POWER2DM

"Predictive model-based decision support for diabetes patient empowerment"

Research and Innovation Project
PHC 28 – 2015: Self-management of health and disease and decision support systems based on predictive computer modelling used by the patient him or herself

POWER2DM D3.7 (or 3.4.1)

Mock-ups for Web and Mobile User Interfaces for

SMSS Interventions

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SRFG	Salzburg Research Forschungs Gesellschaft	Austria
PD	PrimeData	Netherlands
iHealth	iHealth EU	France

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1   INTRODUCTION

1.1 Purpose and Scope

This document provides snapshots/mockups for the user interface (UI) designs of interventions to be provided to patients by SMSS to get feedback from the patients and other stakeholders regarding the interventions and UI designs. For the UI components that has already some progress in development, snapshots from actual implementation will be given. For the others, mockup designs can be given. For each section mockups/snapshots is described as a part of storyboard to give an example context.

In line with these objectives, **Section 2** provides the UIs designed for interventions to be delivered via POWER2DM Web Application as a part of action plan workflow; goal/value/action planning, monitoring, periodic review and barrier identifications. Similarly, **Section 3** provides the UIs designed for interventions to be delivered over POWER2DM Mobile Application which includes daily motivational support for patients to foster the behavior change.

1.2 References

- D1.3 Conceptual Design of POWE2DM
- D3.1.1 Dynamic Behaviour Change Intervention Models for Self-Management
- D2.5 Mock-ups for GUI Components related with Visualization of Predictions and Simulations

1.3 Definitions and Acronyms

Table 1 List of Abbreviations and Acronyms

Abbreviation/ Acronym	DEFINITION
UI	User interface
BG	Blood glucose
BGM	Blood glucose monitoring
JITAI	Just in Time Adaptive Intervention
BCT	Behavioural Change Technique
ODL	Observation of Daily Livings

2 UI DESIGNS OF INTERVENTIONS TO BE DELIVERED OVER WEB APPLICATION INTERFACE

Note: The first version of the Action Plan Engine was developed in the EMPOWER project[1] and will be enhanced in POWER2DM. Therefore the user interface (UI) examples in this deliverable are a mix of screenshots and mockups.

The Web application of the POWER2DM platform is based on the Action Plan Engine offering a guided workflow as an iterative cycle, typically on a weekly basis. If a patient specifies activities on a weekly basis the likelihood that these activities are realistic is higher than planning activities for a longer period. However, the Action Plan cycle can also be bi-weekly, monthly or of another duration.

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[1] https://www.empower-fp7.eu/

2.1 Interventions during Action Plan Workflow

Basically the Action Plan Workflow comprises four main steps (see Figure 1)

(1) Specifying long-term self-management goals based on personalised values and on the treatment plan and goals
(2) Specifying short-term (e.g. weekly) activities based on the self-management goals
(3) Collecting patient data (so-called Observations of Daily Living ODLs) recorded through mobile devices and Web forms
(4) Evaluating the weekly activities and collected patient data and giving feedback about the progress and tips for improvements and motivation.
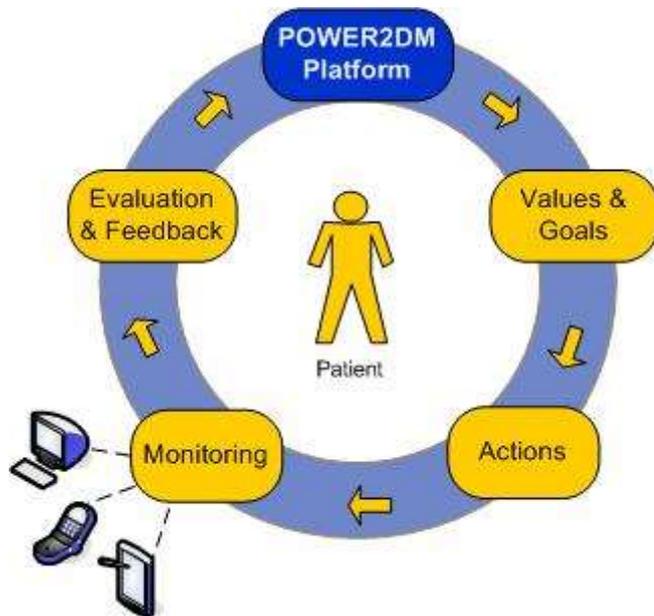
Figure 1 Action Plan cycle

2.1.1 Specify/update self-management goals

Based on the treatment plan and optional on the personal values the patient can additionally to the treatment goals define personal self-management goals. In case, they are already exist the patient can update them accordingly. The first step of the workflow will be to have a look at the treatment plan (see Figure 2) presenting the treatment goals and activities, an additional description and the person who specified the treatment plan

