Care for Counting

A way to improve the experience of counting carbohydrates using minimal cognitive load to improve the motivation for diabetic diet management.

Need background

In general, once you have Type 1 or Type 2 diabetes, you have it for life. But Type 2 diabetes doesn't appear overnight. Long before it's diagnosed, the body begins to struggle to deal with sugars and other carbohydrates. After a meal, the pancreas releases insulin, a chemical messenger that helps glucose to be transported into the cells. Despite advances in medical treatment and technology, nutritional therapy continues to be a cornerstone of diabetes care. Nutritional recommendations for a healthy lifestyle for the general population are also appropriate for children and adolescents with T1D, with the only difference compared to healthy peers being the need for insulin therapy. (1)

Carbohydrate counting (CC) is a meal-planning strategy for patients with type 1 diabetes (T1D) and type 2 diabetes(T2D). It is based on an awareness of foods that contain carbohydrates and their effect on blood glucose. The bolus insulin dose needed is obtained from the total amount of carbohydrates consumed at each meal and the insulin-to-carbohydrate ratio. Evidence suggests that CC may have positive effects on metabolic control and on reducing glycosylated haemoglobin concentration (HbA1c). Moreover, CC might reduce the frequency of hypoglycaemia (2).

People with diabetes manage a complex and demanding treatment regimen, and are at increased risk for depression, anxiety and disordered eating and have high incidence of diabetes distress which can all compromise health outcomes and quality of life. For example in a population-based observational study, SEARCH for Diabetes in Youth, disordered eating behaviors were observed in 21.2 percent of the study participants with T1D and 52.2 percent of the participants with T2D. Disordered eating behaviors were more common in females with T1D and in those who were overweight. Higher scores were associated with higher BMI, in both the participants with T1D and the participants with T2D. Approximately 20 percent of the T1D participants reported skipping insulin for weight control, and more than 20 percent of all of the participants indicated they faced challenges in maintaining a healthy weight while managing diabetes. Some of the participants with T1D (12.4 percent) and some with T2D (34.2 percent) indicated they had a desire to be “thin at the expense of good diabetes control.” Overall, the participants with disordered eating had poorer health outcomes, including higher A1C levels, more depressive symptoms and poorer quality of life (3).

For people who live with diabetes, many are discovering the benefits of using mobile apps for helping with everything from carb counting to fitness tracking to healthy cooking and blood glucose (BG) monitoring. There are now over a thousand diabetes apps available.

Existing solutions

Currently the solutions for this need include apps and devices that can count the calories and carbs in food. Another approach is using a journal to track the food that you intake during every meal. Because of their ubiquitous, inexpensive, interactive and dynamic means of health promotion, diabetes apps may provide effective diabetes self-care by supporting diabetes patients in all self-care behaviors, while overcoming the weaknesses of traditional self-management strategies at the meantime. For example, a review published online in March 2018 in the journal Diabetes, Obesity and Metabolism combined the results of 16 trials of type 2 diabetes apps and found that, on average, using a diabetes app led to a drop in hemoglobin A1C of 0.57 percent (4). Existing solutions can be segmented in four categories, examples can be found in **Table 1**:

- **Apps that log blood glucose, count carbs, and calculate insulin doses**
- **Fitness apps that record exercise and food intake**
- **Apps that personalize recipes to the needs to diabetics**
- **Apps and devices that count the amount of calories in the food without knowing the weight**

Treatment analysis

Diabetes self-management training, the process of teaching individuals to manage their diabetes has been

considered an important part of clinical management since the 1930s. The goal of diabetes education is to optimize metabolic control, prevent acute and chronic complications, and optimize quality of life while keeping costs acceptable. (5)

Treatment options may include lifestyle behaviours, such as dietary management and physical activity. Additionally, medical treatment may be required (e.g. insulin for type 1 diabetes; and metformin, sulfoniluree and sometimes insulin for type 2). See Table 2 for an overview of recommendations for diabetes self-management activities. In type 2 DM, patients should be encouraged to lose weight and thus increase insulin sensitivity. In type 1 DM, having a proper diet is even harder because of the understanding of the importance of the disease and lack of education for the caregivers. In general, the term diet should be avoided in favor of a meal plan or healthy food choices. The main focus is to encourage healthy diets for the heart, low in cholesterol and saturated fats.

