

DIABESITY: A Study for mHealth Integrated Solutions

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Abstract. Obesity is now one of the most critical and demanding public health condition due to the correlation with many medical and psychological comorbidities, such as cardiovascular, orthopedic, pneumological, endocrinological, psychopathological complications, above all the type 2 diabetes. Obesity traditionally needs long and expensive treatments in a chronic care management approach. So clinical research has to develop, test and validate cheaper rehabilitation programs. For this reason, we developed the DIABESITY study, the design of a mHealth integrated platform to promote the empowerment of patients in self-monitoring and successfully managing their pathological conditions (focusing on obesity and type 2 diabetes) through the use of mobile devices. In this paper we report this study by discussing the following two important aspects of DIABESITY. (i) Dietary mHealth tools for home-patients; (ii) Measures to capture the psychological factors and processes which mediate change of behavior and affect initiation and maintenance phases.

Keywords: Type 2 diabetes · mHealth · Psychological questionnaires · Obesity

1 Introduction

Obesity and low level of physical activity are well known important public health problems that are typically correlated with many medical and psychological comorbidities, such as cardiovascular, orthopedic, pneumological, endocrinological, psychopathological complications, above all the type 2 diabetes. Obesity and its comorbidities traditionally need long treatments creating a very expensive chronic care management approach 1. Clinical research has to develop, evaluate and validate cheaper rehabilitation programs above all in out-patient settings. In order to manage these problems, we developed the DIABESITY project. DIABESITY is first of all an innovative approach in health care systems and behind this approach we planned a project with a clinical study that will test the technological platform developed in the project. Diabesity means a new approach,

a project but also a study and the platform we will develop in the study. In particular, in this paper, we will focus on how DIABESITY can help patients in maintaining lifestyle behavior changes, ensuring functional patient empowerment and engagement. With this aim, the following key-points will be discussed: (i) Dietary mHealth services for home-patients (Sect. 2.1) and (ii) Indexes to capture the psychological factors and processes which mediate change of behavior and affect initiation and maintenance phases (Sect. 2.2).

2 Functionality, Measures and Questionnaires

2.1 Functionality

The system is developed as integrable platform that should fit into existing diabetes health system functions and complement the health system goals of health service provision for overweight/obese people and patients with type 2 diabetes. Moreover DIABESITY follows current relevant standards, guidelines, and best practices¹. Here we do not detail the technologies of DIABESITY, rather we discuss which functionality of DIABESITY can be applied in order for patients to maintain significant lifestyle behavior changes, improve health outcomes, and ensure functional empowerment and engagement. Specifically, we report in Table 1 the main functionality of the apps of this study.

2.2 Psychological and Behavioral Questionnaires

As suggested by Katan [9], cognition and feelings have a huge impact on behavior and may thus strength as well as disrupt adherence to treatment with clinical prescriptions. Psychological variables and processes influence every behavior change affecting the starting step and the following phases. DIABESITY program is designed to explore such factors in order to define which kind of patients could benefit from a mhealth based intervention. For this, we consider the indexes and questionnaires reported in Table 2. (taking into account that the psychological theory of change behind the DIABESITY approach is the *Transtheoretical Model of Change* [2–4,8,10]). This table is the same used in another previous project, TECNOB study, as reported in pages 5–6 of [1].

¹ In particular those concerning interoperability, minimum patient summary dataset to be shared across borders, standard on user safety (currently draft standard IEC 82304-1), app certification programs (e.g. NHS in the UK), apps as medical device (directive 93/42/EC under review) or in vitro diagnostic medical device (directive 98/79/EC under review) and compliance with personal data protection rules.