Treatment Plan

Target Date	Treatment Goal	Treatment Activities	Description	Ordered By
2017-04-02	HbA1c 7.0%	-	Our goal of HbA1c for your next visit	Javier Delgado
2017-04-02	Adherence 95%	• Measure Blood Glucose • Log insulin/medication intakes • Log carbohydrates for meals • Use activity tracker device to monitor your activity (steps)	Strictly adhere the KADIS Data Collection action plans to be ready for KADIS Metabolic Fingerpring identification process	Javier Delgado

Figure 2 Treatment Plan

Based on the treatment goals, the patient can specify a treatment goal in a more detailed way (e.g. specifying the type of exercise he would like to do) but also add additional personal goals. They are called self-management goals. Figure 3 depicts an example for specifying a self-management goal.

Self-management goals are described by an entry date, a goal title, related treatment goals, a more comprehensive description and a personal motivation for the goal.

Figure 3 Specification of a self-management goal

Figure 4 gives an overview of all defined self-management goals. New goals can be added by pressing the "Add" button; existing goals can be edited or deleted by clicking on the corresponding table row.

Figure 4 Overview self-management goals

2.1.2 Specify/update activities

In the next step the patients plans and updated the activities for the upcoming week by using a calendar. The calendar view (see Figure 5) keeps track of all user activities with adjustable views (week, overview, 2-day) and activity type filters (completed, in progress, incomplete, in future, observation). Furthermore, completion rates are colour coded.
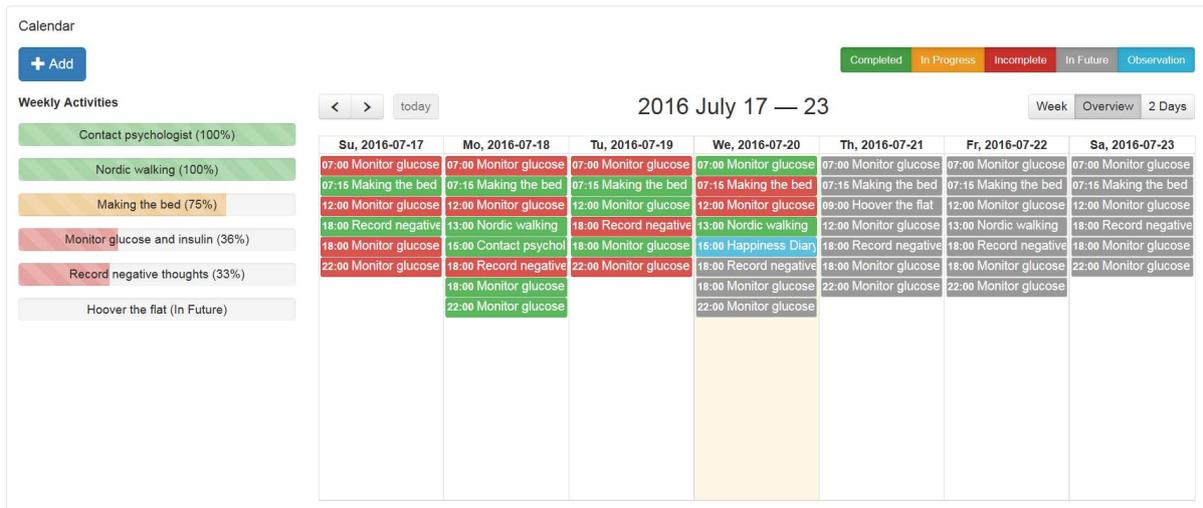
Figure 5 Calendar View

New activities can be added by pressing the "Add" button. The Activity Management view allows for managing activities with an activity title, a description, referring an activity to a journal category (e.g. blood glucose, exercise, stress) and to one or more related goals (see

Figure 6). Relating an activity to a goal keeps the user aware why he is performing an activity. Finally, with the Button "Add schedule" a schedule for each activity can be defined (see

