ON THE CUTTING EDGE

Diabetes Care and Education

LIVING IN THE NOW AND THE FUTURE: TECHNOLOGY AND DIABETES MANAGEMENT

Message from the Theme Editor:
Toby Smithson, MS, RDN, LD, CDE
Livongo Health and DiabetesEveryDay.com
Hilton Head Island, SC

In the late 1960s, the vast majority of U.S. households could select their television entertainment from only three or four local stations whose signals were captured by an antenna, and I, newly diagnosed with type 1 diabetes, could only get an actual blood glucose result at a laboratory. We may debate whether having access to hundreds of TV channels in nearly every U.S. home represents a technological advancement, but there is no question that improved technology for diabetes monitoring is a major step forward. I can now see my blood glucose reading anytime on my smartphone and wirelessly order an insulin bolus, all while reviewing my patient’s blood glucose trends, which have automatically uploaded to secure cloud storage.

As diabetes educators, one of our goals is to advise and counsel our patients on the options available to make diabetes self-management easier and more effective. The variety of technological advances is remarkable. Meters not only provide instantaneous results, but they evaluate blood glucose trends. Technologies offer immediate access to information (apps and social media), serve as motivators (wearables), and provide education and support in the safety and comfort of our own home (virtual education). Diabetes educators need to keep abreast of technology in diabetes to find the latest and greatest for our patients. I confess that anything that promises to make diabetes self-management easier and more effective holds a special place in my heart.

We have gathered experts in the area of new technologies to offer you a one-stop shop regarding medical and technical advances in diabetes self-management. This issue of On The Cutting Edge is packed with practical, forward-looking information that you can use in your practice and share with people you know that have diabetes.

George Grunberger, MD, FACP, FACE, reviews findings from the American Association of Clinical Endocrinologists (AACE)/American College of Endocrinology (ACE) Consensus Conference on Glucose Monitoring.

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ON THE
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Print Communications Coordinator:
Sandra Parker, RDN, CDE

NewsFLASH Editor:
Kathy Warwick, RD, CDE

On the Cutting Edge Editor:
Susan Weiner, MS, RDN, CDE, CDN

On the Cutting Edge Associate Editor:
Mary Lou Perry, MS, RDN, CDE

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Linda Flanagan Vahl
DCE Administrative Manager
Academy of Nutrition and Dietetics
120 South Riverside Plaza, Suite 2000
Chicago, IL 60606-6995

Payable to Academy of Nutrition and Dietetics/DCE noting preferred mailing address.

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MISSION
Empowering DCE members to be leaders in food, nutrition, and diabetes care and prevention.

VISION
Optimizing the health of people impacted by diabetes using food, nutrition, and self-management education.

Conference on Glucose Monitoring. As we all know, glucose monitoring is an invaluable tool in diabetes management. This must-read article examines barriers to using a blood glucose monitoring device and the accuracy of meters, which can have an impact on optimal glycemic control.

Jennifer Schneider, MD, MS, shares insights on alternative methods of measuring hemoglobin A1c with today’s technology. Using this technology could provide more timely information on glycemic control at a lower cost than the traditional hemoglobin A1c test.

Jen M. Block, FNP NP-C, BSRN, CDE, CDTC, examines the new frontier of artificial pancreas delivery systems (APDS), which is an automated form of insulin delivery. She reviews a number APDS and shares research on the potential impact for people with type 1 diabetes.

Hope Warshaw, MMSc, RD, CDE, BC-ADM, FAADE, provides a summary of currently available virtual technologies and telehealth that deliver prediabetes and diabetes management, education, and support. She identifies three important factors that affect telehealth services delivered by registered dietitian nutritionists: compliance, licensure, and reimbursement.

Deborah A. Greenwood, PhD, RN, CNS, BC-ADM, CDE, FAADE, and Tami A. Ross, RD, LD, CDE, MLDE, bring us up to speed on best practices for the big Es: empowering, engaging, equipping, and enabling our patients through a different education model using eHealth. eHealth can enhance the chronic care model. This article shows you how to help your technology-savvy patients with ongoing diabetes self-management support via the Internet.

Catherine Frederico, MS, RDN, LDN, offers her expertise in the area of program applications (apps) development. This article is extremely helpful as well as a big time saver because she highlights the best choices of apps for people with diabetes and the best resources for clinicians in navigating the vast array of apps offered.

Tamara S. Melton, MS, RDN, CD, explores wearable device technology in diabetes management. She offers information on devices beyond insulin pumps and continuous glucose monitoring systems. These new devices can be great motivators that ease daily monitoring required for diabetes management.

Patricia Davidson, DCN, RDN, CDE, LDN, FAND, and Emily Johnston, MPH, RDN, CDE, discuss crowdsourcing as an avenue for

STRATEGIC PRIORITY AREAS

GOAL 1: The public trusts and recognizes DCE members as food, nutrition, and diabetes experts

GOAL 2: DCE members optimize the health of individuals and populations impacted by diabetes

Goal 3: Membership and prospective members view DCE as vital to professional success
helping patients receive ongoing support. Diabetes is a 24/7/365 chronic disease, and crowdsourcing may offer an opportunity to fill in support gaps for people with diabetes when they are unable to meet face-to-face with a clinician.

A warm thank you to Theresa Moutafis, who graciously agreed to be my associate editor and acted as my right hand woman throughout the process. We both want to extend a heartfelt thanks to our editors Susan Weiner, MS, RDN, CDE, CDN, and Mary Lou Perry, MS, RDN, CDE. We very much appreciate their guidance in delivering this issue. It is our hope that sharing some of the cutting-edge information in this issue with your patients, family, and friends can help people reduce their struggle with diabetes self-management.

To view the DCE officer directory, visit: http://www.dce.org/about-us/officers-leadership/officer-directory/
Abstract
Glucose monitoring, either by self-monitoring of blood glucose (SMBG) or continuous glucose monitoring (CGM), is a key component of diabetes management. However, concerns are growing about the quality of current monitoring systems and patient access to these technologies. The AACE/ACE convened a consensus development conference on September 28 and 29, 2014, in Washington, DC, to address these concerns. This report summarizes the issues discussed and points of consensus reached at the conference. The primary conclusion was that providing more accurate glucose monitoring systems and insuring that such systems are used well in medically appropriate patients can improve the quality and safety of diabetes therapy.

Introduction
Glucose monitoring (GM) has long been considered a cornerstone of diabetes management and is recommended by national diabetes organizations (1-3). The increasing incidence and rising costs of diabetes in the United States have renewed interest in finding more efficient and effective methods of using GM. In addition, there is growing concern about the lack of adequate insurance coverage for these technologies. Finally, many medical and patient advocacy organizations perceive the current U.S. Food and Drug Administration (FDA) regulatory requirements to be insufficient for assessing the accuracy and performance of GM systems once they have been cleared for market release.

To address these issues and build consensus on GM among all stakeholders, the AACE/ACE convened a consensus development conference on September 28 and 29, 2014, to develop an evidence base for a comprehensive regulatory action plan for health care insurance providers and to identify both points of consensus and alternative interpretations among key stakeholders.

Consensus Conference Framework
To achieve consensus across a broad range of stakeholders, conference organizers invited representatives from health care associations, insurance companies, government, patient advocacy groups, pharmaceutical and equipment manufacturing companies, and health care systems as well as physicians, educators, and allied health care professionals (4). Participants were organized into four “pillars” and asked to examine the evidence from different perspectives and with different emphases on priorities (Table). Representatives in each pillar were asked to identify issues with GM quality, safety, access, and pre- and postmarketing surveillance needs for both glucose strips and CGM. Within each pillar, attendees discussed and debated four questions. Following the breakout sessions, all met in a general session to discuss the findings and recommendations presented by representatives from each pillar. Based on their input, the AACE writing group compiled a list of key consensus points for presentation at a Congressional briefing and for further specific actions.

Discussion Questions and Recommendations

QUESTION 1: Which data support GM (as distinct from glycemic control) as a means to prevent diabetic macro- and microvascular complications?
Several recent studies demonstrated the importance of glucose control to reduce both short- and long-term complications of diabetes. Although all agreed that GM is essential to diabetes care, particularly for reducing hypoglycemia, such monitoring must be performed within structured regimens and acted upon appropriately to be beneficial. Engaged patients with type 1 diabetes should perform GM at least eight times daily. Similar monitoring frequency was recommended for individuals with...
type 2 diabetes who are at high hypoglycemia risk, such as those receiving multiple daily insulin injection (MDI) therapy.

Participants recommended personal CGM use for all patients with type 1 diabetes and offering CGM to all patients with type 2 diabetes on MDI therapy. Professional CGM should be obtained for those patients receiving basal insulin or sulfonylurea therapy. CGM was also recommended for all insulin-requiring patients who have hypoglycemia unawareness. Medical experts felt that professional CGM may be offered to patients with type 2 diabetes who may benefit through lifestyle and specific changes in their management plan.

Although participants agreed that accurate GM devices are essential, they were concerned that increased accuracy may affect upfront costs and lead insurers to view accurate GM as cost-prohibitive. However, they also noted that glucose values that are far out of range, specifically in the hypoglycemic range, are more problematic than inherent meter bias because these can affect immediate decision making if confirmatory testing is not performed.

In summary, conference participants agreed that GM is essential to diabetes care, particularly for reducing hypoglycemia, and that implementing clinical actions based on monitoring data is critical for glycemic control. However, additional research is needed to determine the efficacy and cost-effectiveness of GM in patients with type 2 diabetes who are managed with lifestyle modifications or low-risk medications. Nevertheless, the consensus called for wider use of SMBG and CGM to realize the full potential of the technology.

**QUESTION 2. Should the FDA improve post-approval surveillance of glucose test strip, glucose meter, and CGM device quality?**

Conference participants expressed concerns regarding the shortcomings in the pre- and postmarketing surveillance of SMBG strips, meters, and CGM device quality. Specifically, attendees cited a lack of consistency in how the FDA postmarket surveillance (which relies primarily on self-reporting by manufacturers) is applied across all manufacturers. At least six recent studies evaluating the performance of SMBG devices have demonstrated that only 14% to 67% met the newest accuracy standard (ISO 15197:2013). Many of the less-accurate meters are manufactured outside the United States and are sold at a lower cost. Importantly, because durable medical device providers receive fixed reimbursement from insurers, they are financially incentivized to promote these low-cost meters.

The FDA recognizes that GM devices that do not perform as designed pose a risk to patients and that reporting of adverse events by manufacturers is erratic and not standardized. Despite a requirement that manufacturers report data on possible patient harm, some lesser known brands report few or no such data. The FDA states that they have tools to effectively assure that meters and strips perform within labeled levels as well as multiple enforcement options, including recalls, seizures, safety alerts, warning letters, injunctions, and civil money penalties. However, use of these tools and enforcement options are inconsistent.

Support was expressed for the AACE recommendations that independent and ongoing pre- and postmarketing testing of GM devices is needed and that funding for such surveillance could be derived from manufacturer revenues or government programs. There was also consensus that the FDA should rigorously apply existing enforcement options and expeditiously prohibit the sale and marketing of devices that do not meet acceptable quality standards, including product embargo, if necessary. Additionally, contemporary accuracy standards (e.g., ISO 15197:2013) should be adopted by the FDA and applied to all blood GM devices available on the US market and accuracy results should be incorporated into product labeling.
QUESTION 3. Do current private insurance and Medicare policies balance the need to provide patient access to high-quality care and effective GM and, if not, what policy changes are needed with respect to patient access to SMBG supplies and CGM technologies?

In January 2011, the Centers for Medicare and Medicaid (CMS) implemented the Competitive Bidding Program (CBP) to limit glucose strip costs. Although conference participants agreed that cost-cutting measures are needed, they expressed strong concerns that the CBP is restricting patient access to more expensive, improved technology devices, thereby limiting choices for patients and health care professionals and possibly increasing patient risk for adverse events. Additionally, participants stated that CMS requirements for patients and clinicians to provide documentation of GM discourages utilization of this technology and increases the potential for serious health risks for the patient with diabetes.

One major concern is that CGM technology is not covered by CMS. Participants stated that Medicare beneficiaries with type 1 diabetes who are stable on CGM before receiving Medicare coverage should not be forced to discontinue CGM, which would leave them more vulnerable to the risks of hypoglycemia. Participants unanimously agreed that Medicare should establish a benefit category for CGM and future advanced medical technologies.

QUESTION 4. What are the most effective ways for the key stakeholders (physicians, allied health care professionals, payers, industry, employers, health care systems, regulators) to achieve appropriate, evidence-based, cost-effective regulation of GM (blood GM and CGM) technology?

The ideal health system would provide an optimal amount of GM, as determined by each individual and his/her health care professional. However, the current system creates distortions in which some people who need more monitoring are denied access, while others may be sent supplies in excess of their needs in the absence of sufficient controls to prevent fraud and abuse.

Participants stressed the importance of addressing diabetes-related processes at the federal government level because the government is the largest payer and its actions affect every other payer. However, they recognized the difficulty of achieving meaningful changes in the current system due to the large number of agencies within the executive branch, each with its own agenda and complex reporting structure.

