

EVIDENCE BRIEF

Implementation Factors for Delivery of Type 2 Diabetes Prevention in the Community

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Key Messages

- Diabetes prevention programs have demonstrated success when delivered in a variety of settings. Transitioning these programs to community settings for improved access, reach and sustainability introduces complexities and in turn, requires more rigorous collaboration and planning. Implementation science can provide a robust foundation for informing the successful design and implementation of Type 2 Diabetes (T2D) interventions within various community settings – including but not limited to community centers, schools, workplace, and places of faith.
- The appeal and success of community delivered initiatives is due to their ability to bring the program to the individual, addressing many of the individual and contextual level barriers identified throughout the literature (access, time, cost, etc.). Community T2D prevention programs are useful for reaching under-invested populations experiencing barriers to participation due to location and access to culturally relevant and safe services.
- Understanding and addressing contextual factors is crucial for community intervention success. Due to the diversity in program delivery settings, resource availability, and mechanisms of influence, a 'one-size-fits-all' implementation approach is not feasible. The goal is not to find blanket solutions but rather identifying what works for who and in what contexts. Participatory design is an effective strategy for tailoring programs to their unique settings, however, strategies and participatory approaches and community engagement are broad and operationalized differently across studies. Tailoring and adapting program design and content to a setting or population has demonstrated promising effects on the appropriateness, uptake and sustainability of T2D prevention programming.

Issue and Research Question

Recent projections indicate that by 2050, more than 1.27 billion people across the globe will be affected by type 2 diabetes (T2D).¹⁻³ Diabetes-related complications include nerve and blood vessel damage, blindness, kidney failure, heart attacks, stroke, lower limb amputation and premature death.^{4,5} Canada spends \$9 billion annually on health care, disability, work loss, and premature death costs related to diabetes.⁶ In Canada, the burden of diabetes is predicted to increase demand on the health system with estimates that, between 2011/2012 and 2021/2022, new cases of diabetes are expected to result in \$15.36 billion in health care costs.⁶ As of 2023, 30% of Ontarians live with diabetes or pre-diabetes resulting in the direct cost of \$1.7 billion to the health care system.^{4,7}

There are demonstrated health and economic benefits of diabetes prevention programs in addressing clinical outcomes and health behaviours (e.g., healthy eating, physical activity).⁸⁻¹⁰ While prevention services have traditionally been delivered in hospitals, clinics or other health care settings, there has been some shifts to delivering these same interventions virtually¹¹ and in community settings. Implementing programs in different settings comes with its own unique lessons and challenges. The layered complexity of adapting program content to new settings and tailoring content to particular populations of interest can impact the success or failure of implementing T2D prevention programs. While there are challenges, adapting and tailoring programs based on population need is critical to their success, particularly for reaching populations disproportionately impacted by T2D such as those with low socioeconomic status, Indigenous, Black and other racialized people.^{9,12-16} There is evidence that supports the effectiveness of community-based educational interventions in improving health outcomes related to T2D. This review summarizes this evidence as well as the implementation factors that influence program effectiveness.¹⁷

The Consolidated Framework for Implementation Research (CFIR)^{18,19} is a comprehensive implementation science framework that gives structure to the contextual factors that influence program implementation, described in more detail in [Review of “The updated Consolidated Framework for Implementation Research based on user feedback”](#).²⁰ Our findings are presented relative to the CFIR constructs. Evidence-based approaches to T2D, such as the ones outlined in this brief, can strengthen success (effectiveness, reach, uptake) of existing programs by applying lessons learned from past diabetes prevention research and programs.²¹

This Evidence Brief answers the question: *For type 2 diabetes (T2D) prevention programs delivered in the community, what are characteristics of the implementation process that can help promote their success?*

Methods

Public Health Ontario (PHO) Library Services searched MEDLINE, Embase, CINAHL, PsycInfo, Health Policy Reference Center, and Scopus. Search strategies were peer-reviewed by members of the Library Services team. All searches were limited to papers published 2013 and later, in English and research involving human subjects within OECD countries only. Primary studies and review-level evidence were included, while commentaries, editorials, books, and conference proceedings, were excluded. Terms for diabetic foot and other diabetes complications were excluded. Search strategies are available upon request.

