Treat With Technology: The Key Is in Their Hands

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Adolescents with diabetes face many challenges. Stigmas are often attached to having a chronic condition at a young age, and there may be feelings of embarrassment for being different. Parents, children, and adolescents need to obtain the education and tools required to manage diabetes. The importance of managing diabetes now in order to prevent complications later may be difficult to grasp.

Datye et al report that only 21% of adolescents with type 1 diabetes meet the goals established by the American Diabetes Association Standards on Medical Care. The lack of glycemic control in this age group can be contributed to a multitude of factors, including a change in hormones during puberty and a general lack of adherence, including but not limited to blood glucose testing, medication regimens, carbohydrate counting, and routine appointments with health care providers.

Datye and colleagues also identified many barriers to adherence in adolescents with type 1 diabetes. Through retrospective analysis of a number of reviews and studies, they report that the biggest barriers are:

- lack of family involvement
- mood
- anxiety
- eating disorders
- patient and provider communication issues.

All or none of the aforementioned barriers may affect individual adherence behaviors, so it is important to discover what exactly may be holding each patient back from controlling their disease. The discovery of individual, personal barriers can help to guide medication regimens and determine what course of action to take in order to realize the best possible outcomes.

Can Technology Aid Adherence?

So, how do we help to increase adherence in the adolescent population? Target what they know! In this generation in particular, it's the use of technology. Children at very young ages have access to mobile devices, such as cell phones, iPods, iPads, and tablets. Why not utilize these tools to benefit diabetes self-management?

Only 21% of adolescents with type 1 diabetes meet the goals established by the American Diabetes Association Standards on Medical Care.

Datye et al determined through another retrospective analysis that the use of cellular phones had a positive impact on increasing adherence. They concluded that technology is on the rise and may play a positive role in adherence when coupled with increased participation by health care providers.

Mulvaney et al from the Vanderbilt University Medical Center evaluated the feasibility of using a cell phone program to measure blood glucose monitoring and insulin administration as well as monitoring and injection times. They compared the use of the ecological momentary assessment (EMA) mobile phone application to self-reporting, and they monitored patterns of adherence to insulin injections and monitoring. To gather adherence data, participants were called twice a day and texted questions via EMA.

Researchers discovered that the majority of missed injections and blood glucose monitoring, 74.1% and 59.4%, respectively, were in the morning hours. This could be due to a variety of factors, including waking up late or lack of a morning routine. Adherence increased as the day progressed. Evenings were associated with the highest rates of adherence, with only 13.15% missed blood glucose checks and 8% missed injections. The authors speculated this could be due to a more regimented schedule in the evening hours.

This information can help clinicians to focus education efforts. Strategies such as setting an alarm, using a check box on a calendar, or asking for increased family participation, if possible, may be implemented to reduce the number of missed injections and blood glucose tests.

There were a variety of limitations with this study, including the length (10 days) and the small participant population (50 subjects). It demonstrated that the use of a cell phone may be an option to increase adherence in the adolescent population. However, a longer study is needed for proven efficacy data since the long-term impact on adherence, blood glucose levels, and A1C rates are unknown.

A third study conducted in 2014 by Kumah-Crystal et al specifically assessed problem solving in 112 patients with type 1 diabetes using mobile applications, social technologies, and glucose software. The aim of the study was to assess if the interventions would result in a decreased A1C.

Results demonstrated that A1Cs did not improve; however, the patients were using the interventions retroactively rather than proactively. Using technology can help to correct issues with blood glucose numbers, but it should be used to prevent the highs or lows by encouraging regular testing and carbohydrate counting.

Top Apps to Improve Adolescent Adherence

Patients may utilize generic medication adherence apps (applications) if they choose, but there are many apps created for and targeted to patients with diabetes. Carey and Chereney published a list of the best mobile applications of 2015 for diabetes (Table 1). Apps are available on iPhone and Android and are designed to easily track and log health information necessary to manage diabetes.

Factors influencing the ranking of Carey and Chereney's "best of" list included user ratings, cost, functionality, and relevance. It was important to the authors to select user-friendly apps that can track all vital health information needed to properly manage diabetes. Many are designed as games for younger patients in an attempt to instill enjoyment in managing their diabetes.

Carb Counting With Lenny U.S. is a free app created for users 6 years and older. It follows Lenny the lion through a storybook and introduces the child to games that engage the patient in the management of diabetes. Diabetes Logbook is another free app that contains a monster avatar to lead the user through the process of logging and tracking insulin administration, carb counting, blood glucose testing, and so on. Diabetes in Check is also a free application that contains healthy recipes, articles, and a platform to track health information. Glooko is an FDA-approved application that allows doctors and patients to track health information. Doctors can link their devices to this application and be alerted when medical emergencies arise. Diabetic Connect is a unique free application that allows patients with diabetes to connect with one another. They can share stories and help each other manage their disease state. This app can be used by users both young and old and brings social networking to the forefront.

