Improving diabetes prevention and management amidst varied resources: from local implementation to global learnings

Over the past decade, diabetes prevalence has risen even more rapidly in low- and middle-income countries (LMICs) than in high-income countries (HICs). Globally, diabetes was the seventh leading cause of death in 2016 [1]. It is estimated that four out of five people with diabetes now live in LMICs and the top two LMICs with the largest number of people with Type 2 diabetes are China (114 million) and India (72.9 million) [2]. In addition, 43% of all deaths attributable to diabetes occur prematurely before the age of 70 years, with the majority of them occurring in LMICs.

Diabetes and its complications contribute to a significant economic loss to people with diabetes, their families, health systems, and national economies. It is estimated that the global losses in GDP due to diabetes during 2011–2030, including both the direct and indirect costs, total more than US\$1.7 trillion, comprising US\$900 billion for HICs and US\$800 billion for LMICs [3]. With a growing burden of Type 2 Diabetes in LMICs, these costs will continue to increase in the coming decades.

A significant proportion of Type 2 diabetes results from long-term, modifiable lifestyle and behavioral factors; these and other sociobehavioral factors related to long-term management are also important determinants of outcomes for those with diabetes. These factors can be substantially addressed using multifaceted approaches at population and individual levels. Many studies have now demonstrated effective diabetes control through a combination of diet and physical activity interventions [4,5]. Compelling evidence also suggests that the prevention of diabetes should take a life-course approach that integrates healthy eating habits and physical activity early in life [1].

Awareness of diabetes status and treatment coverage is very low in LMICs. More than half of the people with diabetes are not aware of their diabetes status [2] and only half of those who know their status are receiving treatment [6,7]. If left uncontrolled, diabetes can damage the heart, blood vessels, eyes, kidneys, and nerves and increase the risk of heart disease and stroke. A comprehensive cardiovascular disease risk approach that enables integrated management of hypertension, diabetes, and

other cardiovascular risk factors in primary care settings is also very important [8].

The increase in the prevalence of diabetes along with its confluence with other chronic diseases in many populations is leading to changes in the spectrum of the types of associated morbidities and causes of death [9]. The presence of shared risk factors is one of the reasons for the resulting multimorbidity. Addressing the complexities of chronic conditions requires a whole-of-government and whole-of-society approach with effective roles played by sectors beyond health. Yet, little is known about how to achieve this, particularly in LMICs [10]. To address this very significant implementation gap, real-world implementation research that engages a range of stakeholders across all stages of evidence development, implementation, and scale-up is required. But there is, currently, a very modest evidence base to inform this approach in LMICs.

Most of the evidence on the effectiveness of lifestyle and other kinds of interventions for diabetes prevention and control has emanated from HICs, although this is beginning to change in LMICs [11]. However, more evidence on cultural adaptation, implementation, and scale-up in LMICs to improve diabetes and related outcomes is a high priority. Three key questions related to this continuum include: what to adapt or scale-up, how to adapt or scale up, and how to evaluate the adaptation or scale-up. While there are many interventions or programs that have been developed and well researched in HICs, their adaptation to the LMICs context has been limited. In addition, interventions that have been developed and tested in some LMICs have significant potential for adaptation and/or scale-up in other LMICs.

A lot of recent research has demonstrated the importance of adaptation of interventions to improve fit to the local context, and there are also important theories, models, and frameworks that can be applied to improve diabetes and associated outcomes in LMICs. These include “Self-Management Approach and Reciprocal learning for Type 2 Diabetes” (SMART2D) [12], Consolidated Framework for Implementation Research (CFIR) [13], the Theoretical Domains Framework (TDF) [14], Normalization Process Theory (NPT) [15], and

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Glasgow's RE-AIM model [16], just to name a few. A theory-driven approach was used for the cultural adaptation of a diabetes lifestyle intervention for Latinas [17]. The Community-Based Participatory Research (CBPR) framework has also been widely used [18]. A multilevel layered framework of contextual factors at the individual, family, community, health care setting, local/district, and national levels has also been used in the assessment of context for adaptation and scale-up [19].