Search results from all databases were combined by PHO Library Services and duplicates were removed, leaving 1,816 results to screen. The PRISMA flow diagram is available upon request from PHO. Results were screened at title and abstract level against relevant criteria by two reviewers who each independently screened the same 20% of results, reaching agreement on any conflicting reviews by consensus. The remaining set was screened independently by one reviewer. All potentially relevant papers were retrieved and screened against the same criteria. Full text screening of the 339 articles that met initial criteria was completed by two reviewers. For inclusion, papers needed to: include outcomes specific to implementation, focus on diabetes prevention (not management), be a relevant study type (review or primary study), include implementation outcomes, and focus on a program delivered in the community (includes YMCA, community centers, churches, schools, workplaces, etc.). Screening at the full document level was validated by the lead reviewer and any questions reconciled for a final decision.

In order to capture community-driven initiatives and evaluations, studies using participatory research were included. Quality assessment (QA) was completed on all studies using corresponding QA tools based on study design. None of the studies were excluded based on quality. Reviews were assessed

using the Health Evidence Tool;²² randomized controlled trials, cluster trials, evaluations, and case studies using Joanna Briggs Institute (JBI) tools;^{23,24} implementation studies were assessed using pre-post-intervention tool;²⁵ and qualitative, mixed methods studies were assessed using the ASSESS²⁶ tool. Considerations that result from study designs and methodological quality are incorporated into the findings section that follows.²⁶

To inform our data extraction characteristics, we reviewed, adapted and applied frameworks related to implementation,¹⁹ equity considerations and methods.^{27,28} Elements that addressed implementation, regardless of the authors linking them to implementation theory were extracted. CFIR was used to guide our analysis of factors specific to community implementation of T2D prevention initiatives. Data were extracted based on CFIR constructs even if the study itself was not informed by CFIR. We report on four of the five CFIR domains: the inner setting, the outer setting, the implementation process, and the innovation itself. Review of individual level facilitators is captured in a related product: [Participant Facilitators and Barriers to Diabetes Prevention and Treatment Programs and Self-Management Strategies](#).²⁹

Main Findings

Study characteristics

A total of 28 papers on the topic of community-delivered diabetes prevention services were included for data extraction and synthesized. Of the 28 studies included, 26 were primary and two were review-level evidence. Within the primary studies, we identified (not mutually exclusive) nine evaluations, four implementation studies, four randomized controlled trial's, two case studies, two qualitative studies, two mixed methods studies, and one cluster-randomized controlled trial.

Implementation theories, models and frameworks

Implementation science relies on a number of validated and reliable theoretical models and frameworks. The most common implementation theories, models and frameworks (TMFs) cited within the included literature describing community delivered T2D interventions included Reach, Effectiveness-Adoption, Implementation, Measure (RE-AIM), CFIR and Community Based Participatory Research (CBPR). RE-AIM³⁰ is a common implementation theory that is used to underpin and justify a program implementation plan, design and evaluation. CBPR is an approach to conducting research that involves working collaboratively with those affected by an issue and who will be the end-users or beneficiaries of the research project.³¹⁻³³ Less frequently cited but still worth noting are implementation theories: Knowledge to Action (K2A);³⁴ Penetration, Implementation, Participation, and Effectiveness (PIPE)³⁵ and implementation salvage strategies framework³⁶.

CFIR is a commonly-cited implementation framework that provides guidance for implementation of complex interventions (or innovations).¹⁹ The inner setting domain is the setting in which *the innovation* is implemented and consists of 11 constructs (and 10 sub-constructs) which include: structural characteristics, relational connections, communications, culture, tension for change, compatibility, relative priority, incentive systems, mission alignment, available resources, access to knowledge and information. These constructs can be further broken down into multiple levels depending on the group (size and type) being studied.^{19,37} In this review, the inner setting refers to where the program is delivered in the community (community centers, faith-based settings (centers / churches), workplaces and schools). The outer setting refers to the context (or multiple contexts) in which a program is being implemented. The updated CFIR outer setting incorporates constructs to capture potential influencers

such as sociocultural values and beliefs, and, political or technological conditions (local conditions). The seven characteristics (and two sub-constructs) of the outer setting include: critical incidents, local attitudes, local conditions, partnerships and connections, policies and laws, financing, external pressure (social and market).^{18,19} The innovation represents the program being implemented. For the purpose of this synthesis, the innovation refers to a diabetes prevention program being delivered.

