthened when they are interactive, multi-component, and tailored to the context of knowledge users (LaRocca, Yost, Dobbins, Ciliska, & Butt, 2012). Evaluation findings identified a range of KT strategies that the KB team facilitated throughout the Action Cycle process, and revealed that many of these were facilitated on an iterative rather than planned basis. We learned that including planned KT strategies throughout the Action Cycle, such as scheduled check-ins to supplement monitoring, could have provided more opportunities to identify gaps and enhance responsiveness to emergent needs, as well as to mitigate

the impact of factors that might have disrupted iterative exchanges (e.g., KB team-member turnover). The appropriate combination of planned and iterative KT strategies should be considered in future KB efforts.

The resulting outcomes of the KT approach should be interpreted within the context of the duration of the Action Cycle process (i.e., 22 months) relative to the time, typically years, that is estimated for evidence to be integrated into policy and practice (Morris, Wooding, & Grant, 2011). Despite the relatively short time period, there was evidence that partners used DPoRT in conceptual ways (e.g., disseminating DPoRT outputs to increase understanding about the problem of diabetes in regions) and instrumentally (e.g., disseminating DPoRT outputs to advocate for diabetes prevention strategies), which are factors that contribute to decision-making (Lavis et al., 2003).

It is noteworthy that this KT approach was employed to integrate an existing tool into practice. An area of future research can explore how the Action Cycle process, outcomes, and sustainability are affected in KT approaches that engage end-users in the initial Tool Creation Path (Peirson & Rosella, 2015), in which partners would be engaged in the KT process earlier in order to provide their input into the development of meaningful health planning tools.

Strengths and limitations

This multiple case-study evaluation offered a rich description of the Action Cycle process and outcomes of DPoRT uptake in four unique health settings. Importantly, because we employed both a novel model for KT in addition to a relatively new approach to knowledge brokering (i.e., a KB team), it is difficult to discern which factors may have directly contributed to outcomes. Nevertheless, given the highly contextual nature of KT initiatives, we believe that the KB team's application and evaluation of the Population Health Planning KtoA model was integral to the positive outcomes of this work. Notably, our outcome assessment largely relied on interviews with partners and document review methods. It should be acknowledged that partners described perceived outcomes and thus recall bias may have limited the accuracy of participants' descriptions of DPoRT's impact. In addition, the knowledge products identified in the document review only captured those that were co-created with the KB team and those that were shared over the course of the study. In interviews, participants acknowledged sharing DPoRT outputs in internal presentations or other venues, which were not captured by the document review. Thus, the outcomes reported in this evaluation are likely an under-representation of the true impact of the approach.

CONCLUSIONS

The integration of evaluation into KT initiatives is recommended (Graham et al., 2006; Wilson, Brady, & Lesesne, 2011), yet there are few published evaluations of KT approaches, and methodologies for such evaluations are not clearly defined. The current study illustrated that the Population Health Planning KtoA model can

be applied to support and evaluate the use of a health planning tool in practice (i.e., DPoRT). Using the KB team to both facilitate and evaluate the Action Cycle process strengthened the KT approach by enabling the KB team to continually use process evaluation results to respond to barriers and facilitators to DPoRT use and to refine the KT strategies used to put DPoRT into action—all in ways that were meaningful to partners. Overall, we found that the partnership and KB team strategy were salient factors that influenced progression through the Action Cycle stages and facilitated DPoRT's use and application by partners interested in diabetes prevention.

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