It is also very important to systematically evaluate and document the processes involved in the adaptation and scale-up of diabetes prevention and management interventions in order to develop generalizable global learnings. Particularly, the evaluation of adaptation or scale-up of efficacy-proven interventions needs to address two key components, namely: (a) the quality and fidelity of the adaptation or scaling-up process and (b) the outcomes and impacts of the adapted or scaled-up interventions. Glasgow's RE-AIM framework has been widely used to evaluate the individual and organizational factors affecting the implementation of public health programs [20]. This framework can also be used at the program design phase to help guide the planning of the program to ensure the adoption, successful implementation, and evaluation of diabetes prevention and management interventions [21]. The Penetration, Implementation, Participation and Effectiveness (PIPE) impact metric is also a useful tool in the evaluation of adaptation and/or scale-up of diabetes prevention and management interventions in LMICs. A critical element in the adaptation of interventions is maintaining the right balance between adapting the intervention to the local context while retaining core elements of intervention fidelity. In this regard, the RE-AIM framework and PIPE impact metric are among the commonly used frameworks for evaluation of adaptation and implementation of prevention interventions.

In light of these above issues and challenges, the focus of this special section—Adaptation and implementation of diabetes prevention and management in five international settings with varied resources: local implementation to global learnings—addresses the urgent need for more evidence on implementation and scale-up of approaches to improve diabetes and associated outcomes in LMICs. This special section of *Translational Behavioral Medicine* presents five landmark studies that report on the adaptation and transfer of evidence-based strategies from HICs to LMICs. They also present and discuss key lessons derived from undertaking situational analyses, contextual translation, implementation, and evaluation of the interventions.

Ranjana et al. present implementation evaluation findings from a scale-up of the Kerala Diabetes Prevention Program (K-DPP) in Kerala, India. K-DPP, a peer-led, structure lifestyle intervention

for diabetes prevention, adapted from HICs, has been previously shown to be effective, feasible, and acceptable in changing lifestyle behaviors among adults at high risk of diabetes [22,23]. This manuscript describes the scale-up of K-DPP to deliver and reach an estimated 375,000 people over 12 months, with the involvement of more than 15,000 peer leaders. Despite some shortcomings, the study findings demonstrate that the approach to the scale-up of K-DPP was quite effective in reaching a large number of households in Kerala and, preliminary results, are suggestive of some beneficial behavioral and clinical outcomes after 1 year.

Liu et al. present a case study on the development, initial evaluation, and community expansion of peer support intervention for people with diabetes in the city of Shanghai, China. Their intervention model integrates primary and specialty care for diabetes. Developed in nine community health centers and later expanded to 12 additional communities, this program shows that peer support interventions are feasible and can add significant value in improving health among people with diabetes in the community in a large, complex urban setting like Shanghai. The approach has been recognized by the Shanghai Government and included as a key strategy for achieving self-management of chronic disease in its 2030 health goals.

Absetz et al. describe the implementation and evaluation of a lifestyle and self-management intervention for participants recently diagnosed with or being at high risk for Type 2 diabetes in rural communities in Uganda, an urban township in South Africa, and socioeconomically disadvantaged urban communities in Sweden. Using a three-staged approach—situation analysis, intervention design, and contextual translation—they have developed an intervention with shared key functions and a good fit with the local context, needs, and resources. The application of phased, collaborative approach and theoretical framework ensured that key functions were not lost in contextualization. The approach also allows for cross-comparison despite the variability of the intervention across the sites.

Johnson et al. present the lessons learned from the adaptation of behavioral intervention components in a depression-focused chronic disease care model implemented in India. In this study, Johnson et al. use a mixed-methods approach to examine adaptations made to a care-coordinator-led behavioral intervention and how patients respond to the adaptations. The model serves two functions: health promotion communication and patient engagement.

Cately et al. describe the process involved and preliminary findings from the adaptation of a diabetes prevention program for LMICs, the Lifestyle Africa Program. In this novel, study of a cultural adaptation of the U.S. Diabetes Prevention Program, the research team is evaluating an

ongoing community-based cluster-randomized trial in underresourced urban communities in South Africa. The program was designed to be delivered by community health workers (CHWs) through video-assisted sessions and supplemented with text messages.

In her commentary, Dr King highlights recent exciting advances in participatory approaches and how these can be applied to behavioral medicine interventions such as those described in this special section in order to extend their reach and impact. Furthermore, she argues that learnings can also be applied or adapted to many other behavioral health changes and populations in LMICs.