CFIR distinguishes between the program being implemented, and the process of implementation of the program. Features of programs that can be considered to support successful implementation include: the innovation source, evidence base, relative advantage of the program over others in terms of achieving implementation outcomes, adaptability, trialability, complexity, design, and cost. For more detailed information about the CFIR domains and constructs: [Review of “The updated Consolidated Framework for Implementation Research based on user feedback”](#).²⁰ The findings that follow are organized by setting but will be described according to the core domains of CFIR: the outer setting, the inner setting, the implementation process, and the innovation itself.^{18,19}

Community Settings

Within the broad umbrella of ‘community settings’, findings are organized by the context which the program is implemented: faith-based, workplace, schools, community centers, etc. The order in which findings are organized does not reflect importance or robustness. Some domains and constructs of CFIR were addressed more frequently and in more detail than others, which is reflected in the findings.

FAITH-BASED

Five interventions were faith-based programs in the US, with a focus on congregation members (West African,³⁸ African American,³⁸⁻⁴² Caribbean,⁴² and Latin American populations⁴¹). All faith-based programs were adapted from existing diabetes prevention programs in other settings such as primary care. For example, the Fit Fab and Fabulous (FFF) program, designed to reach urban and under-resourced African Americans was adapted culturally and linguistically for Latin American and Spanish speaking population in partnership with local clergy members and educators.³⁸

The intervention specific characteristics reported included: complexity of the innovation⁴¹ and sustained effectiveness^{39,42} of the intervention. Faith-based T2D prevention programs describe similar participatory based approaches^{38,39,42} and clinical and implementation^{40,41} outcomes (adoption,³⁹ reach,⁴⁰ and sustainability^{39,41,42}). In addition to CBPR, CFIR and RE-AIM were used by some researchers to inform design and reporting of implementation studies.^{40,41}

Inner and outer setting

The faith-based programs ranged in size and location across the US, addressing exercise,^{38,39,41} weight loss / maintenance,^{39,40} healthy eating³⁸ and diet. Implementation of faith-based Diabetes Prevention Programs (DPPs) were focused in the US and experienced similar outer setting pressures such as cost and accessibility. One program described as "low cost" indicated an average of \$60 per participant for the entire 12 week program (\$12 per class).³⁸

Within the inner setting, lack of time, competing church activities, and low intervention attendance have been reported as reasons for not participating.⁴⁰ For the most part, the inner setting in faith-based locations acted as facilitator to program success due to shared culture and strong relationships / connectedness to the faith community. Characteristics of the environment, such as infrastructure and resources, varies between faith-based settings and should therefore be adjusted based on the specific

structural determinants. Aside from individual level factors, the biggest motivator for participants was having access to exercise facilities.³⁸

Implementation process

Challenges related to complexity of the implementation process (including organizational size) and engaging participants at all levels of faith organizations (from faith-based leaders to community members) are reported.⁴¹ Larger organizations tend to have more resources (educators, instructors, etc.) to support implementation.

The innovation

Programs demonstrated good applicability on the dimensions of reach and adoption, providing generalizable lessons for the translation of evidence-based weight loss and maintenance interventions into community settings that host 'African American populations of faith'.⁴⁰ Faith-based settings also provide opportunity to reinforce program recommendations through health messaging in sermons and signage and changes to organizational food policies.³⁸ Successful strategies included support of the church community to achieve goals related to nutrition and physical activity, combining religious teachings and spirituality with educational curriculum³⁸ guided by culturally appropriate and relevant resources to support sustained changes.⁴²

Reported barriers included intervention and training complexity, competing church activities, lack of support from family / friends and lack of time.^{38,41} Further research is needed to better understand how to tailor diabetes prevention activities to population groups.³⁸ Faith-based programs demonstrate the extent to which culturally adapting approaches and content to the intended audience can significantly impact the reliability and appropriateness of the intervention.^{39,42} Faith-based programs tailored to participant needs and characteristics such as, income,³⁸ culture,^{39,42} or religion/faith^{40,41} demonstrate promise in reaching and engaging participants that are closely involved in faith-based communities.

Participatory approaches

In line with **participatory approaches** reflected across the literature, interventions were designed using engagement with researchers, representatives working groups, faith-based leaders, local public and private institutes⁴¹ and community committees³⁸ (composed of pastors, community members, health professionals, program staff, and evaluators). Learnings from the engagement process suggest that the reality of training peer educators and engaging leadership within their organizations was often more difficult than anticipated, despite initial commitments from all parties.⁴¹