The National Diabetes Clinical Care Commission Act (NDCCCA) was identified as an example of a focused response to this challenge. The NDCCCA, which is currently under consideration by Congress, seeks to coordinate actions of agencies related to diabetes and assist them with direction by clinical experts from a sanctioned advisory body. All stakeholders would benefit from streamlining of regulatory processes involved in access to GM technology. As a starting point, participants suggested that use of a single standardized form for the prescription of GM and documentation of its medical necessity would ease the current regulatory burden.

Summary

Although appropriate use of GM has been shown to improve diabetes control and patient safety, access to GM technology is not currently provided to an acceptable degree by payers. Participants agreed that coverage determination by payers should place a higher priority on the optimal health needs of the patient, as determined by his/her health care professionals.

To better address monitoring accuracy and patient safety, consensus attendees strongly recommended that the FDA enforce existing regulations during both the approval and postmarketing surveillance processes. The inability of the FDA to remove from the
Using Real-time Data for Analysis of Blood Glucose Control: An Option to Standard Glycated Hemoglobin Measurements

Jennifer Schneider, MD, MS
Chief Medical Officer
Livongo Health
Mountain View, CA

Abstract
Glycated hemoglobin (HbA1c) is the standard in diabetes care for assessing an individual’s blood glucose control over the previous 90 days. Increasing real-time data collection enabled by diabetes technologies, such as continuous glucose monitoring (CGM) and cellular- or blue tooth-enabled glucose meters, has prompted efforts to leverage the real-time blood glucose readings to provide insights on diabetes control through mathematical modeling for estimated HbA1c. If widely implemented, use of the data that already are being collected could make glucose monitoring easier and less expensive. Further, coupling real-time data with effective outreach interventions has the potential to reduce diabetes-specific emergency department visits. The real-time data highlight the need for outcomes studies to examine more closely the impact of varying blood glucose readings within the same HbA1c (glycemic variability).

Alternatives to the Standard HbA1c
HbA1c is widely used as an indicator of a patient’s glycemic control over the past 90 days and reflects the extent to which red blood cells undergo glycosylation (bind with glucose). The Diabetes Control and Complications Trial (DCCT) demonstrated that tight control of glucose levels and lowering of the HbA1c were largely responsible for preventing progression of long-term microvascular complications of diabetes (kidney, eye, and nerve disease) (1). Subsequently, HbA1c became an important predictor for complication risk and is the predominant metric by which program quality, outcomes, and costs associated with diabetes are measured. The American Diabetes Association recommends an HbA1c of 7% or lower (corresponds to an estimated average blood glucose of ~154 mg/dL) (2). Studies have shown that people who reduce their HbA1c have better diabetes care and self-management (3). Tracking of HbA1c allows optimal design of interventions and maximizing of clinical outcomes.

Practically speaking, monitoring HbA1c means additional expense (the cost of the test) and commitment (time to get the test) for a patient. A simpler solution might be to leverage blood glucose readings already being taken and to determine control from multiday readings. This approach can be further enhanced by the increased ability to download blood glucose readings via smart meters and provide ongoing HbA1c values. This type of “near-instant” feedback has the potential to motivate patients by allowing for shorter positive feedback loops when improved glycemic

References
control occurs, not necessarily requiring an entire 90-day cycle.

Extensive research has sought to establish the relationship between HbA1c and mean plasma glucose (MPG) and how this relationship relates to overall glycemic control. Using data from the DCCT, investigators found a linear relationship between HbA1c and MPG, which prompted the recommendation to supplement current laboratory reporting of HbA1c with an estimated MPG (4). However, several investigations have shown frequent discordance between the HbA1c and the MPG in clinical practice.

In the last few years, several mathematical relationships have attempted to improve the dichotomy between HbA1c and MPG. These models have used different mathematical weighting factors (e.g., glycosylation caps, length of red blood cell life) to obtain a good fit and to minimize bias between clinically measured HbA1c, calculated HbA1c, and MPG (5). In general, most of these models have shown that HbA1c is strongly associated with the preceding MPG over the previous weeks and months and that these algorithms are adequate for HbA1c ranges of 6% to 9%. However, most of the models require multiple days of CGM monitoring and/or 7-point testing, which is unlikely to occur for most patients. Maximizing mathematical models to extend beyond the measured HbA1c range of 9% without overly burdensome blood glucose checks could further leverage the data already being collected by patients.

**Glycemic Variability Within the Same HbA1c**

Although HbA1c calculations (or mathematically modeled values) remain the standard for assessing glycemic control, a growing group of diabetes researchers is focusing on glycemic variability.

Because HbA1c is a measure of average red blood cell glycosylation, two people may have the same HbA1c, but one might have very little variability around an average blood glucose level, while another might have huge swings. Limiting interpretation of control solely to the HbA1c reading would provide the false impression that both patients had similar glucose control. However, if both patients had access to and wore a CGM, those readings would reveal the highly variable range of blood glucose readings for each. CGM readings could show, for example, that one patient (Suzy) stays in the target range (defined here as 70-160 mg/dL) nearly 90% of the time, while the other patient (Joe) is only within the same range approximately 50% of the time (Figure).

Does such variability matter? Certainly, Joe is at higher risk for costly emergency department visits for hypoglycemia and hyperglycemia than is Suzy. If this information is monitored real-time with interventions such as outbound calls or caregiver notification, could these costly visits be avoided? What about long-term complications such as blindness or kidney failure? Early evidence from connected blood glucose monitors coupled with an outreach arm show substantial cost savings from avoiding emergency department visits. Research has begun to focus on the effect of glycemic variability on long-term outcomes.

**Conclusions**

Today’s technological advances in blood glucose monitoring with the ability to track real-time data (CGM and connected devices) coupled with the ability for real-time feedback (smart analytics delivered to the individual) have the potential to advance the field beyond the standard HbA1c measure. Specifically, such technology can deliver near real-time insights on overall control by leveraging mathematical modeling rather than the 90-day review of the

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**Figure.** Glycemic variability within the same HbA1c.
standard HbA1c. Decreasing cost and time, as well as providing a shorter feedback loop to the patient, has the potential to improve overall control. Moreover, pairing real-time blood glucose data with effective interventions may lower costs attributed to hypoglycemia- and hyperglycemia-associated emergency department visits. The longer-term impact of glucose variability on diabetes complications should be studied.

References

Progress Towards The Automation of Insulin Delivery

Jen M. Block, FNP, NP-C, BSRN, CDE, CDTC
Director of Clinical Innovation
Bigfoot Biomedical Inc.
Milpitas, CA

Abstract
“We are not waiting” is the enthusiastic call to action from within the diabetes community. Health care providers, people with diabetes, and their loved ones, are eager for technological solutions intended to improve clinical outcomes and reduce some of the many burdens of daily diabetes management. This article provides an overview of the development and clinical testing of artificial pancreas (AP) systems as well as the potential impact these systems may have on people living with type 1 diabetes (T1D).

Introduction
Diabetes management is challenging for both providers and people living with T1D. Research from the T1D Exchange clinical registry indicates that many people with T1D remain challenged to achieve optimal glucose control (1). Daily decisions about insulin delivery are made using math and pattern recognition; tasks computers are capable of performing. Automated insulin delivery, closed-loop, and artificial pancreas (AP) systems are designed to transition some of these tasks from the person with diabetes to an algorithm. In an AP system, the algorithm determines how to adjust the delivery of insulin in response to glucose and trend data provided by a continuous glucose monitor (CGM). AP systems come in a variety of form factors and provide varying levels of automation. Some AP systems are designed to suspend insulin in an effort to minimize hypoglycemia and other systems fully automate insulin delivery and the user does not need to enter any information about meals or exercise. The first automated insulin delivery system gained FDA approval in 2013, and temporarily suspends basal insulin delivery in response to CGM glucose levels below the programmed threshold in an effort to reduce exposure to hypoglycemia.

While automated insulin delivery systems have the potential to support diabetes management, the person with diabetes will remain a very important part of the equation. Regardless of the level of automation, the user will need to learn how to operate, supervise, and troubleshoot the AP system. Current and proposed AP systems will require regular maintenance including the insertion and calibration of CGM, as well as reservoir and infusion site insertions for insulin and other medications. In some AP systems, the person with diabetes may be asked to enter information about meals or exercise into the system. An important consideration in the design of AP systems will be striking a balance between the level of support provided through the automation of insulin delivery and the number and complexity of the tasks needed to operate the system.
Review of AP System Development and Testing

Progress in the development and testing of AP systems has accelerated rapidly in recent years. A variety of AP systems are being evaluated in clinical trials run by both industry as well as academic researchers. The U.S. Food & Drug Administration (FDA) published a guidance document on investigational device exemption (IDE) and premarket approval (PMA) applications for artificial pancreas device systems (2). This document provides guidance to researchers, industry and the FDA seeking eventual FDA approval on AP systems. A search of clinicaltrials.gov conducted on November 19, 2015 for “artificial pancreas” yielded a total of 110 clinical trials: 54 completed trials, 12 active but not recruiting trials, 21 actively recruiting trials, and 10 trials that are not yet recruiting (3). Results from recently published studies presented in Table 2 have demonstrated the safety and feasibility of different AP systems (4-16).

Research has demonstrated that use of both low glucose suspend and predicted low glucose suspend systems have resulted in a statistically significant reduction in time spent hypoglycemic (4-6). Use of automated insulin delivery systems overnight has shown a reduction in nocturnal hypoglycemia (7,8), and an increase in time spent within the target glucose range (9,10). AP systems that both suspend insulin delivery in an effort to reduce hypoglycemia and deliver insulin in an effort to reduce hyperglycemia have resulted in a reduction in hypoglycemia (11) as well as an increase in the percentage of time spent within range (15,16). Dual hormone AP systems face a unique challenge; despite recent progress towards the development of stable, soluble glucagon; these glucagon formulations have yet to be approved by the FDA (17).

In addition to the work done by industry and academic researchers, members of the diabetes community have been busy innovating in this area as well. The technologic advances they have designed are based on their personal experience and that of their loved ones with T1D. A team of people with a personal connection to diabetes designed a solution to enable remote viewing of CGM data before a commercial system was available; a technology known as Nightscout. This group of dedicated individuals shared the technology with the larger community through a Facebook Group, CGM in the Cloud.

Bryan Mazlish worked in secret to design an automated insulin delivery system that gained him the moniker “Bigfoot.” His wife, Sarah, and his son have used the automated insulin delivery system he designed daily for more than 3 years. In a recent publication about her experience using this system Sarah said, “While the system hasn’t cured me of diabetes, it has relieved a huge part of the burden of T1D, most notably the constant 24/7 micromanagement of my blood sugar, the fear of hypoglycemia, and the sleeplessness that accompanies that fear. I hope that someday soon, all people with T1D can feel the airiness of handing that burden over to a system such as ours” (18).

Others have also taken up the challenge; their efforts have prompted an emerging online community bringing together people tackling this challenge on their own. Many of these “do-it yourselves” are highly skilled and knowledgeable in their respective fields and likely have been very

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### Table 1. The Different Types of Artificial Pancreas Systems

<table>
<thead>
<tr>
<th>Type of AP System</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Low Glucose Suspend (LGS)</td>
<td>A system that suspends insulin delivery when the CGM drops below a programmed low glucose threshold</td>
</tr>
<tr>
<td>Predicted Low Glucose Suspend (PLGS)</td>
<td>A system that suspends insulin delivery when the CGM is predicted to drop below programmed low glucose threshold</td>
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<tr>
<td>AP System- Overnight Only</td>
<td>A system that adjusts insulin in response to CGM data overnight only</td>
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<tr>
<td>Hybrid AP System</td>
<td>A system that adjusts insulin in response to CGM 24 hours a day, with meals and possibly other variables entered into the system</td>
</tr>
<tr>
<td>Full AP System</td>
<td>A system that adjusts insulin delivery 24 hours a day in response to CGM without input from the user about meals or other variables such as exercise</td>
</tr>
<tr>
<td>Dual Hormone AP System (DHAPS)</td>
<td>A system that adjusts both insulin and glucagon delivery in response to CGM data</td>
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### Table 2. Results of Clinical Trials Using Artificial Pancreas (AP) Systems