Table 1. Apps and functionality

App function	App contents	App specifications
Diet caloric restriction	Aiming to promote revolutionary principle approach of eating low calories density food, i.e. “eat more food while eating fewer calories and feeling the same degree of satiety” to maintain normal weight	(i) Consumer will get combinations of likely successful dietary treatments from a set of patients feature characteristics; (ii) Makes it easy to find a partner doctor in one of National’s healthcare networks, and access to that doctor for advice; (iii) Book appointments at a Health Diabetes, Nutrition and Metabolic Diseases Center; (iv) Secure access to health data and logs via the app
Diet composition	Improvement in dietary patterns national diet (intervention pattern in fat, sugar intake and micronutrients intake)	(i) Tables and reports to suggest confidence to undergo specific dietary improvement; (ii) Makes it easy to find a partner dietician (a registered dietitian) in one of National’s Health Diabetes Center; (iii) Dieticians can make personalized meal plan or can recommend standardized food portion size and can send images of the dietary patterns simply via the app; (iv) The app users will be able to create a personal patient record with standardized food portion size

Table 2. Scales and indexes (adapted from [1])

The self-report habit index (SRHI)	The SRHI is a measure of the development and strength of habits. It has a stem “[the behavior] is something that ...” followed by 12 items such as “I do without thinking”
Weight efficacy life style questionnaire (WELSQ)	The WELSQ is composed of 20 items that measure the confidence of the subjects about being able to successfully resist the desire to eat
Body uneasiness test (BUT)	The BUT is a self-report inventory that measures body uneasiness by a global severity index and five sub-scales: weight phobia, body image concerns, avoidance, compulsive self-monitoring, depersonalization
Binge eating scale (BES)	The BES is a short self-report questionnaire which measures severity of binge eating
Eating disorder inventory (EDI-2)	The EDI-2 is a widely used, standardized, self-report measure of psychological symptoms commonly associated with anorexia nervosa, bulimia nervosa and other eating disorders
Symptom check list (SCL-90)	The SCL-90 is a brief, multidimensional self-report inventory designed to screen for a broad range of psychological problems and psychopathological symptoms
Impact of weight on quality of life-lite (IWQOL-Lite)	IWQOL-lite is the short version of the original IWQOL and is composed by 31 items. The questionnaire is selfreport and consists of 5 scales assessing the impact of weight on QoL-related factors such as physical functioning, self-esteem, sexual life, public distress and work
The outcome questionnaire (OQ 45.2)	The OQ 45 items version is a measure of outcome and it is designed in order to collect repeated measures of patient progress during therapy and after its conclusion

3 Conclusions

The DIABESITY study integrates different solutions for the management and intervention of subjects with diabetes. This integration is designed to promote a stepped down intervention addressed to the behavior change [1]. As already indicated, ICT technologies may represent a functional integration to traditional treatments in order to reduce costs in chronic care management. Moreover ICT can enhance the adherence to prescribed treatments with the use of disappearing and real-time monitoring. In particular, social media [11] and specific analytical techniques [5–7], which share and integrate information, can improve the management of the pathologies e.g. by providing Internet-based spaces where patients can share experiences or by exploring the long-term intervention. Here, we focused on two main issues, which can support home-patients and capture the psychological factors affecting initiation and maintenance of the therapy.

The innovative features of the DIABESITY approach will be:

1. **ORGANIZATIONAL INNOVATION:** the out-patient step of the care will be provided in a new framework reducing hospital admissions and performing mobile and Internet based monitoring and treatment integrated protocols that will avoid high costs for the National Health Services and waste of time for patients attending uselessly hospitals or clinics. This will also reduce the burden of disease of the patients, improving their quality of life.
2. **TECHNOLOGICAL INNOVATION:** the DIABESITY project will not produce new technological devices or biosensors, but it will use the gold-standard technology available on the market in a new user-friendly platform integrated in order to diagnose obesity and to assess severity or complications of it (above all type 2 diabetes).
3. **CLINICAL INNOVATION:** clinical units will manage obesity in a multidisciplinary approach, according to a chronic care management model, including biomedical, psychological, eating and physical activity data, improving the patients knowledge, empowerment, self-awareness and maximizing the rehabilitation impact.

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