

Diabetes clinic reinvented: will technology change the future of diabetes care?

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Abstract: Diabetes is a chronic disease that affects nearly 463 million people globally and involves multiple co-morbid conditions that require effective treatment and continuous management. These include lifestyle and behavioral modifications, compliance to diabetes medications and close patient monitoring, all of which can be efficiently conducted via telehealth. Integrating digital technology of telehealth and mobile health into diabetes care may improve diabetes management and increase its efficiency. In this review, we examine recent advances in healthcare technology of diabetes. Moreover, we present an example of a comprehensive virtual diabetes clinic, the “Joslin HOME,” as an innovative digital ecosystem for future application in diabetes care. This model utilizes digital health technology and comprises frequent short visits with easy two-way scheduling, focused documentation and simple billing methods. In this new model, a multidisciplinary team is connected with their patients using telehealth and mobile health to overcome the barriers of distance and location. It may possibly extend quality diabetes care to remote, underserved or rural areas.

Keywords: diabetes, diabetes clinic, digital health, healthcare, m-Health, technology, telehealth, telemedicine

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Introduction

Diabetes mellitus is a global public health crisis. It is estimated that more than 463 million people worldwide have diabetes and this number is projected to reach 578 million by 2030, and 700 million by 2045.¹ The Centers for Disease Control and Prevention estimate that 34.2 million people of all ages—or 10.5% of the US population—have diabetes, of which 90–95% have type 2 diabetes (T2D).² This number is expected to rise to 40 million by 2030 and 61 million by 2060.³ More than 88 million people in the US aged 18 years or older are estimated to have prediabetes, which constitutes 34.5% of the US adult population.^{2,3}

In 2017, the total estimated cost of diagnosed diabetes was \$327 billion, including \$237 billion in direct medical costs and \$90 billion in reduced productivity.⁴ As of 2018, the US has 7,918 endocrinologists with ratio of one endocrinologist per 3,800 patients with diabetes.⁵ Furthermore, access to endocrinologists became more limited in rural and remote areas.⁵ It is estimated that

85% of diabetes care is carried out by non-endocrinologists, mainly primary care physicians, of whom a shortage of 14,800–49,300 is expected by 2030.⁶ This shortage is pressuring providers to shorten the duration of patient visits within their limited daily schedules. Nevertheless, providers spend the majority of their patients' time in interaction with electronic health records (EHR) rather than on face-to-face discussion with their patients on diabetes self-management strategies that promote patient engagement in their healthcare.⁷ It was found that, on average, only 16.5 min out the 35.8 patient visit time is spent on face-to-face discussion.⁸ The ripple effect of an increasing diabetes population has resulted in increased costs and overburdened physicians, which has exposed the shortcomings of the traditional or the chronic care models for the management of diabetes in which the typical clinic visit is about 30 min and is conducted every 3–6 months through regular appointments.^{9,10} Developing a new model of diabetes care is essential to accommodate the overwhelming number of patients

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while providing a good quality of diabetes care. Fortunately, recent technological evolutions of digital health that focus on improving healthcare efficiency are promising of a better future and new directions in diabetes care. Telehealth is the remote operation of healthcare through telecommunication technologies.¹¹ Telehealth enables long-distance clinical health care and professional health-related education electronically. Telehealth utilizes public health information and health administration concepts to conduct and improve the practice of medicine.¹¹ While telehealth is often referred to as telemedicine or eHealth, telehealth is broader than these terms.^{12–14} Telemedicine is the remote practice of medicine between a physician and a patient using electronic communications.¹⁵ eHealth can be defined as the use of technology to gather information and promote communication between healthcare professionals and patients.¹⁶

On the other side, mobile health (m-health) refers to use of mobile technology to deliver real-time health and metabolic information that enables remote patient monitoring and interaction through a wide range of functions (e.g. text messaging, alerts, trend recognition, email, and educational videos). Through these technologies, patients may be more involved in their own diabetes management and achieve better glycemic control, improve their eating pattern, lose weight, and attain better health outcomes, while maintaining constant patient–provider communications.⁶ As it is difficult for many patients to commit to behavioral and lifestyle changes in traditional ways, technology emerges as an efficient platform to efficiently engage more patients. The promise of telehealth is to improve diabetes care, help in preventing diabetes complications and save patients’ time and cost by eliminating need for traveling long distance to receive multidisciplinary care. Ultimately, telehealth and m-Health may lead to reduction in overhead cost and administrative healthcare expenses.¹⁷ Leaders in the telehealth industry are actively creating novel tools to help patients to improve their diabetes self-management through virtual patient–physician interactions. The COVID-19 epidemic not only uncovered the importance of this technology, but also gave providers and patients an unprecedented chance to experience digital health.