Sustainability

A unique feature of faith-based programs is their intentional considerations for sustainability of health outcomes and/or program delivery.^{39,41,42} Findings reinforce the need for researchers to conceptualize research projects to include sustainability beyond a funding period. Faith-based weight loss programs affect short term weight loss among participants; however, longer term knowledge and maintenance of weight loss emerged as barriers to be overcome in future efforts.³⁹ To improve program effects and address potential decline in participation over time, transition protocols and post-intervention plans should be established at the intervention design stage to ensure maximum participation after the intervention study period has ended.⁴² The 'Pathway to Weight Maintenance' intervention implemented following the 'Fit, Body and Soul' identified barriers to sustained impact of the innovation as lack of support staff and focus on short term goals only.³⁹ Further research is warranted to establish methods

to facilitate ongoing support in combination with contextual and social factors (including pastoral support, social support from the church, etc.).³⁹

WORKPLACE

Three evaluations of workplace interventions⁴³⁻⁴⁵ aimed to reduce the risk of T2D among employees were identified, along with one qualitative review⁴⁶ of the development, implementation and evaluation of interventions to reduce workplace sitting. The evaluations looked at DPP translation to worksites and targeted diet and/or exercise (e.g., reduced sitting time).⁴⁶ The goals of the programs included reduced sitting⁴⁶ and weight loss.⁴³⁻⁴⁶ The interventions are representative of a number of jurisdictions (Canada, US, Australia, etc.)⁴⁶ with majority being implemented in the US.⁴³⁻⁴⁵ Workplace programs specifically target adults (between the ages of 18-65), are often geared towards professions that entail sedentary behaviour or minimal physical activity and target weight loss or weight maintenance.⁴³⁻⁴⁵ More females participated in the T2D prevention programs with the exception of one worksite which predominantly employed males.⁴⁴

A review of workplace T2D prevention programs cited implementation and other TMFs such as Social Ecological Model (SEM),⁴⁷ focus theory, Social Cognitive Theory (SCT),⁴⁸ Diffusion of Innovations Theory,⁴⁹ Goal-Setting Theory,⁵⁰ Theory of Planned Behaviour (TPB),⁵¹ COM-B model⁵² (using the Behaviour Change Wheel and Theoretical Domains Framework⁵³), Self-Regulation Theory⁵⁴ and Self-Determination Theory⁵⁵

Implementation process

The three primary workplace studies were evaluated using RE-AIM.⁴³⁻⁴⁵ Elements of CFIR that were described in the workplace implementation literature included innovation source and evidence base, and innovation deliverers (trained health professionals, occupational health nurses, health coaches, etc.). The reporting of implementation elements of design, complexity, trialability, adaptability, tailoring to workplace setting, and evaluating were consistent at a high level across the included evidence. While these characteristics are not described in great detail, authors allude to how CFIR constructs were considered in implementation and evaluation of workplace DPPs and how it is important to understand local and organizational processes and structures that may be important in terms of intervention implementation. For example, a barrier to implementation identified in the physical work environment was limited opportunities to sit less due to nature of work or workload.⁴⁶ Other barriers and facilitators that contributed to non-participation described in the literature were mainly identified at the individual level.⁴⁵

Facilitators for program uptake and success of implementation and clinical outcomes include accessibility and convenience of workplace interventions as well as economic support of providing the program free of cost.⁴⁵ One of the workplace evaluations included an economic assessment to understand the cost required to run or maintain workplace programming.⁴⁴ A review of workplace interventions found that none of the studies reported formal cost-effectiveness data (or a measure of intervention cost) to allow an assessment of return on investment.⁴⁶ This information could be a facilitator to intervention uptake and therefore an important outcome to evaluate.⁴⁶ Interventions are often described as low-cost but are reported without quantitative cost data, if cost is mentioned at all.

The innovation

Worksite diabetes prevention programs demonstrated success at being translated/adopted to a new context and reaching intended populations (adults between the ages of 18-65).⁴⁴ Worksite implementation of T2D prevention programs aimed at improving reach identified barriers at the

individual level (lack of participation, interest, motivation), whereas facilitators were related to accessibility and cost of the program.⁴⁵ Bringing the program to the individual (e.g., accessible 'when convenient'/at work) was the key benefit of workplace interventions. The programs are successful in reaching the intended population; however, some programs had limited success in engaging this population, mostly due to individual level barriers such as motivation.⁴⁴

The collection of workplace DPP interventions that were evaluated reiterate similar messages. Workplace translations of DPP based on well-established and effective programs demonstrate success in reaching populations of interest and achieving target goals. Quantitative^{43,45} and qualitative^{44,46} evaluation results suggest effective clinical impacts (weight loss outcomes) in addition to achieving goals of reach,⁴³⁻⁴⁵ adoption⁴⁵ and maintenance (sustainability).^{44,45} Participant engagement with the intervention varied with some programs being facilitated by health care or nurse practitioners (e.g., coaching sessions) while others relied on self-motivated engagement.