Figure 7)
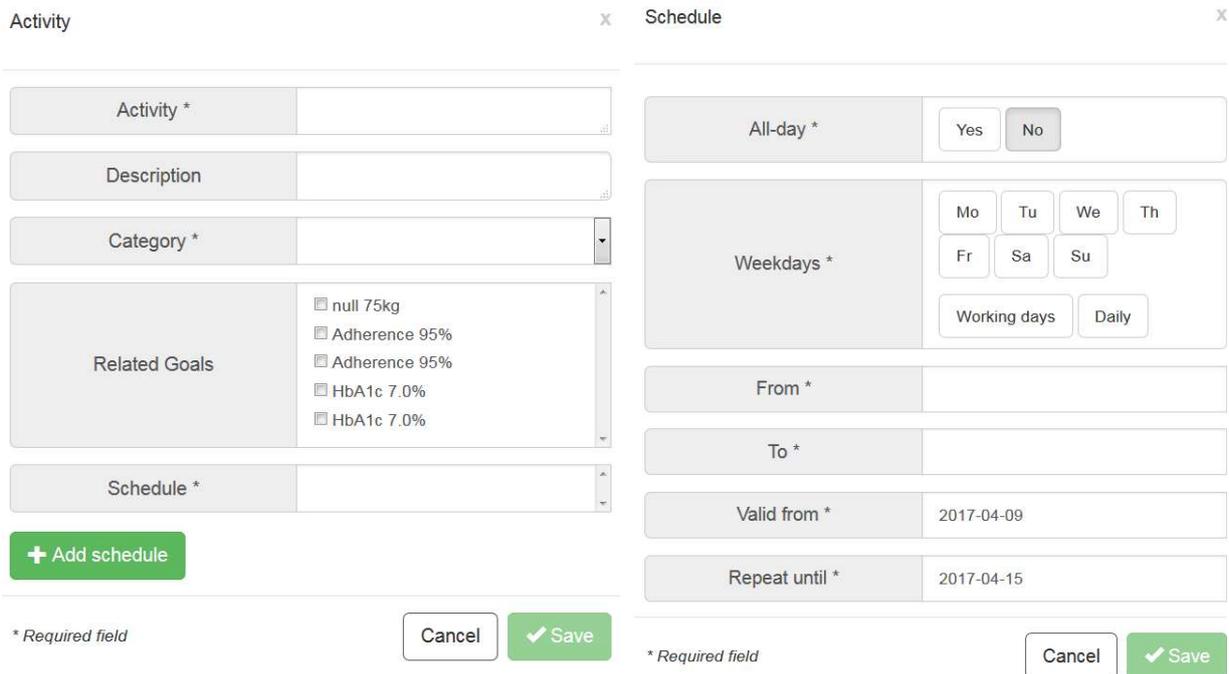
Figure 6 Calendar View

Figure 7 Managing a schedule

Existing activities can be edited or deleted by clicking on the corresponding progress bar on the left hand side; Results of activities (so-called ODLs, Observation of Daily Livings) can be added / edited by clicking on the corresponding calendar item, e.g. confirming a medication intake or inserting the current body weight.

2.1.3 Self-monitoring

During the week, patient data will be recorded by devices but also manually through Web and/or mobile forms. This phase supports the self-monitoring of vital data and behaviour. Currently, the following ODLs can be recorded via Web forms:
- ♦ Blood glucose
- ♦ Blood pressure
- ♦ Exercises
- ♦ Meals
- ♦ Problems
- ♦ Sleep
- ♦ Stress
- ♦ Body weight

Figure 8 and Figure 9 presents two examples for Web forms recording ODLs for stress and exercises,

Figure 8 Recording stress events

Figure 9 recording an exercise

Self-monitoring through mobile devices is described in section **Error! Reference source not found.**

2.1.4 Review and feedback

At the end of the week (or when the patient wants to ask for feedback) the Action Plan Engine evaluates and gives feedback how successfully the patient has fulfilled his planned self-management goals and activities. This includes feedback about the overall performance and of the performance of all concerned self-management goals and activates (see **Figure 10**). To give a quick overview, only those goals and activities with a top high performance (for fostering motivation) and those with top low performance (where the patient should take attention) are presented. For a detailed overview the user can click to "All Activities".

Additionally, the Action Plan Engine provides hints and advices (=interventions for self-management) for all activities and goals. Interventions can be in a different context, e.g. a tip for improving self-management activities, an advice based on national guidelines (e.g. recommended duration for physical activities, a tip for coping with daily problems (e.g. sleep problems or stress) or a motivational message (e.g. reminding on personal values).

Figure 10 Periodic review

The button "Charts" refer to charts based on the review period.
Figure 11 presents an example for blood glucose.

Figure 11 Chart for Blood Glucose

2.2   Barrier Identification and Resulting Interventions

The basic psychological approach of decision trees for barriers and mockups are described in deliverable D3.1/ D3.1.1a "Dynamic Behaviour Change Intervention Models for Self-Management" in section 4.3 "Decision Trees for coping with Barrier".

2.1   Energy Battery as Intervention

The Energy Battery is a metaphor for mood or energy problems, e.g. in case of low mood or too much stress, in case of sleeping problems, if the user feels basically tired or if the performance of exercises is low. A typical situation is when people are depressed and they stop active relaxation and sleep less. The basic assumption of the Energy Battery is that sleep increases energy level and that active relaxation gives the most energy.