Here, we reviewed the latest advancements in healthcare technologies and the cost-effectiveness of their use in patient care through a literature

search using PubMed and Google Scholar of meta-analyses and systematic reviews published within the past 5 years, by use of the terms “telemedicine, telehealth, m-Health, digital health, diabetes clinic, technology and healthcare” in combination with the term “diabetes.” We pursued examples of distinctive strategies through which telemedicine and m-Health interventions have been applied to patients with diabetes to optimize their medical care. Original research studies on digital health published within the last two decades were also included in our review. Also, we explore the possibility of combining and expanding upon existing technologies to develop a “virtual diabetes clinic”—a comprehensive digital healthcare ecosystem that defies the boundaries of location and time—as a promising vision for the future of diabetes care by giving “Joslin HOME” as an example.

Telemedicine and m-Health in diabetes care

Incorporation of telemedicine and m-Health in diabetes care were shown to be successful in engaging patients in their disease management, improving their quality of life and reducing diabetes-related cost. A recent systematic review of published articles on diabetes telehealth over the last two decades showed significant improvement in A1C levels, reduction in diabetes complications and decrease in healthcare cost.¹⁷ It showed that technology was able to help patients with diabetes to overcome common challenges they usually encounter, including inadequate time spent with their healthcare providers, lack of access to specialists and diabetes educators, and inadequate support for proper self-management. It also showed that diabetes care through telehealth is just as effective as diabetes care received in-person, with no difference between the two in A1C, blood pressure or serum lipids.¹⁷ Some meta-analyses included in this review even showed that patients participating in telehealth programs had greater reductions in A1C with superior time and cost efficiency in comparison to standard in-clinic care.^{18–22}

Patient–physician interactions are essential for improving health outcomes and preventing long-term diabetes complications. Network meta-analysis of 93 trials that aimed at investigating the impact of different telemedicine strategies on glycemic control of patients with T2D showed that all telemedicine strategies, including tele-education,

tele-monitoring, tele-case management, and tele-mentoring combined with tele-consultation, were effective in reducing A1C significantly by an average of 0.43%, with a range between 0.37% and 0.71%, in comparison to usual care.¹⁰ The exceptions to this reduction were seen in tele-case management and tele-mentoring. Ranking of telemedicine based on A1C reduction indicated that tele-consultation was the most effective telemedicine strategy, followed by tele-case-management combined with tele-monitoring, and finally tele-education combined with tele-case management.²⁰ It is worth mentioning that tele-consultation during the COVID-19 epidemic became more common and enabled patients to virtually interact with their physicians and educators without the typical barriers of distance and commuting time. However, no data have been published about its efficacy so far.

Other studies showed that telemedicine programs have promising benefits in managing diabetes-specific complications such as diabetic retinopathy, where they allowed tele-screening of vision at primary care facilities. Images were digitally sent to remote ophthalmologists for evaluation.¹¹ Using this technology at primary care facilities resulted in increasing the rate of eye screening to 100% in comparison to 31% when patients were referred to ophthalmologists for screening.²³ Studies on tele-screening for diabetic retinopathy showed significant reduction in rates of vision loss and blindness due to increased adherence to retinopathy screening.^{17,24} As more than 50% of healthcare expenditures for patients with diabetes are related to diabetes complications, healthcare organizations may take advantage of these innovative digital procedures that improve diabetes outcomes and reduce overall healthcare cost.

The use of mobile and wireless technologies (m-Health) to achieve health objectives in diabetes self-management is beneficial and has the potential to transform healthcare delivery across the globe. The drivers behind these changes are the rapid advances in mobile applications and the growth of cellular coverage, with new opportunities coming up by integrating m-Health into existing healthcare systems.²⁵ Mobile applications and direct texting are used to deliver reminders that may improve patients' dietary and exercise practices, glucose testing and improve rate of medication adherence. In one study, clinicians implemented a comprehensive, text-based diabetes education program,

and showed after 6 months of intervention a significant decrease in A1C by 0.7%, and patients reported improved dietary practices, better foot care, and more frequent blood glucose monitoring.²⁶ In another study, a comprehensive smartphone application incorporating blood glucose readings, manual dietary tracking, exercise tracking by a fitness tracker, diabetes education, and communication with healthcare providers resulted in A1C reduction of 0.6% in 12 weeks.²⁷ Basically, smartphones can serve as an interface that transfers blood glucose monitoring data between patient and healthcare providers. Continuous glucose monitors (CGMs), insulin pumps and, most recently, the hybrid closed-loop insulin delivery systems have significantly upgraded diabetes care from the traditional glucometer and insulin pen model to a data-driven model with prediction algorithms. Many of these devices incorporated Bluetooth and near-field technology to wirelessly transmit blood glucose data directly to users' smartphones. These data are easily shared electronically with healthcare providers to enhance remote diabetes monitoring.²⁸