<table>
<thead>
<tr>
<th>AP System</th>
<th>Study Details</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Glucose Suspend (LGS)</td>
<td>• N=247</td>
<td>• Hypoglycemia reduced by 38% at night compared to sensor augmented pump therapy (SAP) measured as area under the curve on CGM (4) • Overall time of glucose &lt;60 mg/dL on CGM reduced from 3.1% to 1.8% (4)</td>
</tr>
<tr>
<td>Predicted Low Glucose Suspend (PLGS)</td>
<td>• N=45 ages 15-45</td>
<td>• PLGS reduced hypoglycemia median area under the curve by 81% and hypoglycemia lasting &gt;2 hours was reduced by 74% (5) • Overnight hypoglycemia with at least one CGM value ≤60 mg/dL occurred on 196 of 942 (21%) intervention nights versus 322 of 970 (33%) control nights (odds ratio 0.52 [95% CI 0.43-0.64]; P &lt; 0.001) (5)</td>
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<tr>
<td></td>
<td>• Duration of use= 42-night trial</td>
<td>• Median time at &lt;70 mg/dL was reduced by 54% on intervention nights (P &lt; 0.001) in 11-14-year-olds (n = 45) and by 50% (P &lt; 0.001) in 4-10-year-olds (n = 36). (6) • Mean overnight glucose was lower on control versus intervention nights in both age-groups (144 ± 18 vs. 152 ± 19 mg/dL [P &lt; 0.001]) (6)</td>
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<tr>
<td></td>
<td>• N= 45 (11-14 years of age)</td>
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<td></td>
<td>• N= 36 (4-10 years of age)</td>
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<tr>
<td></td>
<td>• Duration = 42 nights</td>
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<tr>
<td>AP System-Overnight</td>
<td>• N= 15</td>
<td>• Reduced time of glucose &lt;70 mg/dL from 49 to 4 min/ night on CGM (7)</td>
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<tr>
<td></td>
<td>• Duration of use = 4 nights</td>
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<tr>
<td></td>
<td>• N=19</td>
<td>• Percentage of time with glucose &lt;70 mg/dL on CGM was 2.5% vs. 5.2% on SAP (8) • Overnight mean CGM glucose 148 vs. 161 mg/dL on SAP (8)</td>
</tr>
<tr>
<td></td>
<td>• Duration of use = 6 weeks</td>
<td></td>
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<tr>
<td></td>
<td>• N=16 adolescents</td>
<td>• Percentage of time with glucose 70-144 mg/dL on CGM at night was 64% vs. 47% on SAP, with no increase in hypoglycemia (9)</td>
</tr>
<tr>
<td></td>
<td>• Duration of use= 3 weeks</td>
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<tr>
<td></td>
<td>• N=24 adults</td>
<td>• Percentage of time CGM was in range on overnight AP was 53% vs. 39% on SAP, with no increase in hypoglycemia (10) • Mean CGM glucose was 162 mg/dL on SAP vs. 148 mg/dL on overnight AP (10)</td>
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<tr>
<td></td>
<td>• Duration of use= 4 weeks</td>
<td></td>
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<tr>
<td>Hybrid or Full AP System</td>
<td>• N=18 adults</td>
<td>• Twofold reduction of hypoglycemia requiring carbohydrate treatment: 1.2 vs. 2.4 episodes/session on CLC versus OL (P = 0.02) (11) • Statistically significant increase in mean glucose (152 mg/dL vs. 161 mg/dL) on AP system (P = 0.04) (11)</td>
</tr>
<tr>
<td></td>
<td>• Duration of use =2 sessions each 40-hours</td>
<td></td>
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<tr>
<td></td>
<td>• N=17 adults</td>
<td>• Median percentage of time glucose was 70-180 mg/dL significantly increased on the AP system (75%) as compared to 62% on SAP (P = 0.005) (12) • Mean glucose was significantly reduced (158 mg/dL for SAP vs. 145 mg/dL for AP system) (P = 0.027) (12)</td>
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<tr>
<td></td>
<td>• Duration of use = 7 days AP system vs. SAP</td>
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<tr>
<td></td>
<td>• N=8 x 48 hrs inpatient</td>
<td>• Similar overall time with CGM glucose 70-180 mg/dL: 73.1% on LGS vs. 69.9% on hybrid APDS (P=0.580) (13)</td>
</tr>
<tr>
<td></td>
<td>• N=21 x 6 days at camp</td>
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<tr>
<td>Dual Hormone AP System (DHAPS)</td>
<td>• N=11</td>
<td>• Median time CGM glucose was 70-180 mg/dL unchanged in the first 24 hours of use but increased on day 2 (159 mg/dL vs. 139 mg/dL) (14)</td>
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<tr>
<td></td>
<td>• Duration of use= 48 hrs</td>
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<tr>
<td></td>
<td>• N= 20 adults</td>
<td>• After 1 day of use, reduction in mean glucose to 159 mg/dL vs. 133 mg/dL on usual care (insulin pump with or without CGM) (15) • Mean time CGM glucose &lt;70 mg/dL was 7.3% (DHAPS) vs. 4.1% (usual care) (15) • Mean time glucose 70-180 mg/dL significantly increased: 59% (DHAPS) vs. 80% (usual care) (15)</td>
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<td></td>
<td>• Duration of use = 5 days</td>
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<tr>
<td></td>
<td>• N= 32 adolescents</td>
<td>• Percentage of time CGM glucose was 70-180 mg/dL increased from 61% on usual care vs. 76% on DHAPS (15) • Mean time glucose &lt;70 mg/dL was 4.9% on DHAPS vs. 3.1% on usual care (15) • After 1 day of DHAPS use, mean glucose reduced from 158 mg/dL to 143 mg/dL (15)</td>
</tr>
<tr>
<td></td>
<td>• Duration of use = 5 days at camp</td>
<td></td>
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<tr>
<td></td>
<td>• N=33 ages 9-17 yrs</td>
<td>• Median time CGM glucose &lt;72 mg/dL was 0% on DHAPS compared wto 3.1% on AP system with insulin only, and 3.4% on insulin pump therapy (16)</td>
</tr>
</tbody>
</table>
closely monitoring the systems they have designed. It is important to note that devices that have not been developed within a rigorous quality system or subjected to formal evaluation in clinical trials may have potential risks that have not yet been identified. This author does not endorse the use of a device or system that is not FDA approved for the specific indication.

Innovation from within the community of people touched by T1D serves to emphasize how eager the community is to access technology that may support them with some of the many tasks of daily diabetes management. Community members and fathers of children with T1D, Bryan Mazlish, Lane Desborough, co-founder of Nightscout, Jeffrey Brewer, former CEO of The Juvenile Diabetes Research Foundation, and Jon Brilliant, former CFO of WellDoc, have joined forces to form Bigfoot Biomedical, a company designing an automated insulin delivery system. Ed Damiano, known for his work on the Bionic Pancreas is also motivated by his son’s diagnosis of type 1 diabetes and has designed and is testing an artificial pancreas system using both insulin and glucagon (19). Unlike the do-it-yourself systems described, medical devices that are intended for commercial use will undergo extensive clinical testing and have regulatory oversight to ensure they are safe and efficacious for their intended use.

Progress in this field has been rapid in recent years and the efforts of the community, industry, and academia are impressive. The results of some of the many clinical trials summarized in the Table 2 demonstrate the positive impact use of these systems can have on glycemic control (4-12, 14-16).

### The Human Side of Automation

With advances in clinical research on AP systems come questions about how people with T1D may feel about their ability to use and trust an AP system. Will people with diabetes be willing to transition some of the many daily diabetes management tasks to a system composed of hardware, software, and an algorithm? At the 2015 Advanced Technologies and Treatments for Diabetes (ATTĐ) conference, psychologist Katharine Barnard, PhD, noted this transition may be a welcome change for some, but may be potentially anxiety producing for others (20).

Clinical trials afford a unique opportunity to gain insight into how use of an AP system may impact people with diabetes. In a cohort, of research participants in an AP trial with T1D and prior insulin pump experience (N=132) 75% intend to use an AP system when commercially available (21). In a similar but smaller cohort (N=22) almost all indicated that they would be willing to use AP systems that are not fully automated and either only functioned overnight or required meal announcements (22). A survey of participants with experience using AP systems in a clinical trial found 86.1% of respondents were highly likely or likely to use an AP system when commercially available (23). Adolescents with T1D who participated in an at home AP trial, and their parents, reported experiencing the benefits of peace of mind, “time off” from diabetes, improved sense of safety and glycemic control outweighed the practical challenges, including difficulties with calibration, alarms, and the size of the devices (22). Following a brief 4 night trial with use of an AP system overnight, participants reported a reduction in worry about hypoglycemia as well as a high level of satisfaction and acceptance of overnight automated insulin delivery (24). This research highlights the potential AP systems hold to have a positive impact on diabetes care, but there remains much to be learned about the implications of their use over a longer duration.

### Clinical Application/Summary

AP systems come in a variety of forms with varying levels of automation and interaction with the user. Technology that holds the potential to minimize exposure to both hypoglycemia and hyperglycemia (4-12, 14-16) while possibly reducing some of the cognitive and psychosocial burdens of diabetes management (22,24) is much anticipated. Clinicians and patients alike must understand that all proposed AP systems, regardless of the level of automation, will require regular maintenance and supervision. As AP systems become available, clinicians must work hard to ensure that people with T1D have realistic expectations for their use as well as appropriate training and support.

### References

2. Guidance for Industry and Food and Drug Administration Staff: The Content of Investigational Device Exemption (IDE) and
Premarket Approval (PMA)
Applications for Artificial Pancreas Device Systems


Abstract
Twenty-first century health care reform, consumer demands, and the availability of an increasing array of mobile devices, apps, and virtually available services are shifting the venues for where and how registered dietitian nutritionists (RDNs) can deliver diabetes prevention and diabetes education, and management. These new venues offer exciting ways to engage clients in their care. Some initial research demonstrates successful outcomes with these new technologies and services, which allow clinicians to provide the frequency and chronicity of care that is critical for clinically and cost-effective outcomes. This article presents the case for virtual delivery of diabetes care and education and describes the array of currently available products and services. The article also details three factors that RDNs should be knowledgeable about when delivering care virtually or using telehealth: compliance, licensure, and reimbursement.

Introduction
The confluence of societal changes, consumer demand for 24/7/365 access, the availability of digital devices and myriad technology-enabled services, and the current value-based goals for health care delivery is leading to significant changes in environments in which RDNs deliver counseling (1). Numerous digital devices, mobile health apps, and integrated services specifically designed for nutrition counseling for diabetes prevention and management are currently available for RDNs, RDNs who are also Certified Diabetes Educators (CDEs), and health coaches. Many more are in development. This article presents the case for virtual delivery of diabetes care and education and describes the array of currently available products and services. The article also details three factors that RDNs should be knowledgeable about when delivering care virtually or using telehealth: compliance, licensure, and reimbursement.

The Case for Diabetes Prevention and Management Utilizing Technology
Using one or a gamut of technologies to deliver diabetes prevention as well as diabetes education and management has the potential to enable health care providers, such as RDNs, to offer the frequency and chronicity of service and support that studies have shown people need to achieve clinically and cost-effective outcomes for managing type 2 diabetes (2,3), prediabetes (4), and/or weight control (5). Additionally, it is well documented ongoing support is essential to achieve weight loss and maintain weight loss (4,5). Studies also show that people typically achieve a greater number of positive outcomes, such as improved glucose control, other metabolic parameters, or weight control, with an increased frequency of engagement and attendance (3,6).

Though at present minimal research exists on the clinical effectiveness and cost effectiveness of digital devices and technologies and mobile-health applications (apps), the body of research is increasing. However, making comparisons with this literature is a challenge due to variation in technologies and programs, differences in study designs and a minimal number of studies.

A systematic review by DiFilippo et al. included peer-reviewed, randomized, controlled trials; noncontrolled trials; and cohort studies using apps to increase nutrition knowledge or improve nutrition-related behavior. (7) One recommendation by DiFilippo et al., was for greater integration of behavioral theory in the apps (7). McTigue et al., implemented the Diabetes Prevention Program (DPP), a 16-week intensive lifestyle management program delivered by lifestyle coaches using telehealth, which demonstrated positive changes in weight and several metabolic parameters (8). A two year follow-up pilot study by Sepah et al., using Omada Health’s internet-based Prevent Diabetes Program demonstrated significant reduction in body weight, hemoglobin A1c
(HbA1c), and progression to type 2 diabetes (9). Siminerio et al., delivered diabetes self-management education and support (DSMES/T) using telemedicine in a rural setting in Pennsylvania demonstrated a 1% improvement in HbA1c among people with type 2 diabetes (10). (Note: The abbreviation DSMES/T is used because DSMES is the term used in the National Standards for Diabetes Self-Management Education and Support, however the Centers for Medicare & Medicaid Services (CMS) continues to use the term diabetes self-management training for this Medicare benefit (11).) As technologies and models of care utilizing telehealth evolve, and as published outcomes become available, clinicians will be able to decipher the most clinically and cost-effective modalities.

The availability and implementation of a variety of virtual technology-enabled devices and services also has the potential to help health care providers who deliver DSMES/T circumvent challenges encountered with in-person visits. Challenges can range from travel time, time lost from work or other activities, child care, and cost of parking or public transportation. Diabetes educators in DMSES/T programs regularly report these challenges. They were cited as factors in two recent utilization studies that demonstrate DSMES/T is a woefully underutilized benefit (12,13). Li et al., from Centers for Disease Control and Prevention (CDC), showed that only 6.8% of persons with newly diagnosed type 2 diabetes who have a private health plan participated in DSMES/T within 12 months of diagnosis (12). A review of 2010 Medicare fee-for-service claims data from Strawbridge et al., on the DSMT benefit showed only 4% of Medicare participants received DSMES/T. These statistics likely underestimate the percentage of people who receive DSMES/T for several reasons, including that some programs do not bill for this service.

