App-solutley fabulous: Smartphone apps and type 1 diabetes management in children and adolescents

Living With DiabetesReview

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Introduction

More than 80% of Australian adolescents aged 14-17 years own a smartphone, and are frequent users of phone apps [1]. Increasingly, children also use smartphones, and it is safe to assume that the introduction of subsidised access to phone-enabled Continuous Glucose

Monitoring (CGM) has led to phone use in children and adolescents with type 1 diabetes (T1D) that may be higher than national averages.

High smartphone use among children and adolescents with diabetes in Australia represents an exciting opportunity to change health outcomes through diabetes-related health applications (diabetes apps). This paper explores the diabetes app landscape, categories of diabetes apps, how apps are used and who uses them and ways to improve their uptake and appeal.

Apps and diabetes self-management

Smartphone apps can improve T1D self-management in a number of ways. They can directly influence management tasks (for example, by reminding people to check their glucose or take insulin), help to create positive social connections with others also living with diabetes, and help to make the daily tasks of logging, carbohydrate counting and tracking physical activity easier.

Jacques et al (2019) categorised diabetes-related health apps into six types [2]:

Tracking/logging

Diary-style apps allow users to log information such as glucose readings, insulin doses, food intake and physical activity. Examples include MySugr, RapidCalc and OneDrop.

Nutrition

Nutrition apps allow users to search for nutrition information, in particular, the carbohydrate content of foods, for example Calorie King, Easy Diet Diary and My Fitness Pal.

Fitness

Fitness apps allow users to keep track of physical activity type, duration and intensity, and to set goals and be rewarded for achieving them. Examples include Strava, Endomondo, My Fitness Pal and Runtastic.

Device connectivity platforms

These track and share real-time glucose data and allow input of user data such as food and insulin doses which can be used to compile reports. Examples include Dexcom G5, Medtronic Guardian Connect and LibreLink.

Wellness

Wellness apps target various aspects of healthy lifestyles, including sleep, mindfulness, health check reminders and even customised life coaching. Examples include Headspace, Smiling

[Mind](), [Sleep Cycle]() and [My Possible Self]().

Social networking/blogging

Many health apps include a chat or forum component where users share ideas and get social support. This may occur within the app itself, via a messenger platform or social media platforms.

Of these six categories, only two are truly diabetes-specific – diabetes tracking and CGM connectivity apps. The remaining categories feature apps that were developed for use in the general population and co-opted by the diabetes community for their purposes, such as tracking food and exercise data and connecting with peers.

App uptake and use

App uptake in people with diabetes appears to be relatively low [3-5], even in young people who tend to be early technology adopters. However, the technology landscape is changing rapidly and external factors such as subsidised CGM can influence app use considerably, which makes a clear and current understanding of app use difficult to ascertain.

Few studies specifically examine app uptake and frequency of use in T1D management by adolescents and young people. A 2015 US study found that of adolescents aged 12-17 with T1D recruited through a paediatric clinic and website, 44.8% used mobile apps in relation to diabetes management, with more that 50% reporting they used the technology twice a week or more [6]. By contrast, a 2017 study of participants in the Australian Diabetes MILES Youth Study, found that only 21% of respondents reported using an app for diabetes management, most of which were not specifically designed for diabetes [5].

At the Type 1 Diabetes Family Centre in Perth, we manage a large online community of parents of children and adolescents with T1D. An informal poll of our community showed that apart from CGM apps (which are used by both young people and their parents) it appears to be parents, rather than children and adolescents, who use apps that support diabetes management. Of the six categories of apps identified above, our data show that the most commonly used are CGM apps that log and share glucose data, nutrition apps that count carbohydrates and social connectivity apps.

Logging and sharing glucose data

CGM and flash monitoring apps have seen high uptake rates among children, adolescents and their parents thanks to the 2018 subsidy of CGM for young people with T1D. Dexcom G5, Medtronic Guardian Connect and Freestyle Libre each have a custom app that allows users to share their glucose data with a number of followers, including parents, teachers and health professionals. These apps have allowed children and young people with T1D and their carers to see diabetes data like never before, allowing them to be much more responsive to trends, and often facilitating improvements in the way they manage glucose levels in daily life.

Of the parents we polled who reported that their adolescent shared their CGM data with them via the relevant app, the most commonly cited reasons were that their adolescent felt more confident and safer knowing that someone would be alerted if they needed help, and still wished to call on them for help with diabetes decisions.

Although CGM apps have essentially automated the process of logging glucose data, food and insulin dosing data needs to be manually entered into the apps. Parents we polled report that the need for manual input of these data is a major barrier to their adolescents capturing relevant information using CGM apps.

Carbohydrate counting apps

Accurate carbohydrate counting is vital for people with T1D, and it is not surprising that nutrition apps are popular in the Family Centre community. Unlike CGM apps, which are readily used by both children and their parents, in our experience, nutrition apps appear to be almost exclusively used by parents on behalf of their children.

Although parents are generally the primary users of carbohydrate counting apps for younger children, as adolescents become more independent and begin to eat food away from the home, nutrition apps may provide simple and effective ways for them to estimate carbohydrate intakes and deliver accurate boluses using bolus calculators. Increasingly, nutrition apps include a large number of restaurant and takeaway options typically frequented by adolescents. However, anecdotally, uptake appears to be low in adolescents. It may be that the requirement for the user to input data is a barrier to use.