In conclusion of potential benefits, telehealth and m-Health have great promise in transforming diabetes care, education and group support. They are more convenient and accessible to more patients for remote monitoring of blood glucose and adjusting diabetes medications that are aligned with real-time patient progress. They result in similar or better diabetes outcomes, and are more cost effective than traditional in-person care models. They are also scalable to reach patients in remote areas who lack comprehensive or multidisciplinary diabetes care.²⁹

Challenges in telemedicine

Telemedicine challenges include problems with reimbursement, as coverage of telehealth services has been uneven across payers due to uncertainty of value and concerns regarding duplication of services. The absence of well-defined reimbursement criteria remains one of the biggest threats to expanding telemedicine utilization and adoption. Cross-states license is another barrier, as each state has its independent authority to regulate practice of medicine within its boundaries. Moreover, strict state license laws and requirements limit physicians' ability to offer telemedicine services. High-speed broadband connection does not currently reach numerous rural areas.²⁸

The Federal Communication Commission is promoting telehealth in rural areas through the Rural Health Care Program, which provides financial support to help rural healthcare providers to obtain broadband and other communications services at discounted rates. These services are in turn used by healthcare providers to offer telehealth to patients living in and around the communities they serve.^{30,31} There are also risks of breaching healthcare information, as telehealth interaction itself could lead to data privacy or security violations. As patients are not physically present at healthcare facilities, there is an increased risk of breaching health information, which under the HIPAA (Health Insurance Portability and Accountability Act) Privacy Rule would likely be unauthorized disclosures.³² The COVID-19 epidemic eased many of these barriers and allowed health authorities and third party payers to realize the actual benefits of widespread telehealth utilization and its reasonable safety.

Cost-effectiveness of telemedicine

The financial benefits of telemedicine cannot be ignored. For providers, using telemedicine may improve work efficiency, as it saves time and space needed to complete clinic visits. For patients with diabetes who already have diabetes self-management responsibilities, telemedicine can reduce their travel expenses and enhance their productivity by lowering the cost associated with obtaining care, such as missed hours of work and cost of traveling and parking. For payers, it has the potential to reduce reimbursements because of reductions in overall utilization.³³ Given those promising benefits, virtual appointments will certainly continue to grow in popularity as they become available for patients across the globe. A report from the American Hospital Association concluded that telemedicine services have saved the Veterans Health Administration (VHA) substantially over years. The VHA estimates an average annual savings of \$6,500 per participated patient in the telehealth program. This sums to around \$1 billion in savings for the VHA in 2012.²⁰ Although cost-effectiveness studies demonstrate cost reduction through implementation telehealth, most of these studies are small or pilot.³⁴ Even in studies that report cost-effectiveness, not all economic outcomes were considered. Thus, further research is needed, particularly among low and low-middle income countries, in order to understand the impact of

different m-Health technologies. Answers can be obtained through well-designed randomized clinical trials.³⁵ Furthermore, the variety of digital health models, diverse patient populations and varied geographic locations, as seen in currently available in literature, make it more challenging to get an accurate and comprehensive economic analysis.¹⁷ The rapid advancement in digital health technology coupled with potential ability of telemedicine to transform chronic disease management are sufficient reasons to conduct further research. Evidence of cost-effectiveness will be especially important in developing economies, where digital health can be efficiently used among underserved populations to improve access to health care and to help patients engage in their diabetes self-management.^{17,36} Currently, telemedicine is used in many different forms and has become available at much lower cost. The development and utilization of connected devices, like glucometers and CGMs, to mobile phones though mobile applications are rapidly progressing. Joslin HOME is an example of the implication of telehealth in diabetes management that may close the gaps in the current in-person clinic model. This is a pilot clinical program to evaluate the feasibility of applying telemedicine in chronic disease management such as diabetes.