**The Landscape of Digital Devices and Virtual Technologies**

The following describes the range of digital devices and virtual programs and services available for diabetes prevention and DSMES/T, from the simplistic to more sophisticated. This is not intended to be an exhaustive list. Readers should keep two points in mind. First, each device, program, or service has unique differences. Full descriptions are beyond the scope of this article and can be found on each product’s or service’s website. Second, these products and services undergo rapid iteration, which results in frequent updates to existing products and rapid development of new versions and products.

**Mobile Applications (“Apps”)**

**Apps for self-care actions:** RDNs who work in diabetes prevention and management can choose from an array of apps to recommend to clients to perform one or more of the following self-care actions: track carbohydrate, food, and nutrient intake; take pictures of foods and estimate calories and nutrient content; record steps or minutes of activity; record and analyze glucose results; track weight or other biometric parameters; and/or track psychological factors. Recent guidance from the U.S. Food and Drug Administration (FDA) identifies these as mobile apps (14) and states that the FDA does not plan to regulate them. How these apps are used by the RDN in clinical practice and whether the RDN receives information from a client and uses this to make recommendations may cross the line between education and counseling from a legal and third-party payer perspective (1).

**Apps to counsel clients virtually:** A variety of apps and services have been developed that allow the RDN to communicate virtually with clients they counsel face-to-face, partially in person and virtually, or completely virtually. MobileRD (https://www.mobilerd.com/), FoodCare (https://www.foodcare.com/), and NuPlanit (http://www.nuplanit.com/) are mentioned by Stein (1). These nutrition apps do not appear to be diabetes-specific but can be used with clients who have prediabetes or diabetes.

**Mobile Medical Apps**

In its 2015 guidance, the FDA defined two other categories of mobile medical apps, often referred to as mHealth apps. The FDA intends to apply its regulatory authority for these
two categories of devices (14). The FDA guidance states that although some mobile apps may meet the definition of a medical device under 201(h) of the Federal Food, Drug, and Cosmetic Act (FD&C Act) (15), they pose less risk to the public, so the FDA does not intend to enforce requirements under the FD&C Act. The FDA guidance document indicates that the FDA intends to apply its regulatory oversight to this third category of apps because the FDA deems them as medical devices or mobile medical apps. This difference is based on the FDA’s consideration that the app could pose a risk to a user’s safety if it does not function as intended. A diabetes-specific example could be an app on a glucose meter that offers suggested insulin doses or other management actions.

**Products, Programs, and Services**

The most expansive variety of options for diabetes prevention and management exist in this category. Less intensive products or programs may offer clients the opportunity to upload data from provided or purchased digital devices, such as a wifi weight scale, activity tracker, or glucose meter. Programs may use one or more tools for communication such as text, video, and/or telephone.

A program such as Omada Health (https://omadahealth.com/), which has Diabetes Prevention Recognition Program (DPRP)-pending status (16), may offer clients the opportunity to engage in online group chats with peers and be assigned a “health coach” (see brief discussion under licensure). Another program that has achieved DPRP-pending status is Canary Health (http://www.canaryhealth.com/) (16). This program offers users the opportunity to input weight management parameters, take part in an evidence-based DPP telehealth translation model (8), and receive regular coaching from health care providers asynchronously (not requiring real-time communication). It is also worth noting that two well-known national weight management programs, Jenny Craig and Weight Watchers, have received pending-DPRP status (16). WellDoc (http://www.welldoc.com/) is a program designed for people with diabetes that uses BlueStar™, a device that enables clients to track their glucose and other data and communicate the results electronically to their providers to assist them in achieving positive clinical outcomes. BlueStar™ is the first of its kind mobile prescription...
therapy that can be reimbursed and adjudicated as a pharmacy benefit like other prescription products (17). WellDoc has demonstrated clinical effectiveness with their device in several studies, one of which documented lowering HbA1c by 1.9% (18).

Two other diabetes-specific virtually available programs utilize CDEs to deliver virtual education and management. Livongo Health (http://www.livongo.com/) uses a communication tool that includes a glucose meter, cloud-based data storage, and an accessible care team that includes CDEs. Fit4D (http://fit4d.com/) is another virtual service that delivers diabetes care coaching conducted by CDEs. Readers can access greater detail and supported evidence about these programs on their websites.

Practice Concerns When Using Telehealth and Virtual Technologies

Regardless of the tool or virtual venue used, RDNs need to be aware of concerns related to compliance, licensure, and reimbursement. Key points are mentioned here and a recent article includes more detailed coverage (1).

Compliance

Whether working with a simple app or doing real-time video conferencing, compliance with the privacy protections of The Health Insurance Portability and Accountability Act of 1996 (HIPAA) and protection of the client’s personal health information (PHI) or personally identifiable information is required once any of this content or status is shared with the RDN. Communications technologies and systems used must be in compliance with HIPAA and maintained securely, such as on a computer, smartphone, or cloud storage.

Licensure

RDNs who live in a state with licensure can use apps or virtual services to work with clients within their state with few additional concerns. If the RDN live in a state with a licensure law and want to provide medical nutrition therapy (MNT) or nutrition counseling, they need to consider whether they need to be licensed in the state where the client is located. If so, the RDN needs to determine if the nutrition counseling he or she is performing constitutes the level of practice for which that state requires licensure. Licensure regulations should not be of concern to RDNs who reside in the few remaining states where the practice of dietetics is not regulated. However, most states currently have a licensure law or other form of regulatory statute, such as certification or title protection. Interestingly, several organizations that represent physicians and nurses are beginning to propose ways to support interstate telehealth services by making the process of obtaining state-based licensure uniform. This will be difficult for RDNs due to variation in current state regulations.

The term health coach and role of health coaches has increased exponentially. The nomenclature for and qualifications of health coaches covers a wide range of expertise. Training for individuals who use the title health coach also varies widely from several days or hours to more extensive and intensive training. RDNs and other health care providers can obtain certification as a health coach through numerous live and online programs. Some RDNs have achieved this certification and integrate coaching into their practice. In addition, some RDNs work in telehealth-based programs in which they provide services that are not defined as MNT or nutrition counseling, such as providing behavior change or lifestyle counseling in a diabetes prevention or management program.

Description of CDC Diabetes Prevention Recognition Program (DPRP) Approval Process and List of Virtually Delivered Programs with Pending DPRP Approval

The CDC Diabetes Prevention Recognition Program Standards and Operating Procedures (DPRP Standards) describes in detail the National Diabetes Prevention Program requirements for a lifestyle program to prevent type 2 diabetes. It also explains the application process and how an organization can earn recognition and continue to be recognized over time. Learn more about the DPRP Standards at: http://www.cdc.gov/diabetes/prevention//lifestyle-program/index.html.

The CDC provides an online national registry of all DPRP programs. This includes a listing of virtual, online, or programs that combine in-person meetings and online elements that have achieved pending recognition. The information is available at: https://nccd.cdc.gov/DDT_DPRP/City.aspx?STATE-OTH&CITY=OTH.
Reimbursement
As health care is transforming, so are payment models. There is movement from a reimbursement fee-for-service model to bundled care. Services such as DSMES/T, diabetes prevention, and weight management counseling are slowly transitioning from hospital- and clinic-based to primary care provider-based in accountable care organizations or patient-centered medical homes. Positive clinical outcomes and cost-effective delivery of care may become the most significant driver of coverage, which could open the door to greater virtual delivery of these services.

Although Medicare (17) and many large private payers currently do not globally cover telehealth services of interest to RDNs and diabetes educators, we may be at a tipping point as some private payers in some states are covering specified programs.

Summary
The use of telehealth and various apps and technologies to deliver diabetes prevention and management services is a burgeoning and rapidly evolving area. The landscape will change significantly in the next few years, providing even more novel and innovative ways for RDNs to deliver care and education. RDNs have myriad opportunities in this area and, therefore, should become engaged and keep abreast of changes in technologies, regulations, and coverage for services. They should determine how to partner with technology developers to help them integrate real-world knowledge and expertise from nutrition experts into their apps, devices, and services. Research shows that most people benefit from frequent and chronic care and support. Using telehealth and virtual technologies have the potential to allow RDNs to deliver care and support in this manner.

References
Using Social Media for Ongoing Diabetes Self-management Support

Tami A. Ross, RD, LD, CDE, MLDE
Diabetes and Nutrition Educator
Kentucky One Health – Primary Care Associates
Lexington, KY

Deborah A. Greenwood, PhD, RN, CNS, CDE, BC-ADM, FAADE
Program Director, Sutter Health Integrated Diabetes Education Network
Sacramento, CA

Abstract
The use of social media is exploding, and the dawning of the e-patient has arrived. The purpose of this article is to raise awareness of social media use for diabetes self-management support. Included in the discussion are benefits and challenges of using social media as well as opportunities for engagement. The authors share social media resources, links to tools for both clinicians and clients, and suggested next steps.

Introduction
Diabetes educators and other health care professionals must be savvy about and engage in social media to truly understand the options and opportunities available for their patients.

Studies have identified the need for ongoing support to maintain behavior changes following structured diabetes self-management education (1). Furthermore, regular follow-up over an extended period of time is necessary to maintain successful behavior change (2). The National Standards for Diabetes Self-Management Education and Support acknowledge the need for and value of ongoing support for those living with diabetes (3). Although diabetes is a chronic condition, individuals with diabetes spend less than 0.1% of their time with their health care providers annually (4). Not surprisingly, individuals who are trying to manage a challenging disease on their own most of the time frequently seek and find additional support apart from face-to-face encounters with their health care team. Social media is one option that is growing in popularity. Communities have been established via various social media outlets where people with diabetes, caregivers, and family members connect with shared experiences to combat isolation, fear, and stigma. They get support 24/7/365.

The goals of this article are to review the rise of e-patients and e-health, evaluate the impact of social media and opportunities for engagement in the health care and diabetes arenas, examine associated benefits and challenges, and discuss the role of the diabetes online community in providing ongoing education and support.

What are e-Patients and eHealth?
Health consumers who use the Internet to gather information about a medical condition of particular interest to them and who use electronic communication tools (including Web 2.0- user-generated content – such as communicating via
Twitter or responding to a blog) in coping with medical conditions are known as e-patients (or Internet patients/Internet-savvy patients). The “e” in e-patient stands for “empowered, engaged, equipped, and enabled.” These e-patients are increasingly active in their care (or that of a loved one) and partnering with their health care team (5). eHealth describes health care practice supported by electronic communications and processes.

The chronic care model (6) is widely recognized within the health care community. Expanding on that foundation, the eHealth Enhanced Chronic Care Model (Fig. 1), recently published in Journal of Medical Internet Research, offers deeper insight into the role of eHealth tools and how they can increase effectiveness and efficiency of self-management support for people with chronic conditions, including diabetes (7). This enhanced model presents a variety of unique opportunities for technology to enhance care, with social media being one element.

The Impact of Social Media

Social media and online engagement are changing the world, particularly as e-patients share information that educators and clinicians might not have. This presents a unique opportunity for e-patients and clinicians to collaborate.

In the broadest sense, social media is a “collaborative process through which information (including news, photos, videos, links, podcasts, etc.) is created, shared, and/or altered via social networking sites” (8). Social networks are Internet sites where people, both peers and experts, gather and share information to make informed health decisions (9). Seventy-three percent of Internet
users use social networking sites, with the greatest number of users in the 18 to 29 years demographic and women more frequently than men (10). Nearly 66% of all adults now own a smartphone, an increase from 35% in 2011 (10).

The ability for the average person to search for health care information via the Internet started in 1998, with the launch of Google. This service offered broad access to medical and health information to educate individuals or support family members. This was the beginning of the explosion of social media. Information sharing has expanded exponentially through Facebook, YouTube videos, Twitter conversations, and a multitude of other platforms, all which do different things. The variety of social media platforms includes:

- Community forums
- Online support networks
- Blogs
- Media sharing (videos, podcasts)
- Microblogs (short updates through instant messaging or Twitter, for example)
- News sources
- Advocacy groups

Figure 2 provides some clarity of how social media works.

**Health care-focused Opportunities for Social Media Engagement**

The social media communication system creates significant opportunities to obtain, expand, and spread information and knowledge (both positive and negative) quickly; foster engagement; and ultimately increase access to credible, evidence-based health messages (Table 1).

As health care professionals engage on social platforms, the number of evidence-based messages increases, which underlines the need for eHealth education. Clinicians who engage and educate themselves ultimately can educate and support people and families touched by diabetes. Social media engagement has both benefits and challenges (Table 2).

It is important for health care professionals to familiarize themselves with the variety of social media platforms and use and experiment with them to gain an understanding before they begin sharing sites and encouraging patient engagement. Two-thirds of diabetes educators consider mainstream social media a valid tool to find or provide information/advice about diabetes or its management for themselves or their patients (12). They are most likely to consider YouTube, followed by Facebook and Twitter.

