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Expanding Diabetes Prevention: Obstacles and Potential Solutions

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INTRODUCTION

Accurately diagnosing prediabetes is critical to refer high-risk individuals for intensive lifestyle modification or pharmacotherapy where appropriate. This perspective briefly reviews the obstacles to detecting prediabetes and broader implementation of diabetes prevention strategies as well as potential solutions (Table 1).

COMPLEXITY OF DEFINING PREDIABETES

There are no optimal methods or international consensus for diagnosing prediabetes, as the definitions proposed by the American Diabetes Association and the WHO differ in their sensitivities and specificities. Therefore, glucose or HbA1c criteria can identify different populations who are at risk for progressing to diabetes.[1,2] For example, as much as a 3-fold difference in the prevalence of prediabetes can occur if the HbA1c criterion is used compared with fasting plasma glucose.[3] In addition, HbA1c values can differ based on age, race, and ethnicity,[4] either overestimating or underestimating the prevalence of prediabetes. Complicating this further are the various caveats affecting the accuracy of interpreting HbA1c, which are not always appreciated by treating physicians.[4,5] Repercussions of the discordance between glucose and HbA1c criteria for diagnosing prediabetes are considerable and therefore need to be addressed. Hence, a substantial need exists for a consensus to establish uniform criteria for diagnosing prediabetes.[6]

Prediabetes consists of 2 abnormalities, impaired fasting glucose, and impaired glucose tolerance, the latter detected by a standardized 75-gram oral glucose tolerance test (OGTT), which is performed infrequently. Those with isolated impaired glucose tolerance or combined impaired fasting glucose and impaired glucose tolerance are at risk for progressing to type 2 diabetes,[7,8] supporting the need for an OGTT with its importance documented in several populations.[9–11]

PREDIABETES IS DIAGNOSED LATE IN THE TRAJECTORY TOWARD TYPE 2 DIABETES

As glucose abnormalities evolve continuously, the use of absolute threshold criteria potentially can hinder the early detection of dysglycemia,[12] thereby inadvertently delaying the diagnosis of prediabetes until relatively late in the lengthy trajectory to diabetes. Therefore, by the time prediabetes has been diagnosed, the benefit of lifestyle modification may be limited as β-cell function already has declined significantly.

Therefore, biomarkers with higher sensitivity are required to detect earlier, subtle changes in glucose intolerance. For example, 1-hour plasma glucose ≥155 mg/dL (8.6 mmol/L) during the OGTT, which has been extensively studied, was found to be more sensitive than HbA1c, fasting plasma glucose, or 2-hour plasma glucose in individuals with normal fasting and 2-hour plasma glucose values, for predicting progression to type 2 diabetes, detecting microvascular and macrovascular complications, and predicting mortality.[13,14] In another study, 1-hour glucose >155 mg/dL (8.6 mmol/L) was found in those with the highest central adiposity, impaired β-cell function, insulin resistance, and cardiovascular profile.[11]

These findings suggest that elevated 1-hour plasma glucose could replace the need for a 2-hour OGTT for detecting prediabetes, making it more useful in clinical practice.

LACK OF PREDIABETES AWARENESS, INTERVENTION PROGRAM ACCESS, AND REFERRAL

The prevention of type 2 diabetes is hampered by the lack of awareness that lifestyle modification is effective,[15]

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Table 1. Obstacles to Diabetes Prevention

Obstacles
Complexity and confusion of defining prediabetes
Prediabetes is diagnosed late in the trajectory towards type 2 diabetes with current criteria
Lack of awareness of prediabetes, access and referral to intervention programs
Lack of long-term sustainability of diabetes prevention interventions
Lack of community-wide, population-based strategies

with sizeable segments of the high-risk population not availing themselves of Diabetes Prevention Program (DPP) translation programs.[16]

Diabetes prevention initiatives must be undertaken and expanded to thwart the rising prevalence of diabetes. Approximately 1 in 3 individuals in the U.S. currently has prediabetes. In 2006, when this figure was 1 in 4,[17] only 4% of the estimated 26% of adults aged ≥20 years with impaired fasting glucose were aware that they had prediabetes and 24% with prediabetes participated in risk-reduction activities. The low awareness level suggests that a large number of individuals with prediabetes have not been tested or diagnosed.[18] Although more than one-quarter of adults likely eligible for a DPP expressed an interest in participating, few are referred, and even fewer participated,[18] highlighting the need to enhance referral efforts.