Participatory approaches

There is recognition that participatory and collaborative research approaches are important for ensuring acceptability and feasibility⁴⁶ however none of the workplace DPPs outlined their process for engagement or collaboration with leadership or partners (e.g., staff) in design, planning or tailoring of the interventions. Participatory approaches, tailoring, and engagement are suggested to support overcoming anticipated barriers.⁴⁶ Findings highlighted the importance of identifying and understanding local barriers and facilitators to intervention participation, ideally during the development phase.⁴⁶

Sustainability

While maintenance / sustainability is identified as a key outcome of RE-AIM, none of the programs were sustained or identified the facilitators or barriers for sustaining program engagement or implementation in their evaluations. For example, the 'Fuel Your Life' DPP had fewer than half (43%) of the participants report continuing the program after the first 6 months with even less in the final data collection activities at 12 months (31%).⁴⁴ Within this setting, sustainability of program implementation and uptake was assessed as an outcome but not addressed.⁴³⁻⁴⁵ Longer follow-up periods (beyond 6-12 months) would provide insights for sustaining program uptake and engagement.

SCHOOL

Two programs offered in school-based locations for school aged youth (between 7-18 years of age) represent populations from US and Canada.⁵⁶⁻⁵⁸ Prevention programs in school settings were educational, and aimed to address nutritional⁵⁷ and health education^{56,58} among students. Program evaluations aimed to assess adoption,⁵⁶ fidelity^{57,58} and cultural appropriateness⁵⁸ in addition to measuring effectiveness.

Outer and inner setting

Contextual factors relevant to Canada and the US (the outer setting) are mentioned at high level, including costs of diabetes prevention, and access to diabetes information and resources. Within the inner setting of schools, programs are a key point of access for delivering T2D prevention services to youth in an effort to combat early onset T2D. Barriers to program implementation identified within the school setting included lack of administrative support, and working within existing and inflexible school structure and schedules (structure characteristics and infrastructure). A unique feature of school programs was the importance of parental education and involvement in program facilitation (for example, implementing healthy eating habits and recipes at home).⁵⁸ The complexity of a program made

it more challenging to implement and the program was not necessarily the top priority of the schools participating (i.e., resource constraints, other priority areas, existing physical activity programs).

The innovation

The published evidence demonstrates that by adapting diabetes prevention programs in school settings, success in improving target clinical outcomes, while also addressing other elements like reach or cultural relevancy, can be achieved simultaneously. Even greater success might be seen when program structures and materials go so far as to tailor to a population (physical needs, culturally relevant, etc.), as demonstrated in the Kahnawake Schools Diabetes Prevention Project (KSDPP).^{56,58} Motivated by the importance of T2D prevention in youth, T2D programs in schools might target: physical activity through recreational and sport participation, modifications or improvements to the school food environment through food programs, food education, and so on. The HEALTHY nutrition intervention to modify the school food environment (a large scale multi-centre intervention delivered over five semesters) demonstrates implementation of a complex program with high-fidelity.⁵⁷ The findings of this process evaluation highlight the potential for implementation to inform future efforts in adapting and scaling complex programs to multiple settings.⁵⁷

Participatory approaches

The benefits of a participatory research approach to design and implementation are reinforced across the literature within the school setting. Engagement through participatory approaches was noted as a core element and key facilitator for the design and implementation of both school programs. In Canada, an Indigenous health curriculum for diabetes prevention engages community through talking circles and promotes healthy eating and active lifestyle by increasing knowledge on diabetes and changing the physical environmental and social norms.⁵⁸ This program created a steering committee of community partners and researchers to inform adaption and tailoring of program materials and resources.⁵⁶⁻⁵⁸ Involving end users (teachers, administrators, and parents) throughout design and implementation of *the innovation* helped to maximize appropriateness and likelihood of implementation. Establishment of ongoing working relationships, trust and commitment was noted as a facilitator in delivering the KSDPP.^{56,58} Securing the appropriate partners for the policy committee was key in the policy development process.^{56,58} Strengths of the implemented program included cultural appropriateness, mutual education and shared learning, and providing an example in an Indigenous school district, all of which contribute to enhancing the capacity for future projects. The local relevance of the KSDPP and emphasis on Indigenous ways of knowing provides a strong example of a successful collaborative approach to designing and implementing programs and policies. For example, using photovoice as a method of data collection to involve community members in shaping policy puts the emphasis on community perspectives and action.⁵⁶ In this case, the collaboration between academic researchers and local partners led to the creation of a sound policy that is evidence-based and contextually appropriate using a participatory approach.⁵⁶