Stakeholder analysis

Three different stakeholders are concerned by the need to improve the experience of counting carbohydrates using minimal cognitive load to improve the motivation for diabetic diet management. Different stakeholders involved have different perception of the introduction of a new solution that could resolve the need, as you can see in **Table 3**. A thorough analysis can include even a broader range of stakeholders that have to be taken into consideration when will address the unmet need, as described in Figure 5.

Market analysis

Digital health interventions can provide sustained support and may overcome challenges associated with attending diabetes self-management sessions. Having a solution to continuous counting the amount of carbs and calories in the food would help patients to stick with the diet program and improve outcomes of the disease.

Analysis of the available applications and their features (**Table 4**) revealed no clear gap with respect to features required for diabetes management. However, several applications for calorie counting showed innovative input methods that potentially gives them a competitive advantage in the market, such as: scanning food product barcodes, image recognition through smartphone camera, voice recognition and selecting food items from specific restaurants. The strength of these input methods lies in the combination of the AI recognition engine and the connected food items database. Though, these calorie counting apps were not specifically designed for diabetic patients, applying a combination of these input methods could potentially ease the process of keeping a food diary, and thereby reduce the cognitive load.

Growing prevalence of diabetes is the major driver for the global diabetes care devices market. Additionally, rising awareness regarding diabetes care, growing prevalence of obesity, and technological advancements are further driving the market for diabetes care and management devices (Appendix 1). Though devices provide tools to support diabetes management, incorporation in the practice of daily life remains a challenge. One way of anticipating on the growing devices market would be to bridge the gap between diabetes management devices and software applications for fitness and healthy lifestyle. A 2015 study estimates the size of the U.S. weight loss and diet market at $64 billion, and a annual growth rate of 1.6% for Connected Fitness Platform ($80.447m, an increase of 66% compared to the previous year), which includes all software and hardware (8). This suggests that fitness platforms are rising in popularity. For example, according to Statista 2016 Report on digital markets, the company that created the Calorie Counter & Diet Tracker app had a revenue that amounted to $4.83bn in 2016, $8.8m (7). Using a similar lifestyle focused approach in diabetes management might be worth considering. For example, adaption or integration of already successful fitness and lifestyle platforms with diabetes management platforms can also benefit from the social component that goes hand in hand with lifestyle changes. This could then positively influence the fact that,due to lack of accountability in following a proper diet a lot of patients with T2D can develop psychological diseases as depression and have a greater risk for complications (Figure 2).

References

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8. https://www.statista.com/statistics/625673/total-weight-loss-market-size-in-us/