As interventions to prevent or delay the onset of type 2 diabetes in those with prediabetes are cost-effective, the diagnostic gap represents an opportunity to reduce the burden of diabetes. There must be an increased awareness of prediabetes and encouragement of healthier behaviors for this to occur. Furthermore, the lack of access to health services, although affecting a relative minority, has a significant impact on prediabetes awareness.[19] Even when access is available, primary care physicians often perceive that they adhere to screening guidelines, but in actual practice, referrals to DPP and self-management education programs are limited although most patients receive diet and lifestyle coaching.[20]

Compounding the issue of access is the lack of broader policy support for those that are aware of having prediabetes, as many do not have the means to improve their diets or increase physical activity. The public health sector thus has a considerable role in formulating policies that facilitate lifestyle modification and modify community environments, promoting healthy behaviors.[21] Community-based prevention programs require support by third-party payers[21] as insurance coverage may increase risk-reducing behaviors.[22] As individuals at higher socioeconomic and educational levels may be more aware of and adopt healthy behaviors,[23] policies that promote more significant educational achievement are vital. Wide social disparities need to be addressed for prevention programs to be effective.

Population-based programs designed to increase diabetes risk awareness may reduce type 2 diabetes. Individuals receiving advice from healthcare providers are more aware of having prediabetes and therefore, are more likely to engage in diabetes risk–reducing behaviors.[24] Community-based structured diet and physical activity programs implemented by trained providers are beneficial for type 2 diabetes prevention and cardiometabolic health.[25]

LACK OF LONG-TERM SUSTAINABILITY OF DIABETES PREVENTION INTERVENTIONS

Lifestyle intervention was more effective in the U.S. DPP in those achieving normoglycemia, having greater β-cell functionality, and lower baseline glucose concentrations. Hence, for lifestyle modification to be most efficacious, optimal β-cell function is required. Nonetheless, despite the initial effectiveness of intervention with lifestyle or metformin, most participants developed type 2 diabetes in each treatment group of the DPP 15 years after enrollment. The frequency of progression to type 2 diabetes may have been inversely related to reversion to normoglycemia during the initial intervention. In a commentary on the long-term DPP Observation Study, Misra[26] noted, "Although the Diabetes Prevention Program and its follow-up studies have provided useful information, it is clear that more innovations are needed for more effective and lasting prevention of diabetes." The findings from the U.S. DPP Observation Study are supported by a meta-analysis demonstrating that lifestyle modification interventions were sustained for several years, although their effectiveness dissipated with time.[27] The intensity of the intervention and length of follow-up influenced incidence of diabetes. Higher session attendance and weight loss were associated with more significant reductions in diabetes incidence. Decreased reductions in diabetes incidence were observed in studies with longer follow-up. Future research needs to explore maintenance approaches to prevent type 2 diabetes and long-term sustainability as well as to individualize prevention better.[27]

LACK OF COMMUNITY-WIDE, POPULATION-BASED STRATEGIES

Healthcare practitioners need to detect prediabetes and intervene with evidence-based prevention strategies such as the DPP in high-risk individuals. However, when considered from a population perspective, targeting high-risk individuals, although imperative, is likely to be inadequate if it is the only approach adopted for diabetes prevention.[28] Following the prevention strategy formulated by Rose,[29] small beneficial changes in a total population would produce much more significant net benefit than massive changes in a small segment of the population.[30,31] Therefore, interventions having a small individual benefit may have a significant collective effect when the risk is diffused throughout the population.[28–30] This approach is highly relevant to diabetes, as its risk is diffused moderately within the population, and therefore, many others could benefit from community-wide risk-reduction strategies.[28]

The importance of focusing on community-wide initiatives is highlighted by the observation that other approaches, such as providing financial incentives for chronic disease management geared toward low-income (Medicaid) populations have a negligible impact on health outcomes.[31,32] Furthermore, access to health care is unlikely a significant consideration for the preponderance of the U.S. population. Hence, as the significant underlying driver for diabetes is environmental, emphasis should be on obesity fueled by a sedentary lifestyle and availability of inexpensive energy-dense foods.[28] In this context, participants in the Supplemental Nutrition Assistance Program, which provides nutrition benefits to needy families allowing the purchase of healthy foods, as well as non-Supplemental Nutrition Assistance Program households frequently purchase food products with poor nutritional value. Both groups spend excessive percentages of their food budget on sweetened beverages, prepared desserts, high-fat dairy, and cheese products.[33]