Sustainability

The Kahnawake Schools Diabetes Prevention Project (implemented an Indigenous health curriculum for diabetes prevention) used feedback strategies to address program improvements to support sustainability.⁵⁸ Results of the program evaluation suggest that longstanding relationships to support collaboration and establish programming within the community was a key strength of the KSDPP project.^{56,58}

COMMUNITY CENTERS

Remaining community locations are organized within the “community centers” section of this brief. Of the included studies, 15 primary studies and one review³⁵ identified T2D prevention programs being delivered in a range of community locations. Locations included YMCA,⁵⁹⁻⁶¹ community centers / sites,⁶² public housing communities,⁶³ Veterans Affairs (VA),⁶⁴ Indigenous communities (in Canada, US, Australia),⁶⁵⁻⁶⁷ and in other community locations (summer camps, parks, etc.).^{34,36,68-70}

A number of implementation theories were borrowed to inform design and evaluation of community delivered T2D programs. Community partnership model,⁵⁹ patient centered approach,⁷¹ participatory research approach,^{63,65-70} RE-AIM,^{61,62,64} CFIR^{60,64}, K2A,³⁴ Salvage Strategies Implementation framework³⁶ and PIPE³⁵ framework. While the theory or evidence base underpinning implementation differed across the evidence, there remained similarities in how the evidence base is used to guide decisions, adjustments and adaptations made.

Outer and inner setting

Programs were delivered in communities in the US,^{34,59,61,63,64,67-71} Canada^{60,62,65} and Australia^{36,66} thereby encountering and identifying unique challenges in the outer setting. Broad elements of the outer setting (local policies, laws, critical incidents, external pressures, etc.) are not described in relevant detail. Majority of programs implemented for evaluation were adapted from the National DPP designed for clinical settings.^{34-36,59,61-64,68,69} The innovation implemented in each program is similar with a clinical target of weight loss reduction / maintenance, healthy eating, etc. The inner settings varied in terms of culture, structural characteristics (available resources), readiness for implementation, and so on. Studies that assessed these measures in design or evaluation were able to adapt or tailor as needed to the characteristics of context that might act as barriers or facilitators to achieving implementation outcomes. The implementation processes developed by researchers was unique to each study. Implementation outcomes assessed within this subset of the published literature include reach,^{35,62,64,71} fidelity,^{35,63,64,68} adoption,^{34,62-64} scale up,^{34,59} readiness,⁶⁶ adaptability,^{65,66} feasibility,^{35,61,63,68,69} appropriateness,⁶⁶ acceptability,^{60,61,66,68,69} maintenance,^{62,64} cost,⁶⁴ sustainability,^{34,35,59,60,62,65-67} in addition to clinical outcomes to measure effectiveness. Programs in the literature intended to reach: youth,^{61,65} Indigenous,⁶⁵⁻⁶⁷ African American,^{68,70} Korean⁶⁹, aged 50 and over,³⁶ in addition to those identified as “pre-diabetic”^{34,62,64,71} or “high risk”^{36,60,61,64,68,69} (obese, overweight).

The innovation

T2D prevention programs delivered in the community should be designed to reflect the needs, strengths, and perspectives of populations within that setting. Nuances exist with regards to tailoring program design and content based the population the intervention is aiming to reach. Interventions designed for African American and Korean American⁶⁹ populations reinforce how adaptations, such as integrating cultural values and creating bilingual material⁶⁹ can enhance program implementation. Some of the more complex interventions, such as the Sandy Lake Health and Diabetes Project (SLHDP) provide a locally relevant example of community-wide interventions and activities to encourage engagement in physical activity and the promotion of healthy lifestyles for a population, including: a Northern Food Store program, a home visit program, a diabetes radio show, a school diabetes curriculum, a community-wide walking trail, and a youth diabetes summer camp.⁶⁵ Innovation characteristics that were noted as facilitators include performance feedback to providers,^{59,62} short and long term behaviour goals for participants.^{63,66,70} Tailoring was consistently noted to strengthen program success along with planning (assessing needs and context), reflecting and evaluating. Recommendations from the literature to facilitate program success include: professional development and training for program deliverers (to improve responsiveness and reliability).⁶⁴