**Evidence-based Support for Social Media Use**

Given that social media and social networking are relatively new and still evolving, the evidence base addressing social media and
diabetes self-management support is limited. However, it should expand in the future.

A systematic review of six popular health science databases yielded 15 articles (13). The investigators sought to review the planning, implementation, and overall effectiveness of Web 2.0 self-management interventions for older adults (mean age >50 years) with one or more chronic diseases (13). Eleven were randomized, controlled trials, eight of which were diabetes-related, and 11 were theoretically based. Most study participants were females and there was a high attrition rate. Participants had increased self-efficacy and engagement with health behaviors but no improved clinical outcomes. The authors identified a need for a greater consideration of the costs and benefits associated with using social media and Web 2.0 solutions for chronic disease self-management. More research is also needed to determine whether there is long-term effectiveness among larger samples with more diverse populations of chronically ill patients. Ideally, the development and translation of new knowledge along with new social media technologies should create new opportunities to cultivate e-patients living with chronic conditions.

Weitzman (14) and colleagues evaluated hypoglycemia in the diabetes online community tudiabetes.org. A total of 96.6% of members participated in the study, with more than 33% posting their hemoglobin A1c values on their profile pages, allowing other community members to see their results. The research findings suggested that use of an online community may create new opportunities for rapid research engagement and dissemination because hypoglycemia outcomes in this evaluation were consistent with clinical trial data.

Although research proving its effectiveness is limited, the social and emotional benefits of social media are having an impact on people affected by diabetes. Further, social networking continues to grow at a remarkable pace, as illustrated by what occurs on the Internet in just 1 minute (15):

- 100 hours of video are uploaded (30 hours 2 years ago); It would take 5 years to view all video crossing networks every second
- 7 million Facebook messages are sent
- 347,000 new tweets are sent on Twitter (tripled in 2 years)

Health care social media is creating a global shift in how patients and the health care industry connect (5). The key is not merely informing people with diabetes but engaging them so they can make the best possible decisions during the 99.9% of the time they are away from medical professionals.

Historically, only those with education, power, privilege, and money had access to this type of information. Now it’s available to all (if they choose to access it). This change in the knowledge power structure between patients and clinicians, referred to as “democratization of knowledge,” has helped to create the e-patient (16).

### Diabetes Online Community

The Diabetes Online Community (DOC) encompasses anyone (including individuals with diabetes, caregivers, health care professionals, and industry) who engages online in activity related to living with diabetes. The DOC does not require formal membership or registration. DOC participants often use the

<table>
<thead>
<tr>
<th>Table 1. Health Care-focused Opportunities for Social Media Engagement (9)</th>
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<tbody>
<tr>
<td><strong>Professional Practice</strong></td>
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<tr>
<td>- Networking</td>
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<td>- Engaging clients to enhance communication</td>
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<td>- Empowering people to make safer and healthier decisions</td>
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<tr>
<td>- Peer-to-peer communication</td>
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<tr>
<td>- Expanding reach by leveraging networks to enhance information sharing</td>
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<tr>
<td>- Personalizing health message and targeting them to specific audience</td>
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<tr>
<td><strong>Learning</strong></td>
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<tr>
<td>- Timely sharing of medical, health, and safety information</td>
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<tr>
<td>- Sharing of resources</td>
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<tr>
<td>- Increased access to credible, evidence-based health messages and increased potential impact</td>
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<tr>
<td><strong>Promotion</strong></td>
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<td>- Public health messaging</td>
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<td>- Advocacy</td>
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<tr>
<td>- Events</td>
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<tr>
<td><strong>Support</strong></td>
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<tr>
<td>- Providing client and family support</td>
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<tr>
<td>- Developing meaningful relationships</td>
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<tr>
<td>- Increasing motivation to cope with chronic disease</td>
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<tr>
<td>- Combatting isolation, fear, and stigma through shared experiences</td>
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hashtag #DOC to note their affiliation with the DOC when engaging in a variety of online activities across the broad collection of web-based platforms. Hillard and associates (17) provide a succinct overview of DOC participants, venues, reasons for involvement, benefits and risks, and guidelines for participation. Although research on the impact of DOC involvement is limited, initial findings suggest a positive impact on engagement in diabetes self-care, attitudes, and emotional experience (17).

Select activities in DOC participation include (17):

- Creating and contributing original content
- Reposting others’ content
- Commenting or responding to others’ content
- Observing and digesting others’ content

This engaged social support network and platform for patient advocacy seeks to improve the lives and health of those living with diabetes, providing an “online home.” Social media avenues such as the DOC also can raise awareness. One example is the recent Miss America candidate from Idaho, Sierra Sanderson, who wore her insulin pump visibly on the pageant stage and generated interest through a hashtag campaign on Twitter #ShowMeYourPump. A sampling of other venues is listed in Table 3.

Additional insights about the DOC can be found on the tool provided by the American Association of Diabetes Educators (https://www.diabeteseducator.org/docs/default-source/legacy-docs/_resources/pdf/general/Social_Media_Handout.pdf). This tool highlights the DOC, its benefits, and select sites. It is a valuable piece of information to share with clients, educators, and other health care professionals.

### Summary

Social media is changing the world and will continue to evolve. Those who have not engaged probably do not realize the extent of this interconnected world. Although there are challenges associated with engaging through social media, there are greater opportunities, particularly for diabetes self-management support. Health care professionals must expand their focus on eHealth education and become savvy users of social media. Clinicians must have a level of comfort with social media outlets before referring clients to them, and engagement is necessary to gain that comfort. Following are suggested steps that clinicians can take to enhance personal knowledge and engagement through social media:

- Create a new social media account.
- Visit a new social networking site each week.
- Tweet today something you learned from this publication.
- Share the previously mentioned DOC handout with clients and educators.
- Encourage clients and peers to engage online.

### References


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Table 3. Select DOC Venues and Social Networks

<table>
<thead>
<tr>
<th>Community Forums: provide access to information and connections to others living with diabetes</th>
</tr>
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<tbody>
<tr>
<td>• Children With Diabetes online community (childrenwithdiabetes.com)</td>
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<tr>
<td>• Diabetes Daily, LLC (diabetesdaily.com)</td>
</tr>
<tr>
<td>• Glu Type 1 Diabetes Community (myglu.org)</td>
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<tr>
<td>• TuDiabetes Community (tudiabetes.org)</td>
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<td>• EsTuDiabetes Community (Spanish partner to tudiabetes.org) (estudiabetes.org)</td>
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<table>
<thead>
<tr>
<th>Blogs, Videos, and Podcasts: generally related to personal experiences of living with diabetes</th>
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<tr>
<td>• Scott’s Diabetes Blog (scottsdiabetes.com)</td>
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<tr>
<td>• Six Until Me Blog (sixuntilme.com)</td>
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<tr>
<td>• Texting My Pancreas video (textingmypancreas.com)</td>
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<tr>
<td>• The Type 2 Experience: Demystifying Life with Type 2 Diabetes (thetype2experience.com)</td>
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<tr>
<td>• Vine Entertainment Network (<a href="https://vine.co/">https://vine.co/</a>)</td>
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<tr>
<td>• YouTube videos (<a href="http://www.youtube.com">www.youtube.com</a>)</td>
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<tr>
<th>Social Media Platforms: often referred to as microblogging that include photographs and written content</th>
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<tr>
<td>• Instagram (<a href="https://www.instagram.com/">https://www.instagram.com/</a>)</td>
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<td>• Pinterest (<a href="https://www.pinterest.com/">https://www.pinterest.com/</a>)</td>
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<td>• Facebook (<a href="https://www.facebook.com/">https://www.facebook.com/</a>)</td>
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<tr>
<td>• Twitter (Tweet chats are live chats on Twitter around a topic denoted by a hashtag #) (<a href="https://twitter.com">https://twitter.com</a>)</td>
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<table>
<thead>
<tr>
<th>News sources</th>
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<tbody>
<tr>
<td>• Diabetes Mine (healthline.com/DiabetesMine)</td>
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<tr>
<td>• diaTribe (diatribe.org)</td>
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<table>
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<tr>
<th>Advocacy</th>
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<tr>
<td>• Diabetes Advocates (diabetesadvocates.org)</td>
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<tr>
<td>• Diabetes Social Media Advocacy (DSMA) promotes social media in all forms (diabetessocmed.com); hosts TweetChats on Twitter (diabetessocmed.com/tweetchat/) and radio programs</td>
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<th>Offline Contact with Online DOC members</th>
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<tr>
<td>• Friends for Life national conference</td>
</tr>
<tr>
<td>• JDRF symposia</td>
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<tr>
<td>• Taking Control of Your Diabetes national conference</td>
</tr>
<tr>
<td>• Type One Nation Summits</td>
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</table>
A patient selfie sure to make you smile.

Introducing ACCU-CHEK® Connect

Getting a snapshot of your patient’s diabetes just became a lot easier.

With test results automatically sent from the Accu-Chek® Aviva Connect meter to a smartphone app and online portal, patients are able to log and share data anytime, anywhere. View complete information even when a meter is forgotten. Review electronic logbooks, trend graphs, and meal photos attached to results. Even activate the app’s clinically proven insulin calculator.¹ No matter how you and your patient use the system, you’ll have the tools to see the big picture.


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Abstract
Program applications, commonly referred to as apps, for smart devices were introduced in 2008. Since that time, their use in health and disease management has skyrocketed to more than 165,000 apps! It is impossible for clinicians to know and use all of them, but familiarity with the functionality of a few well-designed diabetes apps can round out a nutritional tool kit of services. The ability to find quality resources, learn the technology, and categorize and critique apps is invaluable in making the best choices. Specific diabetes apps can be helpful for patient education, health tracking, and reminders for glucose testing and medications. Ongoing research is elucidating how to create clinical app libraries and match apps to patient needs and behavior change.

Introduction
Apple introduced the iPhone, the first smartphone, in January 2007 (1), and Android phones followed in November 2007 (2). In July 2008, the iPhone App Store debuted, with users downloading 10 million apps the first weekend; the Android market of apps became available in August 2008. By September, iPhone app downloads tallied 100 million (1). Apple and Android now collectively offer nearly 3 million apps, many of which are duplicates (3). This technology ushered in a new era of digital connectivity with major implications for health care, making it an exciting time to be a health care professional.

A 2015 Pew Research Center smartphone report identified that 90% of American adults own a mobile phone and 64% own smartphones (4). Nineteen percent access online services and 7% use cell phones exclusively for Internet access. Sixty-two percent of smartphone owners use them to search for health information online (4).

A 2013 IMSHealth study identified more than 26,000 health apps, with more than 16,000 targeted to consumers and more than 7,000 for health professionals (5). A 2015 IMSHealth study indicated that the number of health apps had increased to 165,000 (5). The overwhelming growth of health apps makes it impossible for health professionals to know all of them. IMS reports that “just 12% of mHealth apps account for more than 90% of all consumer downloads, with nearly half of all downloads generated by just 36 apps.” They found 10% higher 30-day retention rates when apps were prescribed by a health professional, with the value increasing to 30% for prescribed fitness apps.

As smart devices that employ apps become globally ubiquitous, registered dietitian nutritionists (RDNs) would be wise to learn how to manage and recommend use of this technology to patients for wellness and disease management. Having an awareness of the most popular apps and a willingness to help patients use and adjust to digital health technologies is a necessary skill for the 21st century RDN. This article examines apps relevant to diabetes.

Research on Health Care App Use
In March 2012, researchers at Rutgers University identified 227 diabetes apps in the Apple App Store (6). They reviewed app descriptions to test for adherence to the American Association of Diabetes Educators’ (AADE) seven self-care behavior indices, including healthy eating, being active, monitoring, taking medication, problem-solving, reducing risks, and healthy coping (7). Researchers found a median of two AADE™ skills promoted in the identified apps. Of the 227 apps, 89 addressed insulin delivery, 20 had companion websites, 4 were Bluetooth compatible, and 20 included social media connections.

In 2013, the Institutes of Medicine held a roundtable on health literacy in new technologies. Their subsequent design strategy suggestions included: user identification; actionable content; clear, organized, simple display; engaging tools; and user testing (8).
Nundy et al. (9) studied behavioral effects of theory-driven mobile app interventions in Chicago area African Americans. Following baseline, 3-, and 6-month surveys, they found improvements in self-efficacy, social support, health beliefs, and self-care with use of these mobile apps (9).

Scheibe et al. (10) looked at acceptance factors for apps among 32 patients older than 50 years of age (mean age of 69 years). Fifteen had used apps in the past, but only two had used diabetes apps. They had several nonintuitive use misunderstandings as well as fears about data loss and entry errors. The most liked features were the ability to add remarks to values, define blood glucose thresholds, highlight deviations, and reminder features for blood glucose tests and medications (10).

