DIABETES TYPE I PATIENT-SPECIFIC SELF-MONITORING: COMPARATION OF SMARTPHONE AND PAPER-BASED MONITORING COMMITMENT

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Introduction.

Patients with DT1 must adhere continually to a complex daily regime that includes monitoring of diet, exercise and medication in order to control and maintain blood glucose levels. During last decade were done several deep studies that recognized the tight glucose control to prevent or reduce the progress of many diabetes complications [1].

The traditional paper-based method of self-monitoring is time-consuming, requires patience and persistence, that results is low adherence to diabetes control and long inactive period-gaps. Several studies have shown, that the use smartphones can improve diabetes self-monitoring [2, 3]. However, these studies didn't compare traditional paper-based monitoring and the monitoring using smartphones. A recent paper has studied sequences of active and inactive periods of diabetes in mobile and paper diary user groups, but it focused solely on patients having diabetes type II and obesity [4].

In this research is presented an attempt to compare the traditional paper-based diabetes monitoring and the one using smartphones to find patterns of active behavior in self-monitoring in both groups.

Material and methods

1.1 Dataset. the study was elaborated using data from 5 patients with dt1 using a specially created for this purposes m-health support system. the support system consisted of a mobile application with a diary to collect data, a third-party fitness bracelet providing heart rate data and processed by the mobile application and a cloud-based server to collect and the process the data. the focus group consisted of 3 male and 2 female individuals, data was being collected within a 3-month period.

The focus group was divided into 2 groups: one using only smartphone

for self-monitoring, another
both paper-based and smartphone monitoring solutions.

1.2. Modelling methodology. The collected data consisted of: basal and bolus insulin doses, carbohydrates intake, blood glucose and heart rate measurements. According to [4] each type of input dataset was converted into a binary vector to measure self-monitoring compliance. For example, 11001 represents a 5 days self-monitoring status with 2 days of active period and a 2 days passive period followed by 1 active day. Each type of input dataset had its own threshold to get 1, the thresholds are presented in Table.

Table

Dataset thresholds

Dataset	Threshold per day
Carbohydrate intake	At least 3 intake records
Insulin doses	At least 1 basal and 3 bolus insulin dose records
Blood glucose	At least 3 measurement records
Exercise (heart rate)	At least 4 measurement records

Computation of the conditional probability of an active monitoring sequence continuation is based on equations (1)-(3) from [4]:

$$P(l \geq m \mid l \geq 1) = N(l \geq m) / N(l \geq 1) \quad (1)$$

Where the conditional probability P of continuation of an active sequence of length l for m or more days, given that a new sequence has started, was derived by normalizing the count, $N(l \geq m)$, of active substrings with length $l \geq m$ by the total number of sequences of any $l \geq 1$. The expectation value of the duration of an active sequence was calculated as:

$$L = \sum m\, P(l = m \mid l \geq 1) = \sum m\, [P(l \geq m \mid l \geq 1) - P(l \geq m + 1 \mid l \geq 1)] \quad (2)$$

Results.

The obtained result of self-monitoring adherence show higher rates in the smartphone users group compared to the paper-based users group. The smartphone user group has shown better overall commitment to self-

monitoring and a sharply higher constancy in carbohydrates intake and exercise (heart rate) monitoring. Conditional probability distributions of active sequences durations in all 4 dataset types are shown in Fig.

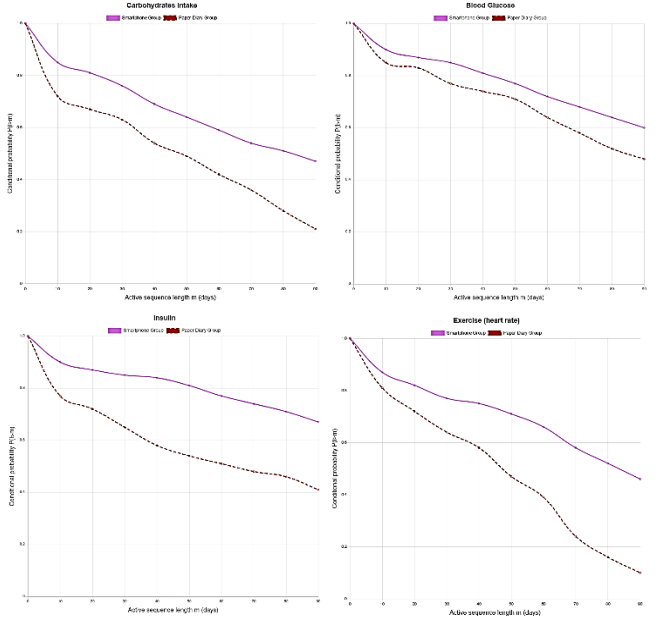

Fig. Conditional probability distributions of self-monitoring active periods durations in smartphone and paper-based groups

Conclusions.

This paper represents a 3 month trial that compared paper-based self-monitoring and the one using smartphones. The smartphone group has shown better persistence in self-monitoring compared to the paper-based group, with overall of +41.25% improvement, having most significant advantages in exercise and carbohydrates intake monitoring, +67% and +55% improvements respectively. According to this study such results are due to automatic reminders, better interactivity and visualization that modern smartphones can provide. This work is planned to be extended by creation of personalized adherence patterns for each patient. To obtain better results, this study requires a larger

target group and a longer trial period.

References:

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