Other recommendations for designing and implementing programs include increasing incentives,^{68,69} maintaining contact with participants between sessions,^{35,68} stronger partnerships and outreach,⁶⁹ integrating technology to reduce cost and access barriers,⁷¹ partnership with communities⁶⁵ and leadership to support promotion.^{63,67}

Participatory approaches

Some of the studies leveraged a participatory or collaborative approach in their design and implementation and evaluation.^{63,65-70} The programs designed and implemented for Indigenous populations in Canada,⁶⁵ US,⁶⁷ and Australia⁶⁶ relied on community based approaches to create appropriate and relevant programs and resources to support implementation and ongoing maintenance of T2D prevention programs. Findings of the adaptation of a youth DPP for Aboriginal children in Central Australia emphasize the importance of acknowledging the environmental and social context of the community while implementing the adapted program which is tailored to community needs.⁶⁶ Based on engagement and feedback from participants, ‘town camps’ were designated as the intervention as opposed to schools and health care settings to increase inclusivity and appropriateness.⁶⁶ T2D prevention interventions designed with participatory strategies, are family-focused, culturally appropriate and are embedded in long standing and trusting relationships between partners demonstrated success in multiple population groups.^{66,69} Program success was attributed to program engagement, largely due to community participation and ownership.⁶⁵ Authors reinforce a strengths based approach to partnerships with participating communities and to center Aboriginal world views and suitable evaluation frameworks prior to implementing the prevention program.⁶⁶ The collaborative planning processes, program components and structure, level of support, and synergy between program and context were important factors in the implementation.⁶⁰

Sustainability

Implementation efforts focusing on sustainability for the purpose of maintaining program delivery and participant involvement long term show promise based on findings. Evaluation feedback loops (including input from users) are noted to be a crucial strategy that helped the National DPP intervention achieve scale and be adopted across the health system, including community settings.³⁴ Similar feedback strategies were used by Dineen et al. 2022 to improve program elements throughout or following implementation.⁶⁰

Limitations

We did not search for community programs or initiatives specifically within our search strategy but rather included all T2D prevention programs and initiatives at population level and organized them by the setting which implementation took place (primary care, virtually, community, etc.). Since we limited our search to “diabetes” specific programs, we potentially missed programs designed to address co-morbidities of diabetes (e.g., obesity), and other important determinants of diabetes (e.g., physical activity).

We relied on authors explicitly stating their theoretical lens or methodology; therefore, we may have missed articles that used implementation theories, models and frameworks (TMFs) without naming them as such. A large subset of the evidence was informed by TMFs that were outside the scope of implementation science and were therefore excluded from synthesis, but, could be leveraged to inform design, implementation and reporting. While evidence-informed implementation approaches likely demonstrate similar success, only studies informed by implementation TMFs were within scope of this review. Well established and trusted theoretical approaches within the excluded evidence include

behaviour change, social cognitive theory, chronic care model, and health promotion models and could be informative for program design and implementation planning at the community level. By including published literature only, we have potentially missed community initiatives and other programs that have not been formally evaluated or published. In addition, by only including studies that used implementation TMFs, we have potentially excluded a subset of literature that provides valuable and applicable learnings related to implementation of diabetes prevention programs.

The implementation outcomes of interest, measures, methods and level of detail reported in implementation studies that met our criteria varied significantly. While all studies borrowed from the implementation science, the approaches used to inform program design, implementation and reporting varied. Characteristics of CFIR were reported comprehensively in some studies and only at high level in others.

Majority of the T2D prevention programs implemented in community settings were adapted from the DPP.⁷² The DPP is an example of a highly successful lifestyle intervention administered to over 1,000 participants in clinical settings, including 45% racialized populations and resulted in a 58% reduction in the incidence rate of diabetes.⁷² While this is a strong evidence base, it only represents one approach to designing and implementing diabetes prevention interventions.

There is limited cost-effectiveness data to highlight the benefit (or costs) of community delivered T2D programming over clinic or hospital delivered diabetes prevention, contributing to the ongoing challenges for funding. Some of the community T2D prevention interventions are described as 'low cost' however detail related to their cost to develop, implement and maintain are not reported. Furthermore, there are even fewer examples to draw from to inform cost considerations and assessment in the Canadian context.