An Australian team developed an app assessment method to assist health professionals in recommending apps for chronic disease (11). They used type 2 diabetes as an example of how to create medical app libraries for patients by: 1) Identifying apps; 2) Categorizing apps by topic and behavior theory strategies; and 3) Matching apps to patient problems, motivation, and preferences.

### Clinical Applications

#### Resources for Finding Apps

Initiating a Google search on “diabetes mobile apps” can yield more than 3.8 million links in just 5 seconds. Several solid resources have been created by reputable sources to help practitioners and clients sift through the maze (Table 1). The Academy of Nutrition and Dietetics maintains a webpage of app reviews and ratings by an RDN at www.eatright.org/appreviews. Ongoing app reviews also appear in the bimonthly *Food and Nutrition Magazine* available on www.foodandnutrition.org. Graduate students at Framingham State University maintain a *Nutrition App Guide* for the John Stalker Institute. Diabetes apps can be found in the *An App A Day* ebook, on Happtique.com, and through IMSHealth’s *Appscripts* tool. Searching for keyword “diabetes” apps in either the Apple App Store or Google Play store produces an app list to review, and initiating a Google search on “diabetes apps” can reveal single apps or articles on favored app lists written by technology journalists.

Other apps that are not specific to diabetes may aid the RDN in staying organized during the day, managing paperwork, offering fitness recommendations, and meal preparation. These include apps for grocery shopping, cooking, morning routines, paperwork, exercise, and travel. The *Complete Diabetes Organizer*, by Susan Weiner, MS, RDN, CDE, CDN, and Leslie Josel provides in-depth information and examples of apps in these categories (12).

### Table 1. Diabetes App Resources

<table>
<thead>
<tr>
<th>Diabetes App Resource</th>
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<tbody>
<tr>
<td>Academy of Nutrition &amp; Dietetics App Reviews</td>
<td><a href="http://www.eatright.pro.org/resources/media/trends-and-reviews/app-reviews">http://www.eatright.pro.org/resources/media/trends-and-reviews/app-reviews</a></td>
</tr>
<tr>
<td>American Association of Diabetes Educators</td>
<td><a href="https://www.diabeteseducator.org/patient-resources/diabetes-goal-tracker-app">https://www.diabeteseducator.org/patient-resources/diabetes-goal-tracker-app</a></td>
</tr>
<tr>
<td>An App A Day - ebook</td>
<td><a href="http://www.AppyLiving.com">www.AppyLiving.com</a></td>
</tr>
<tr>
<td>An App A Day for Health Professionals - ebook</td>
<td><a href="http://www.AppyLiving.com">www.AppyLiving.com</a></td>
</tr>
<tr>
<td>Dietitian Connection &gt;&gt; Apps/technology AU</td>
<td><a href="http://www.dietitianconnection.com/products/resources-materials">http://www.dietitianconnection.com/products/resources-materials</a></td>
</tr>
<tr>
<td>Food and Nutrition Magazine</td>
<td><a href="http://www.foodandnutrition.org">www.foodandnutrition.org</a></td>
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<tr>
<td>Happtique</td>
<td><a href="http://www.Happtique.com">www.Happtique.com</a></td>
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<tr>
<td>iMedicalApps</td>
<td><a href="http://www.imedicalapps.com">www.imedicalapps.com</a></td>
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<tr>
<td>IMS Health AppScript</td>
<td><a href="https://appscript.net">https://appscript.net</a></td>
</tr>
<tr>
<td>UK National Health Service (NHS)</td>
<td><a href="http://apps.nhs.uk/apps/diabetes/">http://apps.nhs.uk/apps/diabetes/</a></td>
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</table>
Resources for Learning Digital Technology

RDNs are well trained to interpret nutrition concepts and need to be prepared to evaluate data from the various means by which they are delivered, including smart devices and apps. Keeping up with the fast pace of technological advances in nutrition is vital to a thriving practice. Those new to digital technology can seek help at colleges and local community centers, senior centers, or online courses (13).

Resources for Critiquing Apps

Both versions of An App A Day for consumers and health professionals include a chapter on app critiquing, with a chart form for users to take notes and compare app features, such as target audience, cost, date, features, content/professional credibility, star rating, and design interface (14). An acronym created by an emerging technologies librarian at The University of Arizona (now at Stanford) can be used to remember similar steps in assessing health apps (15). ABACUS stands for: accuracy, bias/objectivity, authority, currency/timeliness, usability, and scope/completeness.

Diabetes Apps

Many of the apps related to diabetes are developed by major hospitals or diabetes organizations. The Joslin Diabetes Center in Boston has several apps, including HealtheDiabetes, Joslin CME, and Drag 'n Cook, and is testing a new app and web platform called Sugar Sleuth (16). The American Diabetes Association’s apps include Diabetes Care and ADA Standards of Care, and Massachusetts General Hospital has created an app for diabetics and research purposes called GlucoSuccess (17). In November of 2015, the updated 3.01 version of the AADE Diabetes Goal Tracker app became available. This “comprehensive self-management tool” offers general information about diabetes as well as a goal setting and tracking feature and nutrition tracking for calories, carbohydrates, sodium, and total fat.

The OneTouch Reveal app connects to the OneTouch Verio® Sync Meter to aggregate and share data as planned (18). The Accu-Chek® Aviva Connect meter can send test results to the Accu-Chek Connect app on a smartphone as well as an online portal, allowing users to record, view, and share data (19). The IBGStar glucometer takes this concept a step further and is considered a medical peripheral device that has received U.S. Food & Drug Administration approval (20). The glucometer, with its incorporated lancet, attaches to an iPhone (a lightening adapter is needed for newer models) and graphs the glucose results in the accompanying app.

In February 2015, the Tandem t: simulator app was launched (21). It simulates the touchscreen of the Tandem t:slim insulin pump interface to show in demonstrations on a smartphone touchscreen. This is helpful in training and educational settings.

New continuous glucose monitoring (CGM) devices employ a thin subcutaneous needle sensor that sends extrapolated blood glucose data via Bluetooth or a transmitter 288 times a day (every 5 minutes) to a smart device such as a receiver, smartphone, or smart reader. Such frequent testing provides a more accurate picture of how an individual’s blood glucose behaves in response to exercise, food, and insulin throughout the day. Some CGM devices send data to an insulin pump or the cloud that can then be emailed to designees. The Dexcom G5 is considered to have the most accurate blood glucose conversion and uses a receiver or Bluetooth to aggregate data directly to a smartphone app and share data via the Dexcom Follow app for a care team (22). The Medtronic Connect system connects a sensor/transmitter system to a pump and their MiniMed Connect app, allowing data sharing via CareLink (23).

Table 2 lists apps of particular interest to those with diabetes for iOS and Android platforms. Other generic fitness, medication, or nutrition apps may also be of benefit. Many are listed in The Complete Diabetes Organizer (12).

The iPhone’s built-in iHealth app is included in the iOS 8 and 9 software versions. iHealth offers an automated glance at personal physical activity that does not require manual data input. The phone’s GPS and accelerometer collect data as it is carried and automatically graphs steps taken, flights climbed, and walking/running distance. Calories can also be tracked. The app includes a Medical ID feature to post basic information, such as conditions, medications, blood type, weight, height, and emergency contacts. Health practitioners should make iPhone owner patients aware of the app; many people do not realize it is on their phone. Google Fit is the effortless activity tracker for Android phones.

Summary

The growth of mobile health app technology has greatly enhanced medical management opportunities for millions of people with diabetes. Many diabetes apps employ education, tracking, or reminder functions, but presently only a few
AADE® self-care behaviors are incorporated into their design. Researchers encourage the employment of self-efficacy, social support, health beliefs, and self-care behavioral theory into diabetes app design. Much attention has focused on app development for seniors. They desire apps in which they can note remarks, apps that guide them in blood glucose readings, and apps that offer glucose reading and medication reminders.

Multiple resources are helping health practitioners find, learn, categorize, critique, and use digital diabetes apps. With these resources, RDNs who are skilled in nutrition assessment can become leaders in matching app needs as well as teaching and interpreting results through this medium. Needed diabetes app research continues to grow around the globe to elucidate best practices for future use and development.

References


Table 2. Sample Diabetes-related Apps for Consumers

<table>
<thead>
<tr>
<th>Sample Diabetes-related Apps</th>
<th>App Store Availability</th>
</tr>
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<tbody>
<tr>
<td>Australian Carb Counter</td>
<td>AS, GP</td>
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<tr>
<td>Bant-a diabetes app for the ePatient</td>
<td>AS</td>
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<tr>
<td>BG Monitor Diabetes</td>
<td>GP</td>
</tr>
<tr>
<td>Blood Sugar Tracker</td>
<td>AS, GP</td>
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<tr>
<td>Carb Counting with Lenny</td>
<td>AS, GP</td>
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<tr>
<td>Carb Control</td>
<td>AS, GP</td>
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<tr>
<td>CarbMaster Free</td>
<td>AS, GP</td>
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<td>Carbs &amp; Cals</td>
<td>AS, GP</td>
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<td>Daily Carb</td>
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<td>dBees</td>
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<tr>
<td>Diabetes</td>
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<td>Diabetes App</td>
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<td>Diabetes Buddy</td>
<td>AS, GP</td>
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<tr>
<td>Diabetes Companion</td>
<td>AS, GP</td>
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<td>Diabetes in Check</td>
<td>AS, GP</td>
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<td>Diabetes Kit</td>
<td>AS, GP</td>
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<td>Diabetes Log</td>
<td>AS, GP</td>
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<td>Diabetes Logbook</td>
<td>AS, GP</td>
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<td>Diabetes Pilot</td>
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<td>Diabetes Pocket</td>
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<td>Diabetes Tracker</td>
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<td>Diabetik</td>
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<td>dLife Diabetes Companion</td>
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<td>GSK Diabetes HealthMate</td>
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<td>AS, GP</td>
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<tr>
<td>IBGStar</td>
<td>AS</td>
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<tr>
<td>MyMedtronic Connect- for pumps</td>
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<tr>
<td>MySugar- Logbook, Importer, Quiz, Junior</td>
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<td>OnTrack Diabetes</td>
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<td>SiDiary6</td>
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<tr>
<td>Wavesense Diabetes Manager</td>
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AS=Apple App Store, GP=Google Play; prices vary
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Wearable Device Technology in Diabetes Management

Tamara S. Melton, MS, RDN, CD
Nutrition Consultant, La Carte Wellness
Atlanta, GA

Abstract
Consumer use of wearable devices has increased dramatically in the past few years. Activity trackers and smartwatches, two commonly known wearable devices, allow patients and health care providers to monitor behaviors that affect diabetes management. Future innovations in diabetes care include devices that allow for automatic monitoring of blood glucose levels and insulin therapy. This article describes commonly used wearable devices that can be incorporated into diabetes management as well as two future innovations currently being developed.

Introduction
The term "wearables" has a wide range of definitions. One of the most basic from the Oxford Dictionary describes a wearable as “a computer or other electronic device that is small or light enough to be worn or carried on one’s body” (1). Using this definition, continuous glucose monitoring (CGM) devices and insulin pumps were some of the first wearable devices created specifically for people with diabetes. In the past few years, technology companies have designed and produced many different wearable devices that allow users to monitor and track data that would be helpful in the prevention and treatment of diabetes, such as physical activity, sleep habits, and nutrition (2).

Understanding the capabilities of currently available devices can allow registered dietitian nutritionists (RDNs) working with patients with diabetes to incorporate the data provided by these devices into their patients’ treatment plans. Additionally, diabetes practitioners should stay abreast of emerging technologies in diabetes-specific devices, such as CGM devices and insulin pumps.

Current Wearable Technology
There are now several widely available wearables on the market. Some of the best known wearables are Fitbit, Jawbone, and the Apple Watch (3). Fitbit product offerings range from the Zip, a sleek, sophisticated pedometer worn on a belt or pocket, to their top-of-the-line Surge bracelet, which tracks everything from heart rate to multisport workouts to sleep habits (4). Between the Zip and the Surge, Fitbit offers several other trackers with various degrees of capabilities. Jawbone’s UP product line ranges from the UP clip-on, a high-tech accelerometer, to the more sophisticated UP4 bracelet, which tracks steps and sleep habits and includes an idle alert and heart health monitoring (5).

The much-anticipated Apple Watch offers many of the same activity monitoring features as the Fitbit and Jawbone products, but it has the unique ability to use third-party applications and include software updates that gives the Apple watch the potential for more diabetes-specific offerings (6). Application developers, including CGM and insulin pump device companies, can create third-party applications for the Apple Watch. One example of this is the Dexcom G5 mobile app. Approved by the U.S. Food and Drug Administration in August 2015, Dexcom’s G5 device is an all-in-one sensor/transmitter that eliminates the need for a separate hand-held device (7). The corresponding G5 app sends blood glucose readings from the G5 device via Bluetooth to an iPhone. The results of the readings are shown on the user’s Apple Watch.