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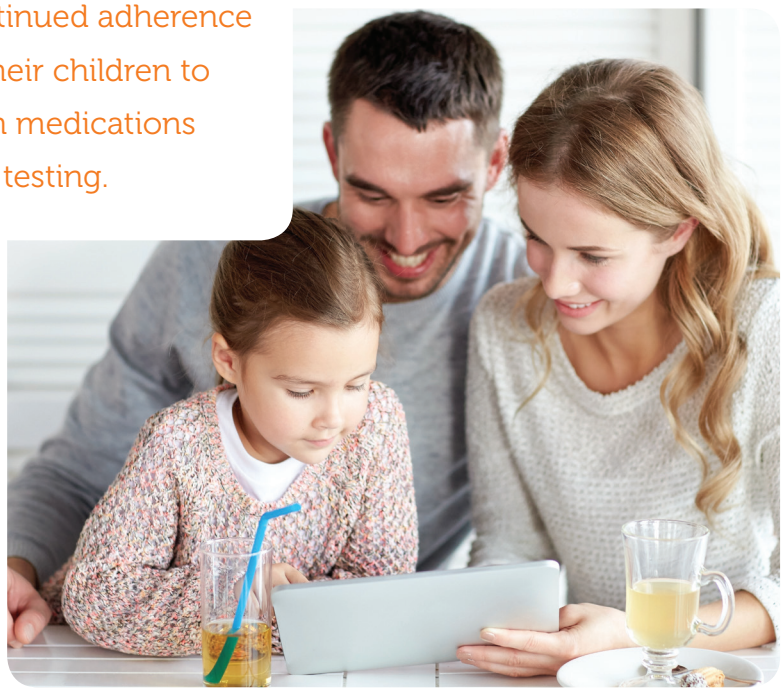

What Part Do Parents Play?

Another vital component to successful diabetes management in adolescence is parental involvement. Parents play an important part in the continued adherence of their children to both medications and testing. However, this is an area that has not been studied in depth. Parental involvement and accessibility to applications is imperative. They should have access to medical information entered into the applications and should have the ability to track their child's adherence patterns.

Table 1. Mobile Apps for Diabetes Self-Management.[a]

Application Name	Features	Pros/Cons	Price	Age (y)
Diabetes Logbook	Monster avatar Bolus calculator A1C estimator	Mimics a game Multiple languages	iPhone: Free Android: Free	4+
Calorie Counter PRO	PhotoFood service Recipes Custom exercises Virtual coach Meal reminder	Not specific to DM Not available in Spanish	iPhone: $3.99 Android: Free	12+
Diabetic Connect	Social networking Logbook to track BG	Only available in English	iPhone: Free	17+
Diabetes Pilot Pro	A1C estimator Food tracker Records glucose Reminders	Only available in English Cost	iPhone: Free (1 week); then 12-month $11.99	12+
Diabetes Tracker	Reminders BG averages Log foods/water Log weight	Not available in Spanish Cost Syncs with Apple Watch	iPhone: $9.99	12+
BG Monitor Diabetes	Stores pictures of meals Insulin calculator Carb calculator/food database Track BG	Emails spreadsheet reports Only available for Android	Android: Free	Everyone
On Track Diabetes	Tracks BG, A1C Reminders Track food and weight	Generates reports for prescriber Only available for Android	Android: Free	Unrated
BlueLoop	Store and share information Sent via text or email	Best app if prescriber has MyCareConnect BlueLoop Multiple languages	iPhone: Free Android: Free	4+
Glooko	Food database Reminders Store and share information Syncs to certain glucose meters	Need Glooko subscription Syncs with prescriber's devices Connects to FitBit, etc Only available in English	iPhone: Free Android: Free	4+
Diabetes in Check	Digital counseling from CDE BG tracking/alerts Reminders Carb tracker Barcode scanner for food Recipes/personalized meal plan Message boards Tools for activity Data to share with prescriber	Only available in English	iPhone: Free	4+
Carb Counting With Lenny U.S.	Games for carb counting Customizable food guide	Only in English Used for younger children	iPhone: Free	4+

[a]This is not an all-inclusive list. List adapted from "The Best Diabetes iPhone and Android Apps of 2015" (http://www.healthline.com/health/diabetes/top-iphone-android-apps#2).

This brings into question if the adolescents would feel watched over. These apps are designed to allow adolescents an easy way to track their progress, communicate with their providers, and also empower them so that they feel in control of their diabetes. Some adolescents may not feel comfortable with their parents being able to access their applications. This speaks to the fact that further studies need to be conducted in order to determine how much involvement parents would like to have versus how much involvement the adolescents would like their parents to have.

All of the aforementioned studies support the idea that the use of technology has the potential to help improve adherence. However, each article called for longitudinal studies to be conducted. The trials had small enrollment sizes and short lengths of study. Some studies introduced bias. These limitations make it challenging to establish a relationship between A1C results and the use of technology. Also, the possibility for boredom to set in and affect results cannot be determined based on the current studies.

Clinician Communication Counts

It is critical for providers to communicate effectively with adolescent patients. Establishing healthy eating patterns, improving blood glucose

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control, and meeting A1C goals at the earliest stages is vital to aid in preventing future micro- and macrovascular complications.

Educating patients on the vast array of tools available to assist them in the management of diabetes, the proper use of technology tools, and how they can help to control diabetes is an area of counseling that health care providers have the opportunity to develop.

Most of the apps discussed here are free or come at a very low cost. They offer reminder texts, games, and trackers for blood glucose, carbohydrates, and weight changes. Properly used, these applications can help hold the patient accountable for self-management and improve outcomes.

Conclusion

Who doesn't have a cell phone these days? Using technology and electronic devices to improve adherence could be a great way to reach the younger generation.

Health care professionals are responsible for making patients aware of the technology available to help them manage their diabetes while making sure it is age and developmentally appropriate. However, this must also be coupled with an educational component.

Marrying diabetes education, patient communication, and technology just may be the key to increased adherence in the adolescent population. ■

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