Discussion and Conclusions

Effectiveness of T2D prevention is well proven and translation to community settings is supported (e.g., DPP)⁷³, whereas the elements of implementation that impact success or failure of programs are not as well understood or documented. Implementation informed studies provide opportunities to utilize implementation research methodology to examine the process of implementing an evidence-based diabetes prevention program in the real world.³⁶ By using implementation TMFs to guide design and reporting, clear alignment between efforts and outcomes can be understood, evaluated and improved. By reporting based on guidance and standards reinforced by the implementation evidence base, researchers and implementers can build on the available evidence base. Building on the current evidence base means adapting, expanding and sustaining new and existing diabetes prevention programs. While it is not necessary for all implementation studies to address or measure all outcomes and factors that could impact the implementation, it is important to approach it with intention and thoughtfulness. There are tools available to support implementation efforts such as the Guide to CFIR,⁷⁴ Context Compass Framework⁷⁵ and EQUIP Equity Action Kit⁷⁶. Implementation researchers continue to advance and expand equity considerations through the recently developed intersectionality supplemented CFIR tools for intersectionality considerations.⁷⁷

It is important to recognize, address, and leverage *implementation process* and contextual factors (inner and outer setting) that contribute to the success of T2D prevention programs. Similar to what is found with virtual T2D prevention,¹¹ programs are often successful in reaching the intended population; however, have limited success in engaging the population.⁴⁴ Being able to implement programs on a large scale (reach), to populations that need it most (adoption, adaption) and over a long period of time (sustainability), requires a nuanced understanding of the factors and mechanisms that influence how

these programs are implemented in real world scenarios. By unpacking and understanding the diverse and complex factors that can hinder or help implementation of programs across settings, researchers and practitioners can systematically build on these lessons learned to optimize their efforts and improve value for money. Qualitative data supports the meaningful improvements in reach and appropriateness, achieved when T2D programs are delivered in the community while maintaining known clinical effectiveness in addressing health outcomes.

From a burden of disease perspective, diabetes is a substantial pressure on our economy and health system.⁷⁸ Diabetes prevention is an important area of chronic disease prevention that can be adapted to the community setting, which is important for addressing gaps in services for communities facing marginalization. Community led programming provides opportunity for tailored and accessible program delivery from a trusted source, including the community itself. A review of T2D prevention studies highlighted participatory approaches, community consultation and leadership engagement were all elements of implementation planning that correlated with improved design and program success.⁴⁶ Engaging populations and designing culturally responsive programming involves recognizing populations as experts in their own experience and what is meaningful and relevant to them.^{79,80}

The current structure of the health-care system often fails to address the ongoing impacts of the social and structural determinants of health, including colonialism and racism.^{79,81} Similarly, the impacts of T2D prevention programs will be limited if structural and deeply rooted barriers are not addressed in the how T2D prevention policies and programming is implemented. Intentional efforts to consider and incorporate equity, anti-racism, and anti-oppression in research and implementation are foundational for providing culturally safe programming.⁷⁹

In order to sustain program effects and uptake, long term planning of how to maintain programs through funding (space, materials and equipment, partnerships) beyond grants and trials is recommended to be integrated as early as program planning.³⁹ We identified evidence about sustainability across programs and settings, likely due to the guidance of the RE-AIM framework which was used frequently across the literature. While sustainability was not considered or measured in all of the community settings synthesized in this review, some of the lessons about sustaining program implementation and impact are transferrable across settings. In terms of sustaining intervention goals (e.g., maintaining weight loss) important themes included: support staff/consistent support, personal support systems, community support, emphasis on short and long term goals, provision of tools and evidence-based information; importance of partnerships with community resources such as recreational centers for low-cost and comfortable facilities to exercise.³⁹ Sustained impact requires continuous support for program staff (training, resources, etc.) and participants (in providing community resources) to support the lifestyle behaviour changes.^{39,42} Technology could aid in achieving intervention goals and maintaining those goals beyond the conclusion of the study (i.e., weight loss and maintenance) however authors caution against intervention delivery by mobile applications and suggest that effective interventions may require efficiency of mobile technology combined with social support and human interaction (i.e., personal coaching).³⁹ This was reinforced in the [Evidence Brief: Implementation Factors for Virtual Delivery of Type 2 Diabetes Prevention](#).¹¹

The evidence available and synthesized here, despite approaching and reporting implementation characteristics inconsistently, serves as a good foundation for continued research, design and implementation efforts. While this review includes a substantial amount of high level detail about the use of CFIR and other implementation TMFs, there are other important resources included in this review that are specific to the community setting of interest. We argue that it is necessary to report in this level

of detail to reiterate the importance of evidence-based and community-based research to inform implementation process design and planning.

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