The Energy Battery is an exercise consisting of three steps:

Step 1 – Raising awareness: the user will be informed about the four categories of the Energy Battery (see **Figure 12**):
- Active relaxation – these are activities the user choses to do because he enjoys (or used to enjoy) them. These are activities in which the user is 'actively' doing something and feel mentally recharged afterwards, e.g. walking, dancing, going out with friends
- Passive relaxation – these are activities that help the user to calm down, relax, and maybe take his mind off of things. Usually these activities are helpful after the ''must do's'' and after the ''active relaxations'', e.g. reading, watching TV, surfing the internet, taking a bath
- Sleep – getting enough sleep at night helps to recharge the battery for the next day, so the user can function well. Some people need more sleep than others. In general everyone needs between 6-10 hours sleep per night.
- Must do's – these are activities that the user doesn't really have a choice about, he needs to do them. Sometimes the user can feel fulfilled after doing them, but still they use up some/a lot of energy, e.g. work, cleaning your home, taking care of your health, caring for family or others

Step 2 – Energy Diary: In the next 7 days the user is asked to record what he is doing according to the four categories of the Energy Battery by using a calendar. The user is asked not only to relate an activity to one of the four categories but also to specify the type of activity. **Figure 13** presents an example.

Step 3 – Feedback: in the last step POWER2DM gives a summary and feedback according the user's energy level (see Figure 14). Feedback also includes some advices how to increase the level of the user's energy battery in particular in case the activities for active relaxation are too low.

Energy Battery
Step 1 - Raise Awareness

Your activities contributes in different ways to your energy battery:
* **Active relaxation** gives the most energy
* **Sleep** also increase your energy level
* **Passive relaxation** helps the user to calm down
* and finally, there are **things you have to do**, such as household and your job

Let's now have a look how your activities contributes to your Energy Battery.
Click into the coloured segments of the circle and insert your activities.
Some activities may already inserted from your past Action Plans.

Active relaxation, e.g.
* Singing
* Walking
* Cinema
* Running
<more>

My activities:
* Walking with Sue
* Dancing with Joe

Must do's, e.g.
* Work
* Houshold
* Caring
* Health
<more>

Passive Relaxation, e.g.
* Reading
* TV/Internet
* Shower/bath
* Coffea/tea
<more>

Sleep – should be between 6-10 hours per night
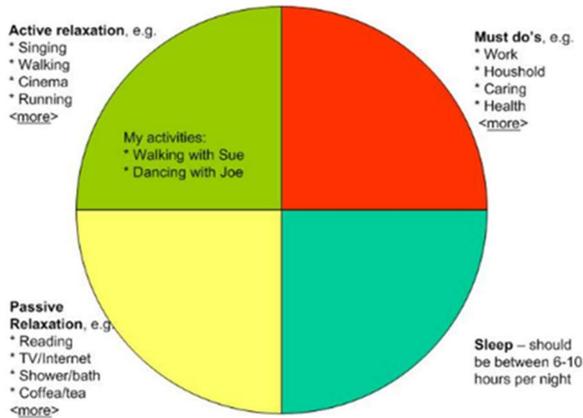
Figure 12 Energy Battery Step 1: Raising awareness

Energy Battery
Step 2 - Energy Diary

In the next 7 days you will be asked to assign the hours of each day to one of the four categories (active relaxation, passive relaxation, must do's and sleep) and to indicate the type of activity.
Below you find an example

	Day 1	Actvities
00:00		
01:00		
02:00		
03:00		
04:00		
05:00		
06:00		Shower, breakfast, reading my newspaper
07:00		
08:00		work
09:00		
10:00		
11:00		
12:00		
13:00		
14:00		
15:00		
16:00		
17:00		buying food at the supermarket
18:00		gardening
19:00		preparing diner
20:00		watching TV
21:00		
22:00		
23:00		
00:00		

Figure 13 Energy Battery Step 2: Energy Diary

Energy Battery
Step 3 - Feedback

You did a good job for writing down all your activities.
Below you can find a graphical overview:
* You sleep about 8 hours each night. That's fine. Keep on doing that!
* Your activities for active relaxation covers only 3 hours in your week.
  Increase your active relaxation by adding some activities you enjoy.
  Look at the slide show for some tips.