PROPOSALS FOR EXPANDING DIABETES PREVENTION

Table 2 summarizes proposals for expanding diabetes prevention awareness. Healthcare policies geared toward the population level involving environment and nutrition are critical but take considerable time to implement. There is a greater need to emphasize the importance of primary prevention of diabetes in medical school and residency training. Therefore, healthcare providers must be educated more extensively in preventive medicine so they acquire relevant skills that subsequently can be transferred to the outpatient setting. To do so will require a concerted effort to adapt medical school and residency curricula. Fellowship training in preventive medicine should be emphasized so specialists in prevention can be deployed to the community and academic medical centers.

As prevention requires considerable time and effort, resources and adequate compensation must be available to primary care physicians, in particular, to engage high-risk patients in lifestyle modification and referral to structured programs. In this context, hospitals and multigroup practices need to leverage their access to sizeable patient pools and negotiate appropriate reimbursement with health insurers for preventive care. In addition to

Table 2. Proposals for Expanding Diabetes Prevention[a]

Proposal
Investigate alternative diagnostic modalities for detecting prediabetes with higher sensitivity (e.g., 1-hour plasma glucose ≥155 mg/dL [8.6 mmol/L])
Develop Grand Rounds and CME programs on prediabetes and prevention for primary care and family physicians (webinars, scientific meetings)
Establish prediabetes and diabetes prevention symposia at national meetings for pediatricians, adolescent physicians, primary care, family and geriatric physicians, endocrinologists, and allied healthcare professionals
Enhance referrals to structured community-based intervention programs
Enhance reimbursement for prevention by insurers, third party carriers
Enhance community screening of high-risk populations (schools, houses of worship, community centers)
Establish hospital and community clinics diabetes prevention programs particularly those serving high-risk ethnic groups
Public outreach seminars and advertising campaign on prediabetes and prevention
Involve allied healthcare professionals (e.g., nurses, dietitians, podiatrists, dentists) in screening and referring for prediabetes
Increase prevention training in medical school and residency curricula
Investigate alternative customizable approaches to structured prevention programs
Pursue community-wide initiatives to reduce obesity, limit sedentary behavior, and improve nutrition

[a]Adapted from Bergman et al.[21]
CME, continuing medical education.

offering prevention instruction in the office setting and referral to community-based prevention programs, establishment of DPP within academic medical centers should be considered.

Alternative approaches that may benefit broader segments of the population should be considered, as many individuals with prediabetes may be unable or unwilling to participate in structured, lengthy prevention programs. Pragmatic trials that could influence policy in diabetes prevention, designed to assess the effects of an intervention under the conditions that will be ultimately applied, have substantial relevance.[16] Unstructured, personal strategies in diabetes prevention have not been investigated adequately to determine their clinical and cost-effectiveness. If proven effective, novel strategies providing a menu of interventions may be better suited for a diverse populace, rather than adopting a "one-size-fits-all" strategy.

Postgraduate education, including seminars, symposia, and continuing medical education programs that focus on diabetes prevention should be offered to all healthcare specialists (e.g., dentists, podiatrists) caring for high-risk individuals. Given the increasing prevalence of prediabetes in the younger population, pediatricians and adolescent medicine physicians need to be involved as well, particularly given the insufficient number of primary care physicians and endocrinologists to screen a burgeoning population. Emphasizing the critical importance of lifestyle modification at a younger age could influence behavior, which may reduce the prevalence cardiometabolic risks at a later stage in life.

From a population perspective, targeting obesity with behavior-based weight-loss interventions, which lower the risk of progression to diabetes without proven harm[34] while limiting advertising of and access to junk foods or sweetened products, needs to be examined judiciously. Decreasing intake of sugar-sweetened beverages is rational given the compelling evidence that higher consumption of these products is associated with tooth decay, weight gain, type 2 diabetes, fatty liver disease, cardiovascular disease, and all-cause mortality.[35] Whether taxes imposed on sugar-sweetened beverages improve health outcomes is unknown and requires further investigation, although they raise substantial revenues that can be invested in programs focusing on community needs and health inequities.[36]

Diabetes prevention is a work in progress[16] and requires identifying the obstacles impeding progress in implementing intervention programs. It is only by continuously, systematically, and creatively approaching impediments to prevention that society can find appropriate solutions that significantly reverse the seemingly insurmountable challenges inherent in the global burden of type 2 diabetes.

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