Future Wearable Technology in Diabetes Treatment
Researchers are working on other wearable technologies for patients with diabetes. The Bionic Pancreas Team is a collaboration between Boston University and Massachusetts General Hospital. This team is working to create an artificial pancreas using wearable technology for people with type 1 diabetes (8,9). The Bionic Pancreas uses a computer algorithm to coordinate the functions of a CGM device and an insulin pump to balance blood glucose levels. This and similar artificial pancreas devices would
improve upon current CGM/insulin pump systems, which send data wirelessly between two devices to manage blood glucose and insulin injections. Current CGM/insulin pump systems that use Bluetooth technology can be affected by lapses in or weak connectivity (10). As a self-contained system, the artificial pancreas would not require wireless connectivity to transmit data between devices.

Another much anticipated wearable device made for people with diabetes is Google’s Smart Contact Lens. The patent application for this wearable device shows that the contact lens should sense a wearer’s glucose level from tears produced in the eye (11). Google has partnered with Novartis in the development of this product and states that it will take at least 5 years of development and testing before the lens is brought to market.

**Clinical Applications**

A study published by the consulting firm PriceWaterhouseCooper (PWC) found that about 20% of American adults own a wearable device (12). Consumers are beginning to warm to the idea of wearable devices as part of their health care treatment. The PWC study also found that 80% of consumers thought that wearables can make health care more convenient. A few apps have been created that integrate patient data generated from wearables into an electronic health record (EHR), and many EHR vendors and health care organizations are looking to adopt such technology (13). Patient-generated data from wearables could soon become an integral part of a patient’s health record, with the data used to monitor and treat many conditions, especially ones as complex as diabetes. Therefore, RDNs need to become proficient in using data from wearable devices in diabetes education and management.

Although most data from patients’ wearables are not currently available in EHRs, clinicians can still use these devices in diabetes treatment, especially when working with patients on setting goals to improve lifestyle behaviors. Patients who are using activity trackers can keep a more accurate record of their physical activity and nutrition. RDNs can use such data to gain insight into areas where patients may be struggling to manage steady blood glucose levels. Clinicians can also use the data to encourage patients to set goals, such as increasing physical activity or improving sleep habits.

Continued improvement in CGM and wireless insulin pump technology will allow more patients to manage their blood glucose levels more effectively. However, RDNs need to become familiar with some of the technical challenges that may occur when using these devices or, at the very least, where to refer patients who may be experiencing problems with their devices. RDNs who provide CGM and insulin pump education need to keep abreast of new generations of CGM devices and insulin pumps and any associated apps. A good rule of thumb would be to download the app on a smartphone and become familiar with the functions and navigation before including training on the app with other patient education. Developers are constantly updating their apps, so RDNs should keep track of any updates that may affect user function and encourage patients to keep their apps updated to avoid any issues related to device performance or security.

**Summary**

Diabetes is a chronic disease that requires constant monitoring, and innovations in technology for diabetes care will continue. The invention and subsequent use of CGM devices and insulin pumps in diabetes management foreshadows the incorporation of other technology, such as activity trackers and artificial pancreases in future diabetes treatments. RDNs should strive to stay current on wearable devices that can be used in the management of their patients’ diabetes. These advancements in technology should provide patients with tools that allow them to better manage this complicated condition and prevent or delay onset of the serious complications associated with diabetes.

**References**

6. Broussard M. Apple watch set to include third-party glucose
Abstract

Health care professionals encourage people with diabetes to participate in self-management and take ownership of their health. Some people are forced into self-management by limited access to health care providers. Regular blood glucose monitoring provides a wealth of data, but without a clinician to help interpret the data, many patients seek other resources to assist them in decision-making. In a changing health care landscape, diabetes educators must be aware of new technology, such as crowdsourcing, that holds the potential to increase access to patient-centered care. This article describes crowdsourcing and its relevance in diabetes care.

Introduction

Research supports the benefit of a coordinated effort between the person with diabetes and their health care team to allow the patient to be an active participant in their care (1). The Internet is a commonly used source of information for those with diabetes who are seeking information about self-care methods, especially those who cannot afford or have limited access to clinicians.

Patients may seek information online to support necessary decisions about their care. In a changing health care landscape, diabetes educators must be aware of new technology, such as crowdsourcing, that holds the potential to increase access to patient-centered care. Crowdsourcing is effectively using the Internet to state a problem and ask for a solution from anyone reading about the problem, not just specialists in a field (2,3). This new technology is now being used to bridge the gap between a patient’s knowledge and his or her self-care skills taught in diabetes self-management education/support (DSME/S).

A major challenge of diabetes management is the demand for proactive engagement of the affected individual. Patients must repeatedly refine their approaches to blood glucose management based on their own history and experiences. With 90% of Americans owning a cellular device and 58% of those using smartphones, it is incumbent upon health care professionals to learn about cell phone applications and websites that patients access for medical
information (4). The specific aim of this article is to introduce the concept of crowdsourcing as it relates to the work of registered dietitian nutritionists (RDNs) and diabetes educators in improving patient engagement.

**Literature Review**

**Status of Diabetes Self-Management and Care**

Only 5,496 board-certified adult endocrinologists were practicing in the United States as of 2011. According to a commentary published in the *Journal of Clinical Endocrinology and Metabolism*, this reflects a shortage of about 1500 providers (5). With more than 29 million people in the US living with diabetes (6), this shortage of specialists to assist patients with tasks such as interpretation of self-management of blood glucose (SMBG) data is clear and this gap will only widen as the incidence of diabetes continues to increase (5).

Timely feedback, along with proper explanation of the purpose of SMBG, can improve a patient’s understanding of his/her blood glucose readings. This, in turn, can lead to more appropriate decision-making by patients and prevention of problems related to abnormal blood glucose levels (7,8).

The care model for chronic diseases, such as diabetes, has shifted from physician-centered (compliance model) to patient-centered (empowerment model). An integral part of the patient-centered care model for successful diabetes management is DSME/S (1,9). An estimated 90% of diabetes treatment depends on self-management (1). The patient’s perspective on self-management is especially important for improving clinical outcomes (10).

DSME/S is recommended for persons with diabetes, but fewer than 7% of privately insured adults and only 4% of those with Medicare received this training within 1 year of diagnosis in 2011 (11). As of 2010, only 57.4% of adults with diabetes documented participation in diabetes education (12). Nationally, we are not on the trajectory to meet the Healthy People 2020 goal of increasing the percentage of people with diabetes receiving DSME/S to 62.5%.

Studies have demonstrated that although the patient’s interpretation of SMBG results in diabetes management is an effective tool in improving glucose control, many complain of not understanding necessary actions to take based on SMBG results (7,8). Evidence supports incorporation of components of interactive technology in DSME/S to help patients effectively understand and use SMBG results. Computer-based interactive tools and social media can help to improve a patient’s self-efficacy and encourage healthful lifestyle changes with the goal of improving self-care practices (4,13-15).

**Crowdsourcing Defined**

Patients with diabetes are seeking information online to supplement their clinical care and management (4). Crowdsourcing is a less expensive and more widely accessible mechanism by which patients can access tailored feedback regarding their glucose logs and food diaries.

According to a crowdsourcing industry website, the term can be defined as “the process of connecting with large groups of people who are tapped for their knowledge, expertise, time, or resources” (crowdsourcing.org). Crowdsourcing is based on human capital, and although it uses technology, the content and data must be input by humans.

Crowdsourcing is all about intersection; it can be used to ask for assistance, ideas, or information from defined or undefined groups of people on social networks. The goal is to bring a problem and the problem-solver together online without either party having to leave his or her desk or home.

Crowdsourcing is not the same as outsourcing, which involves a contract and a client sending a defined work order to a specific consultant or company. In crowdsourcing, the organization with a need for a specified service lists an order online seeking someone else to do the work. Payment for crowdsourcing services ranges from well- and low-paid jobs to completely unpaid jobs.

Crowdsourcing can be accomplished through social media, but there is an important distinction between these two entities. Although social media can be interactive, users can work parallel to each other without intersection, whereas crowdsourcing requires engagement from all parties involved.

**Uses of Crowdsourcing**

Workers who earn money or dedicate their time voluntarily through crowdsourcing have varying levels of training, from a retired biochemist, practicing physician or computer programmer, to a layperson with no skills or training in the area. The use of crowdsourcing varies from focus groups to research interests to personal medical questions (Table).
Many innovative sites are built on the concept of crowdsourcing. *Crowdmed*, for example, is a site where people can post the details of a difficult medical case and health care professionals and laypeople can assist in diagnosis or treatment options via the Internet (crowdmed.com/). In addition, patients can post their own conditions and ask for help with a diagnosis or treatment option. Successful “medical detectives,” as they are known, can earn money for their insights if they are helpful in solving these cases.

Another example, known as Amazon Mechanical Turk, uses crowdsourcing with a global group of workers known as “Turkers,” about 51% of whom live in the United States (16). Turkers are assigned human intelligence tasks such as image tagging, classifying, or analyzing data online. This crowdsourcing technique has demonstrated cost savings in health

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**Table. Crowdsourcing Examples**

<table>
<thead>
<tr>
<th>Company or Organization</th>
<th>Focus</th>
<th>Description</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>HealthMap</td>
<td>Reporting of disease outbreaks</td>
<td>Travelers can view alerts and public health organizations can track outbreaks in real time</td>
<td><a href="http://www.healthmap.org/en/">http://www.healthmap.org/en/</a></td>
</tr>
<tr>
<td>Crowds Care for Cancer: Supporting Survivors Challenge</td>
<td>Led by the Office of the National Coordinator for Health Information Technology (ONC)’s Investing in Innovation (i2) program and partnering with the National Cancer Institute (NCI)</td>
<td>This challenge requests input from the crowd of ways to help cancer survivors transition from specialty to primary care</td>
<td><a href="http://www.health2con.com/devchallenge/crowds-care-for-cancer-challenge-supporting-survivors-2/">http://www.health2con.com/devchallenge/crowds-care-for-cancer-challenge-supporting-survivors-2/</a></td>
</tr>
<tr>
<td>UberHEALTH</td>
<td>A 1-day pilot program by Uber to provide vaccinations by delivery</td>
<td>In several cities, users had a flu prevention pack and a flu vaccine delivered to their homes and a nurse visit to administer the vaccine by a company called Passport Health</td>
<td><a href="http://newsroom.uber.com/boston/2014/10/bringing-house-calls-back-with-uberhealth/">http://newsroom.uber.com/boston/2014/10/bringing-house-calls-back-with-uberhealth/</a></td>
</tr>
<tr>
<td>helparound</td>
<td>A cell phone application that allows users to connect with others with a chronic disease or condition</td>
<td>Examples: A person with diabetes who is away from home and forgot supplies can contact another person with diabetes through the app to ask for help. A person with severe allergies could contact someone nearby who has an Epi-pen.</td>
<td><a href="http://helparound.co/blog/liking-when-your-loved-one-needs-you/">http://helparound.co/blog/liking-when-your-loved-one-needs-you/</a></td>
</tr>
</tbody>
</table>
care where online workers were trained to do the job of ophthalmologists. According to an investigation published in *The Journal of Medical Internet Research* in 2014, Amazon Turk workers could correctly identify as normal or abnormal photos of patients with diabetic retinopathy (17). The Turkers required only minimal training and the data were correctly interpreted for a fraction of the cost of skilled professionals. However, providing specific grading of the photos would require further training of the workers. This small study showed the potential for substantial health care cost savings (17).

People with diabetes and other chronic diseases may benefit from online programs to monitor and analyze dietary intake. For example, keeping a food log to accompany a blood glucose log can be beneficial for those investigating the impact of their diet on their diabetes control. Unfortunately, compliance rates for accurate food diaries are low, and many diaries are inaccurate due to the burden of recording every bite of food eaten in a day (18). The advent of cell phone applications such as “Platemate,” a crowdsourcing app that uses nonexperts to analyze a person’s meals based on cell phone photos of the plate (19), makes these recording tasks easier. Evaluations of Platemate accuracy showed that the Turkers overestimated the calories approximately 7% of the time compared to 5.5% for RDNs. In addition, users found Platemate user-friendly, and RDNs could not identify the difference between what was estimated by Platemate and the information determined manually by the person using the platform.

### The Effect of Crowdsourcing on Health Care

Although crowdsourcing sites may be popular among people with diabetes, many sites lack evidence-based recommendations for diabetes self-management practices. Crowdsourcing sites can be subject to bias and lack oversight by trained professionals. Most articles written about crowdsourcing are not academic papers but reviews or interest pieces. Incentives for trained persons participating in crowdsourcing are limited; many tasks are performed by lay people who can be trained simply and quickly to perform a specific task. Thus, crowdsourcing may hold great potential, but its usefulness in diabetes care is still evolving. Clinicians may play a role in determining the function of crowdsourcing sites in supplementing the care of people with diabetes.