Active relaxation:
* gardening
* dancing

Passive Relaxation:
* Reading
* Watching TV
* Shower
* Coffea
* Visting a friend

Must do's:
* work
* preparing breakfast, lunch & diner
* Bying food
* household
* catching kids from school

Sleep
8 hours on average
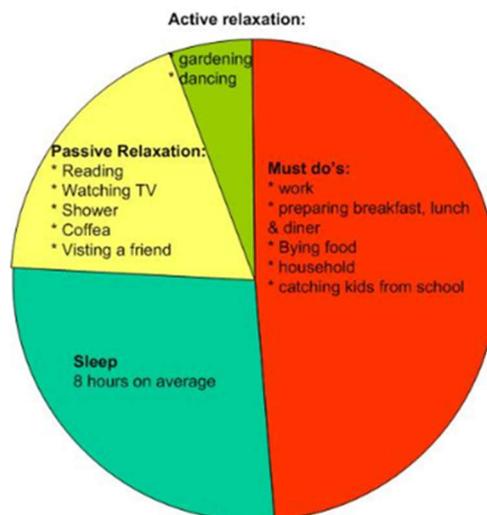
Figure 14 Energy Battery Step 3: Feedback

3   UI DESIGNS OF INTERVENTIONS TO BE DELIVERED OVER MOBILE APPLICATION INTERFACE

IMPORTANT NOTE: These designs are published on https://www.invisionapp.com/ which is a collaboration tool for UI design where others can comment on designs. You can reach the designs from the following link; **https://invis.io/5GB5UK54B**

By switching to commenting view, anyone can also see the comments and feedbacks received for the mockups and provide his/her own comment. We are sharing the link with POWER2DM experts, and external physicians and patients to get further feedbacks and anyone can follow the latest version of the designs from the link.

3.1   Daily Dashboard – Goal/Action Plan Monitoring
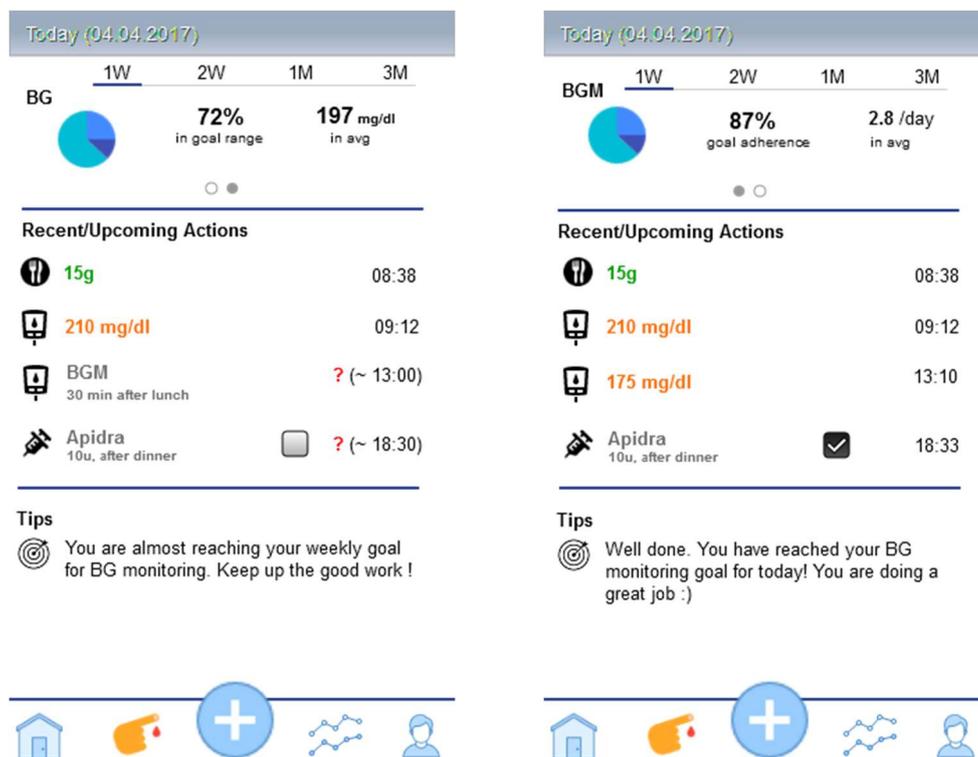
Figure 15 Main page (Daily Dashboard) v1

Figure 15 illustrates the Daily Dashboard view of POWER2DM Mobile Application which shows patient about his/her daily status and planned and recent actions/measurements done within the day. The opening will always show the current day ("Today") but swiping on the view can change the context to yesderday and conitunously to other past days.

The top panel shows "How much patient is good at his/her goals (including behavioral goals)"? The left figure provides an example for Blood Glucose (BG). By swiping on this part, patient can see latest status on other goals as shown in right figure; Blood Glucose Monitoring (BGM) goal.

The pie chart in this panel shows the percentages of;
- patient achieves the goals

- patient almost achieves the goals
- patient achieves less than goals.

Then the first number indicate percentage of how well goal achieved; for BG it is the percentages of measurements which are in the goal range and form BGM it is the adherence percentage. The second number shows average value related with the goal. e.g. Avg BG measurements within the period.

Above the panel, patient can select the period (weekly, biweekly, monthly, 3 monthly) for goal evaluation. As 1W selected, this screen shows each goal evaluated based on last week performance.