Joslin HOME model

Joslin HOME is an innovative model of virtual diabetes clinic which was developed as a collaboration between Joslin Diabetes Center and American Well Inc., a telehealth company, to explore if telehealth can be used in managing chronic diseases like diabetes. We reviewed the gaps in the current classic clinic visit and identified two major problems as described in the manuscript; the first is the waste of most of the visit time on EHR at the expense of direct face-to-face contact. The second is the relationship between the frequency of visits and the time needed to achieve the glycemic and metabolic targets, which is typically prolonged as the frequency of visits decreased. To overcome those barriers, we eliminated most of the time used on EHR and shifted to a focused and precise documentation and increased the frequency of visits while shortening their durations. We also considered the wasted overhead time and the cost in scheduling and canceling visits by using an electronic technique instead. Joslin HOME is a scalable program that aims at providing continuous and on-demand

assistance that aligns with the wide demands of diabetes as a complicated chronic disease. In this model, Joslin Diabetes Center provides accredited live and online training in diabetes to primary care physicians and other supporting healthcare providers. In particular, it trains them on how to conduct a multidisciplinary diabetes care virtually and efficiently. The Joslin HOME model is a team approach that includes physician, nurse practitioner or physician assistant, certified diabetes educator, registered dietician, exercise physiologist, behavioral therapist, pharmacist and, if needed, a patient caregiver and/or community member. The team is not necessarily from the same location or even from the same state. Patients build their teams from a pool of healthcare providers after reviewing their qualifications and expertise. Meanwhile, the patient can change any member of their own healthcare circle at any time. The Joslin HOME team collaborates and communicates virtually to deliver the best care possible and to provide patients with information and support necessary to make informed decisions in their day-to-day diabetes management. All communications are two-way, which means patient and healthcare provider make their independent decision on when to communicate and how frequently to interact without predetermined frequency. We used computerized decision support in scheduling/rescheduling patients' visits and for internal referrals, while electronically capturing blood glucose data and remotely collecting other vital signs like weight, blood pressure and heart rate. This is a valid alternative to the direct conduction/measurement of these parameters by clinic personnel.

The Joslin HOME coordinator ships a box containing weight scale, blood pressure cuff and cellular glucose meter with unlimited strips to each patient.

The Joslin HOME model consists of five new pillars of diabetes care:

1. Short visits: The duration of each visit in the Joslin HOME model is between 5 and 15 min. When short visits are conducted remotely, multiple healthcare professionals are easily involved in diabetes care. Additionally, short and more frequent visits can be scheduled and customized to patients' needs outside the limitations of location and time. The entire duration of virtual visit is in direct face-to-face communication. This is

different from the current physical visit which, as explained earlier, is consumed mostly in interaction with the EHR rather than with the patient. Visits can be as short as few minutes, based on the nature of requested advice; for instance, adjusting insulin dose or discussing side event. Cancellation or rescheduling of short visits is easier for both providers and patients using the telehealth platform without outside assistance. The Joslin HOME model also allows a patient's spouse or partner to join the visit even if they are at different location. Such capabilities have a positive psychological impact, as this increases motivation and decreases feelings of isolation.

2. Frequent visits: It was obvious that two to four medical visits per year are not sufficient for the majority of patients with diabetes, as they require frequent assistance to make educated decisions around their medications, dietary plan, physical activity and behavior modification.²⁶ A study examined the impact of visit frequency on the duration taken to reach target A1C of <7%. For patients with T2D on oral medications, it takes in average 4.4 months to reach the target A1C of <7% when visits are conducted weekly, whereas it takes in average 24.9 months to reach the same target if the visits occur every 3–6 months as we currently do. For patients treated with insulin, it takes on average 52.8 months when visits are conducted every 3–6 months in comparison to an average of 10.1 months when visits are conducted weekly. Similarly scenarios are seen with the target blood pressure and LDL-cholesterol, as shown in Table 1.³⁷

In the Joslin HOME model, visits are scheduled as per patient or provider request without a capped limit. Visits are not necessarily with a physician but with any one of a multidisciplinary team as outlined before. Increased frequency of visits improves adherence to the management plan and increases compliance to medications. As visits are very short in duration, they do not add significant burden on healthcare providers. With further improvement in glycemic control, visit frequency may be spaced as needed. The Joslin HOME model particularly incorporates ongoing behavior and emotional support for their documented benefits.²⁶

3. Two-way scheduling: The Joslin HOME model enables easy scheduling and canceling of visits whenever needed by the patient or