At least four major approaches to diabetes prevention and management are evident from the findings presented in these articles, and each of the studies used one or more of these approaches. First is the role of peer-led groups to improve diabetes and associated outcomes. This approach has the potential to benefit hard-to-reach populations [24]. For example, as it has already been evaluated for scale-up in Kerala, India, the peer support approach for diabetes prevention has great potential for wider scale-up. The findings from the implementation of peer support interventions in Shanghai, China, also support the feasibility and effectiveness of this approach.

Second, for interventions that focus on community-level prevention and management of diabetes, involvement of well-trained CHWs have the potential to increase the community's knowledge about diabetes, improve health behavior, including healthy dietary habits and physical activity, and, in turn, lead to health outcomes related to prevention and management of Type 2 diabetes in LMICs [25]. A systematic review of the effectiveness of community-based programs on diabetes prevention in LMICs has shown that community-based interventions may reduce the incidence rate of Type 2 diabetes and may also positively impact on other clinical and behavioral outcomes [4]. Beyond direct involvement in the delivery of interventions, CHWs can also contribute to diabetes prevention and management by training and mentoring peer leaders. They can also have a role in directly supporting patients in diabetes self-management [26]. The lessons learned from the Lifestyle Africa Program can be cited as examples of this approach.

Third, with the expanding reach and penetration of mobile and internet technology in LMICs, diabetes prevention and management interventions that integrate mHealth could also be adapted and/or scaled up in LMICs. A review of mHealth interventions reported that there is promising but limited evidence on the effectiveness of mHealth interventions for improving glycemic control in LMICs [27–29]. The use of video-assisted sessions and supplemental text messages in the Lifestyle Africa

Program shows the potential benefit of integrating mobile and internet technology into diabetes prevention and management interventions.

Finally, diabetes self-management interventions could also be adopted and/or adapted in LMICs. A case study of programs that applied this model is the SMART2D program that used a cross-contextual reciprocal learning approach in a multisite implementation research project to improve self-management for Type 2 diabetes [30]. This case study presents a Type 2 diabetes self-management support intervention in a multisite implementation trial in Uganda, South Africa, and Sweden.

In addition to the evidence provided by each of these studies on the feasibility and effectiveness of adaptation and implementation of the interventions, there are three key lessons from the programs reported in this special section. The first major lesson is about *multiple priorities and limited resources* in the health system. Adaptation and implementation occur within health systems that often have multiple priorities and competing interests. In this regard, one of the main factors that will likely affect the adaptation and scale-up of diabetes prevention and management interventions is that of constrained resources and lack of well-qualified and trained health workers. To efficiently use the limited resources in addressing multiple priorities in LMICs, evidence of the cost and cost-effectiveness of diabetes prevention and management interventions is also very important.

The second lesson is about the *health system capacity* in LMICs. One of the major challenges in LMICs is the limited capacity of the health system to adapt and/or scale-up diabetes interventions. Prioritizing and sustaining diabetes prevention and management programs against the backdrop of other public health challenges like infectious diseases and maternal and child health programs is a challenge in LMICs. Therefore, high-level advocacy along with health system strengthening interventions is required prior to or as part of adaptation and scale-up of diabetes prevention and management interventions.

The third lesson is the need for documenting *evidence of “spinoff” effects*. Often during or following the implementation of health interventions, there are “spinoff” or “rippling effects” of the interventions. These effects are suggestive of effective adaptation and maintenance of the interventions in the community. Therefore, it is important to document and measure these ripple effects in order to learn more about local adaptations that take place in real-world implementation.

Overall, there are scalable diabetes prevention and management interventions that have been proven to be effective in different settings. The adaptation and implementation of these interventions in LMICs are beginning to yield promising outcomes. The studies reported in this Special Section indicate that context is one of the most

important factors in the adaptation and scale-up of diabetes interventions in LMICs. It influences the design, implementation, and evaluation of diabetes interventions. Context also contributes to effectiveness and implementation outcomes. Hence, in any adaptation and scale-up of diabetes interventions, understanding the context under which interventions are implemented is critical. The articles in this Special Section demonstrate that intensive cultural adaptation of the interventions and continuous engagement with patients and other stakeholders are essential for the success of interventions. However, for larger public health impact in the context of LMICs, further research on adaptation and refinement is needed.

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