Next panel, Recent/Upcoming Actions, shows the scheduled action plans for today as well as observations or performed actions. As shown in the figure left, some of the actions are already done;
- e.g. Patient enters a carb intake for breakfast
- e.g. He measures his BG with his glucometer.

And others are action plans not done yet.
- e.g. Blood glucose monitoring after lunch
- e.g. Insulin Apidra, 10u after dinner

If some action is about a measurement which is manually logged by patient, a checkbox appears next to it as shown in left figure. For easy data entry, patient may click this checkbox to state the medication is taken now with the same dosage as planned.

The last panel, "Tips", shows the JITAIs already delivered within the day to motivate the patient, etc.

The application has 5 main views, as shown in the menu panel at the bottom;
- 1st one (with home icon) is the Dashboard View (this one)
- 2nd one opens the "Daily blood glucose management" view
- 3nd one (with plus icon) opens a "Add Event" view which patient may log any measurement
- 4th one (with char icon) opens a "Performance Analysis" view where he can compare his/her performance in comparison to his/her goals

In the light of feedbacks that we received from the POWER2DM experts, we have the update the views as shown in Figure 16. The changes are as follows;
- The periods for goal evaluation are changed to include "Today" to show how well patient is performing today against his/her goals. (Based on comment from LUMC: "Patients tend to focus on what they need to do now and today rather than how it is going over long periods of time.")
- The goal percentage number is changed by an indicator which can be; "High Achievement", "Medium Achievement", "Normal Achievement", "Some Achievement". (Based on comment from LUMC: "We need to keep the focus on what can still be achieved and not what was missed. So let's keep the focus on completed tasks")
- In the "Recent/Upcoming Actions" panel, the actions which corresponds to a planned action are marked by "P" icon to show that they are standard measurements or actions and others are extra ones. For example, the insulin performed at 13:28 is not a planned one. (Based on Comment from LUMC: "I think one of the major issues is whether a glucose value is part of a standard measurement (i.e. standard fasting/pre-meal) or that it is a measurement due to feeling unwell/activity/doubt. In clinical practise that makes a huge difference.")
- For medication actions, as shown as the last item in the figures, if the present dosage is not given, a text box appears so that patient can log the dosage of insulin/medication intake. (Based on comment from LUMC: "Insulin is very variable, so it is likely to be difficult to use present dosage. Oral medication is most of the time the same.")
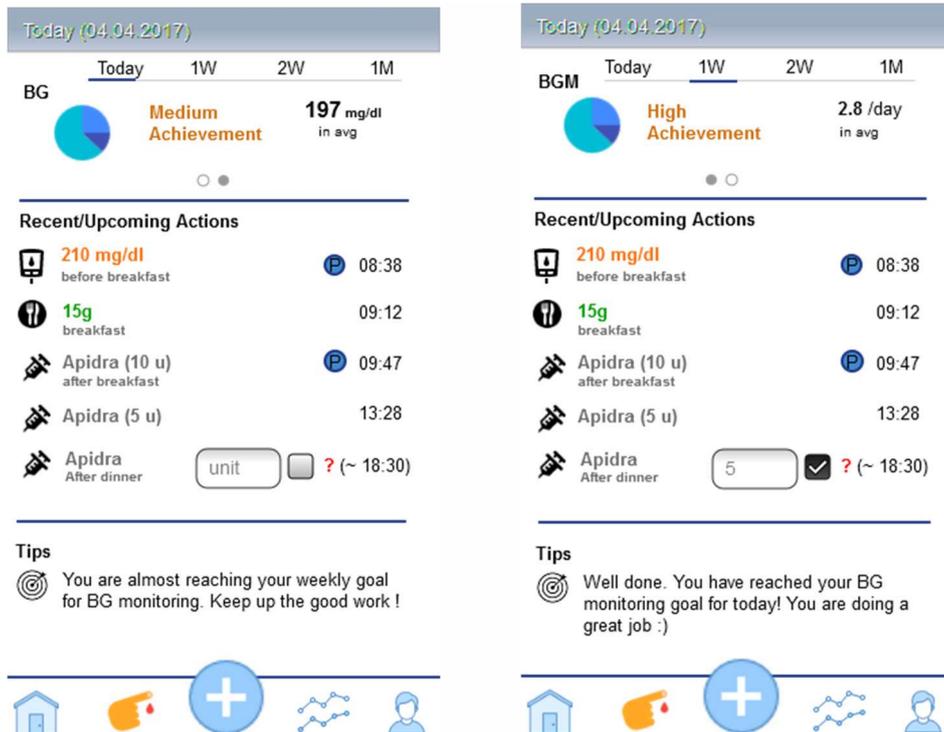
Figure 16 Main page (Daily Dashboard) v2

3.2 Daily Blood Glucose Management and Metabolic Profile

The objective of this view is to support patient for his daily blood glucose management. The view is illustrated in Figure 17 and the upper graphic shows the KADIS Metabolic Fingerprint and BG measurements for the day. If a possible problem is detected, it also shows the simulation based on the latest information (BG measurements, dietary intakes, exercises, etc.) and the problem risk.