Social media apps

T1D can be a profoundly isolating condition to live with, and social connectivity can facilitate information exchange and peer support. The Family Centre's online parents' and new adults' (18+) communities are managed through Facebook Groups, and with engagement rates at over 95% in each group and over 500 engagements on average each day, the Facebook app is an appropriate and effective way to reach, build and engage adults impacted by diabetes.

However children and adolescents use different social connectivity platforms altogether, and it is well-known that these age groups are far more engaged on Instagram and SnapChat than with Facebook. T1D content on Instagram is varied but generally centres around individuals' lives and stories, which can be followed and engaged with through the images they post. Instagram is an important storytelling and information sharing medium, building empathy, awareness and engagement. By contrast, SnapChat is a messenger app that allows direct communication or communication to groups and the sharing of images, messages and video — all of which is deleted within seconds of opening. SnapChat is designed for fun, social engagement; the Family Centre's adolescents have formed a SnapChat group to stay in touch with each other.

Like SnapChat, the messenger app WhatsApp supports group and one-to-one messaging, and we feel this may have valuable applications for communication and support in diabetes.

The app has end-to-end encryption and messages are retained, ensuring secure communication. The Family Centre and the Telethon Kids Institute recently collaborated on a mentoring research project that used WhatsApp as the communication platform between mentors and mentees. WhatsApp is used in individual and group counselling contexts elsewhere, and there is real scope for use to support mental and other health initiatives in diabetes.

Diabetes app use among young people with T1D

In our experience, social media apps have high uptake rates in young people with T1D and their parents alike, but apart from CGM apps, which offer safety and peace of mind around-the-clock, other diabetes- and health- related apps are underutilised by young people. The Diabetes MILES Youth Study confirms this: of the 79% of respondents who didn't use diabetes apps, 44% said that they didn't know such apps existed, or didn't believe that diabetes apps would help them with their diabetes management [5]. Vaala et al (2015) found that where adolescents did not use mobile diabetes apps they reported that it was because they didn't know of any apps (20.8%), they didn't like available apps (14.6%), they didn't feel they needed apps (14.6%), or they didn't want to use a diabetes app (6.3%).

It seems that apps are not being developed for this age group. A 2018 study identified only two apps that were tailored to supporting diabetes self-management among adolescents with T1D (7), while findings from the Diabetes MILES Youth Study suggest that the products don't appeal to young people (5).

Improving uptake: Sticky, social and seamless

Sticky

Successful apps are 'sticky' — they have features that encourage or compel users to return to them again and again. Apps that are popular among millennials provide them with attention, the ability to express themselves to a community, social connectivity and entertainment [8]. It is vital for diabetes app developers to consult extensively with young people with T1D to discover features that would make a diabetes app 'sticky'. Gamification, for example, is a feature that can draw users back to an app frequently [9], and could function to change behaviour, incentivise data input, and reward healthy choices.

Social

Social connectivity that allows for both public and private communication in a visually appealing format is another feature of popular existing apps. Husted et al (2018) piloted a T1D smartphone app with a group of adolescents and young adults, Young with Diabetes. The group reported that the most significant aspect of the app that lead to improved diabetes self-management was the messaging capability, allowing for peer support and social connection [7].

Diabetes app developers could consider building social connectivity into their products, or co-opting existing social apps to support product uptake. Interestingly, Vaala et al (2015) found that among adolescents who used social networking for diabetes, 75% of them cited the main reason for use was that it allowed them to help other people with diabetes – a potential marketing angle for future apps.

Seamless

Manual data input appears to be a major barrier to app uptake. A critical feature of apps should be interoperability and seamless integration of data feeds, for example CGM data and data from other wearables such as fitness and sleep trackers. There are steps in the right direction: Dexcom now integrates with third-party fitness platforms such as Fitbit, software from companies like Tidepool integrate diabetes data from different devices, and emerging devices like the SmartPlate are attempting to use photo recognition and artificial intelligence (AI) technology to identify, weigh and calculate the nutrition components of meals automatically and deliver the information immediately into an app in the user's phone.

In 2017, Dexcom announced the availability of a public API, empowering third-party developers to connect patient-authorised CGM data into their applications. There are now ten developers working with Dexcom's glucose data, across various projects and applications.

A solution that feeds CGM data, fitness and other tracking information, and nutrition information into a single app remains elusive. However the spirit of collaboration that Dexcom has demonstrated in opening up access to its API suggests that it may not be far off.

Drawbacks of apps

There are thousands of apps that could have applications to diabetes management, and quality is critical. Not all apps use verified data and not all data is represented in appropriate ways for the Australian context. An example is My Fitness Pal, which includes user-inputted nutrition data – a preferable app is Calorie King Australia, which is verified against the FSANZ database. Apps from overseas may have translation issues. For example, Australian nutrition apps represent carbohydrate amounts without fibre, whereas American apps include fibre; this key difference is vital to be aware of when calculating insulin doses. We recommend practitioners use app ratings to guide them towards quality products, and that they test apps themselves to ensure they are confident in their safety and effectiveness.

Embracing apps

Understanding the diabetes app landscape is important for diabetes professionals who want to stay current. Diabetes apps inform decision-making, store and share important data, provide vital reminders and warnings, and connect people up in convenient and effective ways. Although there is work to be done to improve their appeal to young people, diabetes apps can be valuable tools for clinicians and people with diabetes alike.

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