The Emerging Role of Telemedicine and Mobile Health Technologies in Improving Diabetes Care

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THE GLOBAL DIABETES EPIDEMIC CONTINUES to challenge clinicians, health care systems, and payers. It is estimated that >425 million people, worldwide, have diabetes, and this number is expected to increase to beyond 629 million within the next 25 years.¹ The largest increases will occur in countries where economies are shifting from low income to middle income levels.¹

In addition to the serious clinical consequences of this disease, the financial costs are overwhelming for many countries' ability to provide adequate care, growing from \$232 billion spent by people with diabetes worldwide in 2007, to \$727 billion in 2017 for those aged 20–79 years.¹ In the United States, the cost of diabetes in 2017 was ~\$327 billion, which includes \$237 billion spent on direct medical costs and \$90 billion in reduced productivity; ~62% of the direct costs are due to the treatment of diabetes complications.²

We have long known that achieving near-normal glucose levels early in the disease leads to improved microvascular outcomes in the short term and better cardiovascular outcomes in the long term.^{3–7} However, despite ongoing advances in diabetes medical devices and medications, a significant number of people with diabetes are not achieving glycated hemoglobin (HbA_{1c}) levels of <7%, the glycemic target recommended for most individuals.^{8–11} Importantly, diabetes control is actually worsening. A recent study found that achievement of individualized targets declined from 69.8% in 2010 to 63.8% in 2014, and the percentage of individuals with A1C >9.0% increased from 12.6% to 15.5% during the same time period.¹¹ Similar data were recently published from type 2 diabetes (T1D) Exchange showing that more than two-third of patients are not achieving American Diabetes Association (ADA) HbA_{1c} targets and are overweight or obese.¹² In fact, glucose control has worsened in the 5-year follow-up across all age groups. In addition, the disease is diagnosed in earlier years of life, especially T1D, with higher risk of long-term complications and the need for insulin treatment.¹³

A key contributor to poor glycemic control is “therapeutic inertia.” Although failure of clinicians and patients to in-

tensify therapy when needed and suboptimal patient adherence have often been cited as the cause of therapeutic inertia,^{14–17} we now recognize that the problem is multifactorial, involving numerous stakeholders, including patients, clinicians, health care systems, payers, and industry. In most parts of the world there are not enough trained diabetologists/endocrinologists available to care for the alarming increase in the number of patients with diabetes.

At a recent ADA summit, held on November 28, 2018, in Arlington, Virginia, representatives from all stakeholder groups met to identify and assess issues related to therapeutic inertia, discuss barriers, and develop solutions and next steps that will have a significant impact on long-term outcomes.¹⁸ A common theme echoed throughout the summit was the increasing role of telemedicine and mobile health (mHealth) technologies in addressing inertia and improving clinical and quality of life outcomes. mHealth guides patients on a day-to-day basis to avoid hypo- and hyperglycemia. Also, it is important to incorporate different technologies (self-monitoring of blood glucose [SMBG], continuous glucose monitoring [CGM], insulin delivery devices, etc.) into one platform that facilitates care and improved outcomes.

In this supplement, O'Connor and Sperl-Hillen present a comprehensive review of how advancements in data exchange, data security, and human factors research have improved the design and effectiveness of point-of-care clinical decision support (CDS) systems in primary care setting.¹⁹ Emerging data provide compelling evidence that current diabetes CDS systems have high rates of usage and have improved glycemic control, blood pressure control, and cardiovascular risk trajectories in adults with diabetes. CDS systems both personalize care to reflect individual patient needs and standardize recommendations, thus reducing undesirable variation in care.

Through use of mHealth technologies such as diabetes-related apps, a growing number of individuals with diabetes now have the ability to monitor their glucose control and track other lifestyle factors (meals, exercise, etc.) that impact their overall diabetes control. Although app use has been shown to improve glycemic control in users, the attrition rates

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for app use remains high. In her article, Ramchandani emphasizes the importance of “virtual coaching”—through human contact or artificial intelligence (AI) software—as a key component of app current and future app offerings.²⁰

Evidence supporting the benefits of virtual coaching and other app features is further elucidated in the article by De-bong and colleagues, who present findings from real-world assessments of the utility and benefits of the mySugr diabetes mHealth app.²¹

Cafazzo presents a wide-ranging discussion of the evolution of digital health interventions during the past decade, focusing on successes, barriers to adoption, and future requirements of telemedicine and mHealth technologies. Included in his discussion is how the use of digital health in diabetes must examine the fundamental nature of how health care is delivered and develop new models that address the holistic needs of individuals living with diabetes as well as address access challenges to diabetes care providers.²²

Johnson et al. discuss the utilization of digital glucose data in diabetes management through the ambulatory glucose profile (AGP), focusing on the rationale and use of key glucose metrics and role of standardization in retrospective CGM data analysis at health care provider and patient levels.²³ Information to guide interpretation of the AGP-generated data that have been optimized for use by clinicians and patients naive to CGM and AGP is outlined in the article.²³

Mohan and colleagues report on the status of diabetes care in India and discuss various ways telemedicine is improving diabetes care outcomes at the community level to create awareness about the risk factors and prevention of diabetes, facilitate patient monitoring, and provide education and support to health care workers.²⁴ The authors also describe a model of care that utilizes automated AI software combined with telemedicine to conduct real-time screening of diabetic retinopathy and other complications in remote areas where such services are unavailable.²⁴

Individuals with diabetes face many obstacles in following their daily self-management regimens. However, because health care providers are often unaware of the daily challenges of their patients, the regimens they prescribe may be unacceptable or impossible to follow, resulting in poor clinical outcomes and diminished quality of life. In her article, Barnard-Kelly discusses a novel web-based clinical tool—KALMOD—that provides a structured systematic approach to assessing patient needs and barriers, which can focus consultations in ways that enable health care providers support their patients with individualized holistic care.²⁵ The KALMOD assessment is web based and easily accessible on a number of devices, including smartphones, tablets, and computers.

We hope that you will enjoy and learn by reading this supplement. We sincerely thank all the authors who contributed in a timely manner to the supplement and the sponsor for providing an unrestricted educational grant to make this possible.

Author Disclosure Statement

S.K.G. has received advisory board consulting fees from Medtronic, Roche, Merck, Lexicon, Novo-Nordisk, Sanofi,

Mannkind, Senseonics, Zealand Pharmaceuticals, Astra-Zeneca, and Eli Lilly. S.K.G. has received research grants through the University of Colorado Denver from Eli Lilly, Novo-Nordisk, Merck, Lexicon, Dexcom, Diasome, REMD, Medtronic, Dario, NCI, T1D Exchange, NIDDK, JDRF, and Sanofi. S.K.G. does not own stocks in any device or pharmaceutical company. C.G.P. has received consulting fees from Dexcom, Diasome, Insulet, LifeScan, Onduo, and Roche Diabetes Care.

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