The events to be detected currently considered are as follows. However, the decision will be taken after getting Quantification Campaign results which will show how reliable these predictions and simulations can be.

- Possible hypo detection from latest BG measurement
- Hypo warnings for intense exercises

The "Tips" panel includes the description of the risks, instructions and warnings related with the findings and simulation. Clicking on the info icon at the right top corner shows detailed descriptions of how simulation is done and data used for the simulations as described in D2.5.

In the upper tabs, patient may select "Metabolic Profile" to see his/her latest metabolic profile calculated by KADIS, M2TD Marvel and risk scores. Figure 18 illustrates the "Metabolic Profile" view.
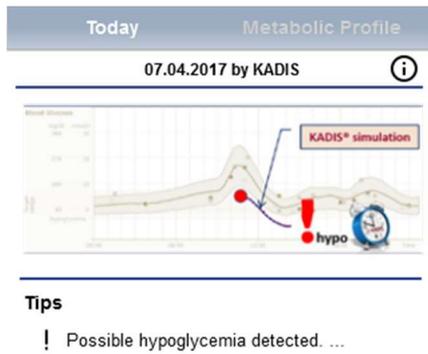
Figure 17 Daily BG Management view

Figure 18 Metabolic Profile view

The upper HbA1c panel in the left figure shows latest HbA1c results. The number next to the goal icon shows the goal set for patient for HbA1c e.g. below 7%. On the right the latest measurement is shown e.g. 9.1%. Also, other values calculated by KADIS system are shown; HbA1c analysis from Self-Monitoring of Blood Glucose (SMBG) results and Mean Blood Glucose (MBG) value.

The middle panel, QScore panel, shows the latest QScore analysis results calculated by the KADIS system. The last panel shows the Daily Blood Glucose Profile of patient calculated by KADIS based on the measurements obtained for a specific period by KADIS protocol.

By swiping up, patient can see other panels as shown in the right figure. The Diabetic Health Progress Indicators panel shows the Marvel predictions for several diabetes related indicators. Risks panel shows the calculated risks for patient, previous and goal. These panels are described in detail in D2.5.

3.3   Logging events/measurements (Add event view)

Figure 19 Add event view

Figure 19 illustrates this view by which patient can log any of the measurements or events. The first panel, Scheduled Actions, helps patient can see what is scheduled for him for today and immediately can enter the result. In the example shown in figure, he need to take the insulin Apdira   after dinner with 10 units dosage and have a planned 1 hour walking session at 19:00.

Patient can enter the values to the text boxes on the right to indicate they are performed. Patient can also log other measurements from the bottom panel, which are not mandatory for the patient (does not have an Action Plan regarding those). The measurements listed above are not a complete list, and the view will be updated based on the Pilot Protocol specified for the POWER2DM pilots.