Table 1. The impact of visit frequency on the duration taken to reach target A1C, blood pressure and LDL cholesterol.³⁷

	1–2 weeks	3–6 months
A1C < 7% (no insulin)	4.4 months	24.9 months
A1C < 7% (on insulin)	10.1 months	52.8 months
LDL < 100 mg/dl	5.1 months	32.8 months
BP < 130/85	1.3 months	13.9 months

A1C, glycated hemoglobin; LDL, low-density lipoprotein; BP, blood pressure.

healthcare provider. Providers post their available times, which are divided into 15-min slots. The patient browses each provider schedule and selects the most convenient appointment time. A text is automatically created and is sent to both provider to confirm and patient as a reminder. Flexible cancellation is granted to both provider and patient. Cancellation or rescheduling of virtual visits by providers is generally accepted by most patients, as they are still at home or work place. Because visit duration is very short, cancellation or rescheduling has limited negative impact on both parties. This system, similar to other telehealth models, breaks the boundaries of time and location. During the visit, provider may directly book other visit(s) with any member of the Joslin HOME team, such as nutritionist, diabetes educator or behavioral therapist. This flexibility makes this system more convenient for both providers and their patients.

4. Focused documentation: Before each virtual visit and while patient is still in a virtual waiting room, patient is asked to answer five simple questions:

- 1- Are you taking your medications as prescribed? Do you have any question about them?
- 2- Did your blood glucose exceed 200 mg/dL or was lower than 70 mg/dL at any time since last visit and when?
- 3- Are you following your diet plan?
- 4- Are you following your exercise plan?
- 5- What exactly do you need to accomplish from this visit?

Answers are combined in a paragraph delivered to the healthcare provider to enhance focused discussion on the most relevant issues away from

lengthy open-ended questions. In this way, documentation is simpler and is not time consuming. In the Joslin HOME model, the burden of documentation that takes up most of the classic visit is eliminated. It was shown that from the average 35.8 ± 16.6 min of classic clinic visit for patients with diabetes, only 16.5 min is spent in direct face-to-face interaction and the remaining time is spent in creating encounter notes. The time spent in interaction with EHR was on average 2.9 min prior to the visit, 2.0 min in the room, 7.5 min of non-face time and 6.9 min outside clinic hours.⁸

Quality documentation in telehealth is still required for proper reimbursement and for medico-legal purposes. Thus, coming up with a telemedical model that ensures consistent, accurate, timely, easily accessible and non-duplicative documentation in the telehealth scenario is crucial.³⁸ Joslin HOME created simple and straightforward documentation that has been shown to be more efficient than traditional lengthy encounter notes.

5. Billing: Billing in the Joslin HOME model is based on duration of visit, which is spent entirely on consultation. This model may be suitable for direct cash payment with retrograde billing of insurance, or for use within a bundled care model covered by a third party payer. One of the major advantages of this telehealth model is reduction in billing complexity and expenses. The cost saving is immediately seen in scheduling, organizing clinic care, checking-in and checking-out and billing, as all are done electronically. Paying medical expenses is also simple and direct through the app. A highly secured gateway for payments allow users to directly pay for their medical expenses as a one-step payment or as a bundled payment. The latter remains a popular reimbursement option for payers as it increases care efficiency, decreases care cost, and properly controls healthcare spending. This ultimately reduces the overall healthcare cost for both payers and healthcare organizations. In most cases, Medicare reimburses for live telemedicine—in other words, a real-time video-chat between physician and patient that provides face-to-face contact during the visit.³⁹

Table 2 shows the main differences between the classic or chronic care model for the management of diabetes and Joslin HOME model.

Joslin HOME may help in retaining patients through its convenience and consumer-centric care

Table 2. The main differences between the classic or chronic care model and Joslin HOME model for the management of diabetes.

Classic model	Joslin HOME
Long visits (30 min)	Short visits (5–15 min)
Infrequent visits (3–6 months)	Frequent visits (1–4 weeks)
Rigid schedule	Flexible two-way schedule
High overhead cost	Low overhead cost
Travel time and cost for patients	Home or work and low patient cost
Not suitable for some patients	Suitable for most patients

approach. Additionally, technology use enhances the clinician–patient experience through its user-friendly features. Lastly, easy access to specialists may allow for efficient communication among the multidisciplinary care team and may reduce wait time and possibly reduce hospital admission.