Appendix 1: Figures

Figure 1: Global Diabetes Devices Market 2015

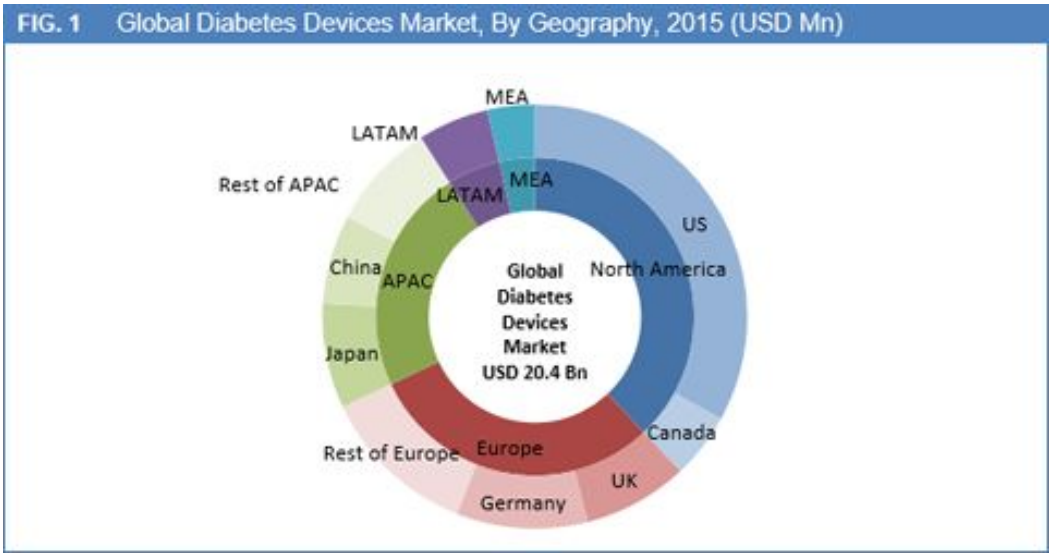
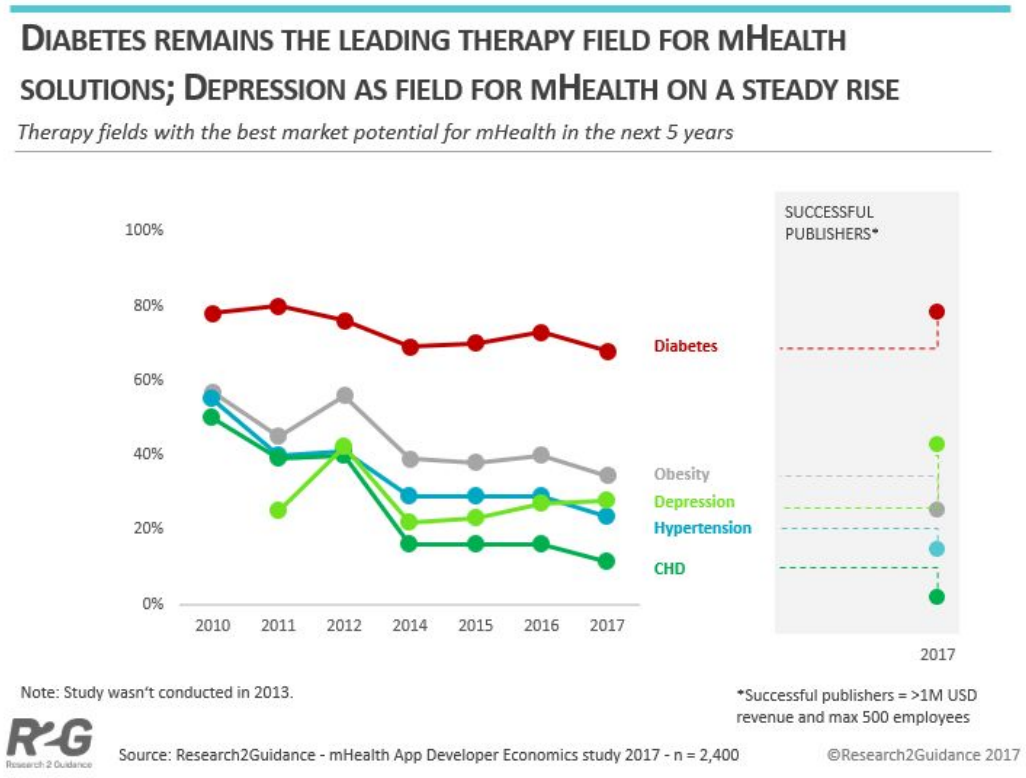


Figure 2: Diabetes market apps and emerging markets



Appendix 2: Tables

	Segment	Examples	
1	**Apps that log blood glucose, count carbs, and calculate insulin doses**	1. mySugr Diabetes Logbook – easy-to-use app that records diabetic data. 2. GlucOracle- it helps to forecast a person's blood sugar levels. 3. Glucose Buddy - keep close track of important statistics, such as blood glucose, carbohydrate intake, medication use, activity levels, A1C, blood pressure, weight. 4. BG Monitor- can help calculate insulin levels for each meal based on the data that it is given. 5. Glooko 6. DiabetesConnect 7. Diabetes:M 8. Carb counting with Lenny	
2	**Fitness apps that record exercise and food intake**	1. Lose it! – tracks daily percentage of carbohydrates, proteins, and fats and can scan the food. 2. Fooducate – gives food ratings based on their nutritional value. 3. MyFitnessPal - it has more than 6 million foods in its database, and is equipped with a barcode scanner to make input even easier. 4. MyNetDiary - it can track and plan the intake of: fat, carbs, calories, protein, nutrients 5. Fitbit – currently all the rage in the fitness community, this app tracks your exercise, sleep, water and food intake, and counts the daily amount of calories burned.	
3	**Apps that personalize recipes to the needs to diabetics**	1. iCookbook Diabetic – recipes to suit the unique needs of diabetics. 2. Slow Carb Diet – designed to give recipes for meals that won't spike blood sugar.	
	Apps and devices that count the amount of calories in the food without knowing the weight:	1. SmartPlate 2. CaloRieco 3. SCiO	