Social media and crowdsourcing are pervasive and have established a foothold in diabetes self-management (3, 16). Because clinicians cannot identify all erroneous material on the Internet, they should incorporate inquiries about where patients obtain their health information into clinical practice. Educators can simply ask patients where they get their nutrition or health information and encourage them to ask their clinicians to verify information that they find online for safety. Patients, in order to help them discern safe information from unsafe recommendations. Many patient blogs and forums allow patients to connect to others who have the same conditions and share stories or ask questions. Such sites can encourage patient engagement, but some offer advice that should be provided by a medical professional. A benefit of these sites is they can collect patient data to help inform the U.S. Food and Drug Administration of adverse events related to prescription medications, or to be used for research by companies working to improve patient care (patientslikeme.com). *Patients Like Me* reports on their website that they partner with researchers and even help to recruit participants. It is important that people with diabetes are able to post many types of information, but disclaimers such as “speak with your physician before changing or discontinuing your medications” are needed for safety and are currently present on many of them. Patients who have limited health care access may take the advice of a blog or forum despite the disclaimer.

Technology is growing rapidly and requires diabetes educators to stay current. Crowdsourcing holds the potential to improve patient-centered care in a health care landscape where access to care is decreasing. Future research should explore the potential for increasing
access to diabetes care for the underserved community through crowdsourcing.

Some inventive diabetes educators are becoming involved online. These innovative professionals can capitalize on the need for information by providing evidence-based recommendations in different diabetes-related media. Professionals may not be paid for this work, but could potentially use it as free advertising for their paid services. The interaction and advice that patients receive online from a trained professional can result in a trusting patient-provider relationship, just as an in-person relationship can.

Research has shown an association between the quality of patient-clinician relationships, social environment, and patient adherence to treatment recommendations. These relationships should be recognized and highlighted by educators to help improve self-care behaviors in patients (13). Patients who feel connected with the self-management process, their practitioners, or support providers such as online or in-person support groups are empowered to adhere to their diabetes treatment goals (13-15).

As a profession, RDNs and diabetes educators can become more informed about the technology that our patients are using by taking some simple steps. Perform a Google search for diabetes advice, follow social media platforms, and review new applications for diabetes management. Many of these innovations are credible and possibly even beneficial. However, policies are needed to establish industry standards and ensure reliability of information. Diabetes educators who contribute to crowdsourcing can help to dilute inaccurate information with safer and more accurate recommendations. There is a need to improve patient engagement and participation in DSME/S, and an online platform may be a step in that direction. At the very least, professionals providing diabetes education should stay current with diabetes technology and help ensure that safe, evidence-based advice is being provided.

Summary
How does crowdsourcing fill a need? Why are people reaching out online for strangers to help them manage their diabetes? Perhaps people feel alone in their diabetes management. Due to increasing insurance premiums and shortened physician visits, patients are not always receiving the support they require (5). If they cannot get the information they need from trusted clinicians in a timely manner, crowdsourcing offers an attractive option for reaching out to others who also have diabetes. When posting a question online, a patient could have an answer within seconds. Diabetes is a fluid condition that changes every minute, and there is often a need for almost immediate feedback and problem solving. Diabetes educators should look for opportunities to help patients remain engaged in their care between appointments with a process that is safe, accessible, and acceptable to the person with diabetes.

References


Using Real-time Data for Analysis of Blood Glucose Control: An Option to Standard Glycated Hemoglobin Measurement

<table>
<thead>
<tr>
<th>Instructor’s Plans</th>
<th>Objectives</th>
<th>Student’s Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide the article “Using Real-time Data for Analysis of Blood Glucose Control: An Option to Standard Glycated Hemoglobin Measurement” to students.</td>
<td>Students will create three statements that compare and contrast use of continuous glucose monitoring (CGM) with the HbA1c test, identifying advantages and disadvantages of both methods.</td>
<td>The student will create a handout, using a bulleted format, on the advantages of CGM.</td>
</tr>
<tr>
<td>Explain the assignment of evaluating technologies for monitoring blood glucose control.</td>
<td>Students will independently evaluate the effectiveness of various technologies for real-time blood glucose control based on cost and other features. This preparation will be important for the group assignment.</td>
<td>Within a group discussion, students will compare five meters used for real-time blood glucose control based on cost, ease of use, size and shape, reimbursement, accuracy, and ability to download data.</td>
</tr>
<tr>
<td>Through a company representative, locate individuals with diabetes who use CGM as a means of blood glucose monitoring to speak to the class about their CGM experiences and challenges.</td>
<td>By interviewing one to two patients with diabetes who use the CGM, the dietetic student will become more fluent with CGM technology.</td>
<td>Students will prepare two to three questions to ask the speakers about CGM.</td>
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</tbody>
</table>

Smart Apps for Digital Diabetes Management

<table>
<thead>
<tr>
<th>Instructor’s Plans</th>
<th>Objectives</th>
<th>Student’s Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide links and information to students on app reviews from the Academy of Nutrition and Dietetics webpage (<a href="http://www.eatright.org/resources/media/trends-and-reviews/app-reviews">www.eatright.org/resources/media/trends-and-reviews/app-reviews</a>) and the bimonthly Food and Nutrition Magazine (<a href="http://www.foodandnutrition.org">www.foodandnutrition.org</a>). Other links could also be provided.</td>
<td>By researching the information materials, students will identify at least two appropriate diabetes apps that can be helpful to a patient with diabetes.</td>
<td>Students will locate five diabetes apps that can be helpful for patient education, health tracking, and reminders for glucose testing and medications. Each student will provide the name, link, and the description of each app; prospective audience; cost; features; and personal critique. The instructor will use this information to develop a class listing for patient handout distribution.</td>
</tr>
<tr>
<td>Locate a local member from the Diabetes Care and Education practice group who is knowledgeable about apps to speak to the students.</td>
<td>From the five diabetes apps that each student located, each student will develop a PowerPoint presentation of one app to communicate to the class.</td>
<td></td>
</tr>
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</table>
### Use of Virtual Technologies and Telehealth to Deliver Prediabetes and Diabetes Management, Education, and Support

**Using Social Media for Ongoing Diabetes Self-management Support**

<table>
<thead>
<tr>
<th>Instructor’s Plans</th>
<th>Objectives</th>
<th>Student’s Assignment</th>
</tr>
</thead>
</table>
| **Provide a list of the following apps to students**  
  • MobileRD  
    (https://www.mobilerd.com/)  
  • FoodCare  
    (https://www.foodcare.com/)  
  • NuPlanit  
    (http://www.nuplanit.com/) | Students will identify two types of mobile apps, devices, programs, and services for delivery of diabetes prevention and diabetes education and management virtually or via telehealth. | Students will write a short blog about the benefits of providing frequent diabetes education and management services. The class will select one to two favorite blogs to post on a diabetes website. |
| **Provide information and the link to the Diabetes Online Community (DOC) to students:**  
  https://www.diabeteseducator.org/docs/default-source/legacy-docs/_resources/pdf/general/Social_Media_Handout.pdf | To increase knowledge of patient resources, the student will identify at least three eHealth platforms for consumer use. | Students will visit one of the large active Community Forums, follow one of the weekly Twitter Chats, and interface with a diabetes group on Facebook. Students will describe this experience in a one-page report. |

### Crowdsourcing 101: Implications for Health Care Professionals

<table>
<thead>
<tr>
<th>Instructor’s Plans</th>
<th>Objectives</th>
<th>Student’s Assignment</th>
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</table>
| **To demonstrate crowdsourcing, present different online nutrition websites from different sources.**  
With the class, compare and contrast nutrition information found on the Academy of Nutrition and Dietetics website with information on an alternative medicine website or other professional sites.  
After this discussion, provide the following diabetes-related subject areas for class research: self-blood glucose monitoring, nutrition, insulin, exercise, and stress. | By investigating different nutrition and diabetes resources, the student will identify at least three publication resources that contain accurate information pertaining to one diabetes-related subject and those sites that provide questionable information. | Each student will locate a pharmaceutical company website and a general diabetes website (3-5) to compare and contrast their usefulness to a patient with diabetes. This can be a week-long assignment with one subject area addressed each day. |
| **Discuss blood glucose pattern management, including blood glucose logbook documentation (blood glucose values, carbohydrate grams, ketones, and medications) and documentation analysis.**  
Provide a list of web-based diabetes pattern management sites for patient use. | After identifying a patient with diabetes and educating him or her on a web-based diabetes program, the student will obtain hands-on experience in reading a blood glucose pattern. | From the list provided by the instructor, each student will teach a patient with diabetes about one website and follow-up with the patient two to three times during a set period. |
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Sandra Parker, RDN, CDE
sandynda@aol.com

ACADEMY/DCE STAFF

Administrative Manager
Linda Flanagan Vahl
312-899-4725 / Fax: 312-899-5354
lflanagan@eatright.org

DCE WEB ADDRESS
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After reading this issue of On The Cutting Edge, “Living in the Now and the Future: Technology and Diabetes Management,” current DCE members can earn 4.0 hours of free continuing professional education units (CPEUs level 2) approved by the Commission on Dietetic Registration (CDR). CPE eligibility is based on active DCE membership status from June 1, 2015 to May 31, 2016.

DCE members must complete the post-test of the CPEs page on the DCE website: http://www.dce.org/resources/cpeus by 3/15/19. For each question, select the one best response. After passing the quiz, to view/print your certificate, access your CPEU credit history or view the learning objectives, go to: http://www.dce.org/account/history.

Please record 4.0 hours on your Learning Activities log and retain the certificate of completion in the event you are audited by CDR. The certificate of completion is valid when the CPE questionnaire is successfully completed, submitted, and recorded by DCE/Academy of Nutrition and Dietetics.

CPE Credit Self-Assessment Questionnaire

Select the one best answer for each question below.

1) Which one of the following statements does not describe crowdsourcing?
   a. It requires engagement from all parties involved.
   b. Its goal is to bring together a problem and the problem-solver(s).
   c. It can be used to ask for assistance or information via the Internet.
   d. It involves a client sending out a defined information request to a specific consultant.

2) While using diabetes self-management education and support telemedicine, the registered dietitian nutritionist (RDN) should be aware of:
   a. The need to protect the client’s personal health information.
   b. State-based licensure requirements for RDNs.
   c. The reimbursement or fee-for-service model.
   d. All of the above.

3) Which of the following statements best describes the artificial pancreas?
   a. APDS are designed to use continuous glucose monitoring (CGM) data in combination with a mathematical formula to determine the required insulin dose.
   b. The insulin dose is administered through an insulin infusion pump.
   c. APDS require regular maintenance, including blood glucose testing.
   d. APDS have infusion site changes for insulin and other medications.

4) Research related to the design and use of mobile applications in the population with diabetes identified:
   a. The need for health professionals to acquire and retain technology skills.
   b. Improvements in self-efficacy and self-care with the use of mobile apps.
   c. Reminder features for blood glucose tests as one of the most liked tools.
   d. All of the above.

5) Which of the following statements related to diabetes glycemic control is true for near-instant feedback?
   a. It is widely used as an indicator of glycemic control.
   b. It is the current gold standard for assessing glycemic control.
   c. A reduced measure is strongly related to better diabetes care and self-management.
   d. Coupling real-time data with effective outreach intervention has the potential to lower costs and improve overall control.

6) Which of the following statements best describes wearable devices in diabetes treatment?
   a. Before clinicians can effectively teach clients about the benefits of wearable devices, clinicians must use devices themselves.
   b. RDNs should stay proficient in using data from wearable devices to better provide diabetes education and improve management.
   c. To be effective for diabetes management, wearable devices must integrate into electronic health records.
   d. About 20% of American adults own wearable devices.

7) The eHealth Enhance Chronic Care Model includes:
   a. The ability for the consumer to search for health care information via the Internet.
   b. A selection of social media platforms.
   c. A variety of opportunities for technology to enhance care.
   d. Shared resources.

8) Which one of the following was not included in the American Association of Clinical Endocrinologists/American College of Endocrinology Consensus Conference on Glucose Monitoring?
   a. A variety of opportunities for technology to enhance care.
   b. Glucose monitoring is essential to diabetes care, especially for reducing the incidence of hypoglycemia.
   c. The U.S. Food and Drug Administration should monitor wearable diabetes technologies.
   d. Shared resources.

9) The availability of information online that has changed the knowledge power structure between patients and clinicians is referred to as:
   a. Democratization of technology.
   b. Scientific knowledge.
   c. Democratization of knowledge.
   d. Evidence-based knowledge.

10) Which of the following statements regarding the Predicted Low Glucose Suspend, an AP, is true?
    a. It suspends insulin delivery when continuous glucose monitoring (CGM) values drop below a programmed low glucose threshold.
    b. It suspends insulin delivery when CGM values are predicted to drop below a programmed low glucose threshold.
    c. It adjusts insulin 24 hours a day in response to CGM data.
    d. It is an automated insulin and glucagon delivery system designed to adjust delivery in response to CGM data.
Living in the Now and the Future -- Technology and Diabetes Management

CDR Activity Number: 125793 (Expires 3/15/2019)

Date Completed: __________ CPEUs Awarded: 4.0

Learning Need Code: __________ CPE Level: 2

Provider Signature

*Refer to your Professional Development Portfolio Learning Needs Assessment Form (Step 2)
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