Benefits and limitations of Joslin HOME

In addition to scalability, convenience and cost saving, the main advantage of Joslin HOME is quick access to diabetes educators, dietitians, exercise physiologists and behavior therapists. Technology also allows electronic food and exercise logging, medication reminders and alarms for prescription refills, visit reminders, and virtual coaching for weight management. Other advantages of technology include remote blood glucose monitoring and group social support and interaction. The limitations of this model include loss of direct patient–physician contact, health insurance issues and technology challenges in the elderly population. To overcome some of these obstacles, we suggest conducting the first visit in person in order to build a trustful patient–provider relationship. Although this pilot clinical program showed that the telehealth diabetes care model is feasible, having a small sample size did not allow us to comprehensively evaluate this model by healthcare professionals and patients. This evaluation can be done in a large randomized clinical trial that compares the telehealth model *versus* the classic in-person clinic model.

Future of telemedicine and m-Health

New healthcare delivery models that promote patient self-management and integrate advanced

communication systems are being developed and tested. Recent surveys indicate that patients are willing to actively participate and take control of their own care, and that self-monitoring at home is one way to increase their involvement. One systematic review showed a reduction in A1C by 0.3% in type 1 diabetes and 0.8% in T2D after 12 months of m-Health intervention when compared with the traditional care model.⁴⁰ These models also serve as vehicles for invention of devices that enable noninvasive monitoring of other vital parameters (e.g. blood pressure, oxygen saturation, and body weight) that may open new opportunities for managing chronic diseases. One pilot study tested a home blood pressure tele-management system that actively engages patients and showed significant improvement in blood pressure control.⁴¹ In the context of diabetes care, similar devices can be built to communicate with insulin devices. Meanwhile, CGM manufacturers have begun to offer artificial intelligence-connected recognition devices, which determine glucose pattern (e.g. Medtronic's Sugar.IQ® by Medtronic, Minneapolis, MN) or incentive programs that offer financial rewards for time spent in the target glucose range (e.g. Medtronic's Inner Circle, Medtronic, Minneapolis, MN).⁴² Cellular transmission of glucose data (e.g. iGlucose® by Smart Meter, Tampa, FL) in real time may allow physicians to send timely messages or signals if a glucose pattern is determined or possibly identifies high-risk patients through their glucose patterns. Use of artificial intelligence and population-management software may allow monitoring of and texting to a large number of patients and determination of their average blood glucose levels and glycemic trends. Telemedicine may also help in close monitoring of high-risk patients in between visits. This may reduce cost and improve diabetes management.

With advancing technology, management of chronic diseases such as diabetes may continue to shift toward value-based payment models like Joslin HOME. Moreover, drug manufacturers and device companies will continue to innovate in the technology space. Currently, the three major insulin manufacturers are competing to develop smart insulin pens, pumps and mobile applications that may help patients to use insulin more safely and effectively. In other words, they are moving from providing drugs to providing “care.”⁴²

Conclusion

Telehealth and m-Health have shown great promise in turning diabetes care, education and group support to more convenient experiences with accessibility to a larger number of patients. Increased connectivity with diabetes care teams allows for efficient remote glucose monitoring, medication adjustments and real-time overview of patients’ progress. Mobile apps and devices provide additional benefits to both healthcare providers and their patients, as they significantly increase access to point-of-care tools, which may improve clinical decision-making and health outcomes. Evaluating these tools and validating their benefits through well-designed clinical trials are needed. Connected diabetes care may largely replace most of the expensive, less convenient face-to-face clinic visits in the near future. New models of diabetes care that extensively use technology may emerge as valid alternatives. This was clearly tested during the COVID-19 epidemic. These models involve multidisciplinary approaches that were not traditionally available for patients living in rural or remote areas. The Joslin HOME innovation is an example of these models, where frequent short visits with easy scheduling, focused documentation and easy billing could break the limitations of location, distance and time to offer quality diabetes care to larger numbers of patients. These new models of diabetes care must be tested and validated to prove that they are effective, convenient, secure and financially sustainable.

Authors contributions

MA: conception or design of the work, data collection, analysis and interpretation, drafting the article, critical revision of the article
OH: conception and design of the work, drafting the article, critical revision of the article and final approval of the version to be published

Conflict of interest statement

Marwa Al-Badri, nothing to disclose. Osama Hamdy, consultant to Abbott Nutrition, Sanofi Aventis, AstraZeneca, shareholder of Healthimation Inc, his employer Joslin Diabetes Center receive research grants from Novo-Nordisk, Eli-Lilly and National Dairy Council.

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