Table 1: Carbohydrate counting application segmentation

Self-management category	Treatment	Recommendations
Drugs	Medical treatment options	DM type 1: insulin DM type 2: metformin, sulfoniluree and sometimes insulin
Lifestyle modifications	Lifestyle modifications that benefit all patients include:	1. Eat regularly and in consistent amounts; 2. Limit intake of refined carbohydrates and saturated fats; 3. Increase the amount of physical activity practiced;
Dietary management	Simple steps to improve the diet and manage caloric intake include	• Eliminating sugar-containing drinks and foods made of refined, simple sugars; • Discouraging skipping meals; • Avoiding grazing on food throughout the day; • Controlling portion size; • Limiting high-fat, high-calorie foods in the home; • Increasing fiber intake by eating more fruits and vegetables.

Table 2. Treatment recommendations

Stakeholder	**Personal entity**	**Impact** How much the project impact them	**Influence** How much influence do they have over the project	**Priority** What is important to the stakeholders	**Contribution** How the stakeholders can contribute to the project	**Block** How the stakeholder can block the project	**Engagement strategies**
Beneficiary	DM 1 DM2 Gestational diabetes	High	High	Accuracy Fast decision Validation Personalized	Feedback Direct monitoring	Non-participation Age Digital/health literacy Culture Personal traits	Medical staff engagement Educational videos
User	Software developers	High	High	Access to data analytics	New features Interoperability with EHR	Lack of knowledge/ infrastructure/HR	Strategic alliances
Payer	Insurance companies Patients (DM1, DM2) Fitness aware	Medium	Medium	Reduce DM complications	Advice/checking status of diabetes management	Culture	Lower the price of infrastucture for patients

Table 3: Stakeholder analysis

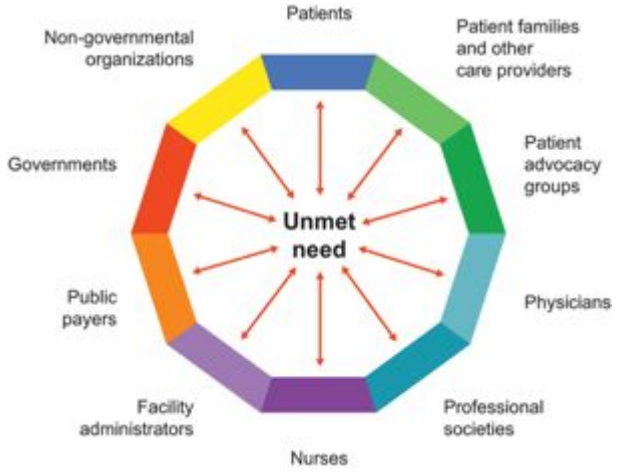


Figure 3 Interaction flowchart of all stakeholders involved

App	**Features**									
	Record			**Track**	**Calculate**	**Predict**	**Recommend**	**Advice on diet**	**Data access**	**Price**
	Record blood sugar level	*Record other medical data (e.g. medication use, activity levels, A1C, blood pressure, weight)*	*Record carbohydrate intake*	*Track carbohydrate statistics*	*Calculate insulin levels*	*Predicts blood sugar level*	*Food recommendations*		*Healthcare providers*	

mySugr Diabetes Logbook	✔	✔	✔	✔(PRO version)	✔(PRO version) - EU only	✔(PRO version)	✔	✔	✔	$39.99 /month (Bundle version)
GlucOracle	✔	✔	✔	✔	-	✔	✔	-	-	Free
Glucose Buddy	✔	-	-	-	-	✔	-	-	✔	$5/month premium version
BG Monitor	✔	-	✔	-	✔	✔	-		✔	Free
Glooko	✔	✔(activity)	✔	✔	-	✔	✔	✔	✔	$59.95/ year individual user Custom for clinics and others
DiabetesConnect	✔	✔	✔	✔	✔	✔	-	-	✔	$26.99 lifetime access
Diabetes:M	✔	✔	✔	✔	✔	✔	-	-	✔	$24.49(Premium version)
Carb counting with Lenny (USA only)	-	-	✔	✔	✔	✔	✔	-	-	Free

Table 4a. Gap analysis (see appendix Table 4b for extended review with calorie counting apps)