3.4 Performance Analysis View
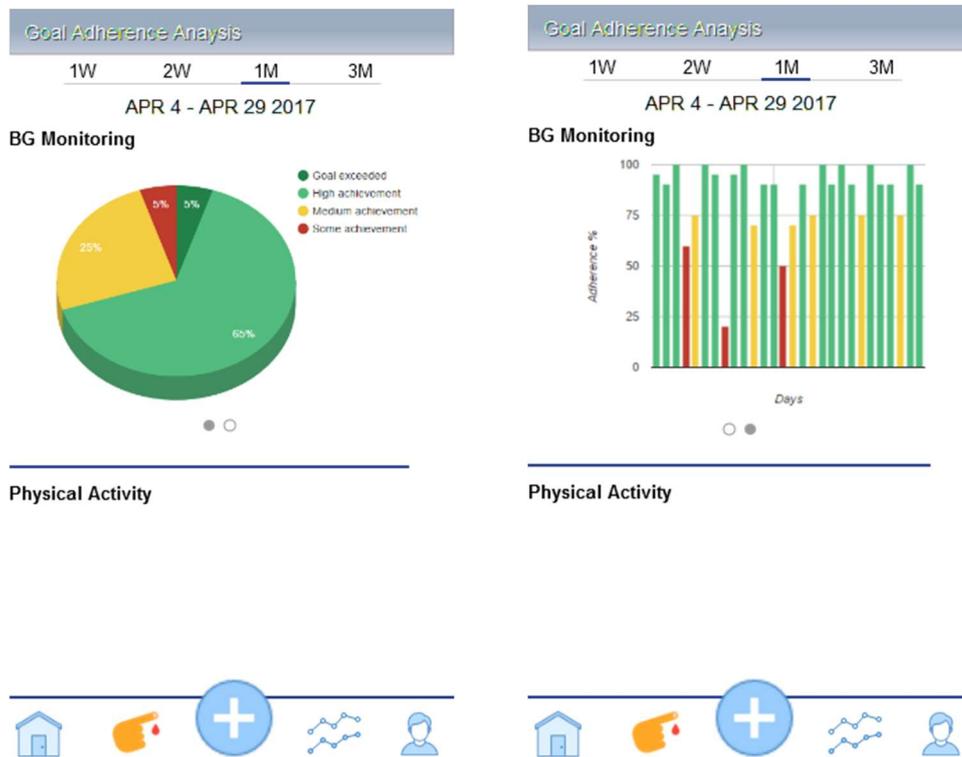
Figure 20 Goal Adherence Analysis view

Figure 20 illustrates the view that patient can analyze his/her adherence performance to his/her active goals. From the above, patient can select to analyze last week, last month, last 3 month and yearly evaluation.

For each active goal, the pie chart show the categorization of how well patient perform his goal; Goal exceeded, High Achievement, Medium Achievement, Some Achievement. By swiping left another graph will replace for the active goal. This time it shows how well patient performed each day. The y axis shows the related number with the goal and colors of bar show if he reaches the goal for that day.

3.5 JITAI Delivery – Push Notification Messages and Showing Data about achievements or failure

3.5.1 Push notification messages

We have 3 major category of Jus In-Time Adaptive Interventions (JITAIs) to be delivered within the day via push notifications over Mobile Application. See D3.1 and D3.3 for more details of JITAIs.

- **Motivational Messages** are messages sent after some performance of planned actions (either missed or performed); by using some behavioural change technique (e.g. positive comparison with self, positive comparison with others, general reinforcement, social support)
- **Reminders** are motivational messages before a scheduled action by using some behavioural change technique (e.g. positive comparison with self, with others, social support, positive reinforcements, simple reminder, etc.)
- **Instructions/Warnings** are warnings and clinical instructions after some event (e.g. overloaded exercise, too low BG measurement) by using some behavioural change technique like "anticipatory coping" or "planning".

Figure 21 illustrates the "Intervention Preference" view that will be part of patient settings. Patient can select his preferences for interventions to be received for his/her active goals.

Figure 21 Preferences for Interventions

In this example, she has only one active goal BG Monitoring, and for this she sets her preference for major categories of interventions as listed above. Possible preferences are as follows and descriptions of them are also shown to patient;

- Each time: A message will be sent to patient each time a corresponding action is planned within the day.
- Frequently: A message will be sent to patient at least once a day if a corresponding action is planned for that day.
- Occasionally: A message will be sent to patient at least once a week for one of the planned actions in that week.
- Rarely: A message will be sent to patient at least once a month for one of the planned actions in that month.
- Never: Messages will never be sent to patient for this goal.

For Prototype 1, POWER2DM behavior change experts, specify the following Behavioral Change Techniques (BCTs);

- Positive comparison with self
- Positive comparison with others
- Social support/reinforcements
- Showing summary of behaviour in past
- General reinforcement

For all these, the push notification message will provide the main information to patient but for some of them giving a better insight to patients will be helpful. For such cases, clicking on the message will open a specific view for each BCT. The following sections provide a general design for these views specific to interventions with a specific BCT.

3.5.2   Positive comparison with self – Showing comparison data

Figure 22 illustrates the concept for interventions with "positive comparison with self" technique.

Figure 22 "Positive comparison with self" view

The figure in the left shows the notification received for a goal related with physical activity; walking. At the end of the day, system sends a motivation to patient that evaluates the day and provide a positive comparison. When patient clicks to the message, the view shown in the right figure will be opened.

Based on the goal, this view shows a chart comparing the current performance of patient for that goal with a past performance. This past performance can be;
- Performance of yesterday
- Average recent performance (past 3-4 days)
- Average performance of last week
- Average performance of last two week
- Average performance of this month or last month
- Average performance of this 3-month period or last 3-month period
- Best performance
- Worst performance

Above the chart, the message will be shown and below the chart the details of the related goal and action plans are listed.

3.5.3 Positive comparison with others – Showing comparison data with others

Figure 23 illustrates the concept for "positive comparison with others" type of interventions. Patient has a BG monitoring goal, and a motivational reminder is sent to patient to remind him for an upcoming BG monitoring schedule after lunch. Clicking on the message will open a detailed view.

Figure 23 "Positive comparison with others" view

The chart this time is a histogram of all patients that has a BG monitoring goal in POWER2DM system. Each pile of block in the chart may corresponds to a number of patients (e.g. 100 patients). The x axis is the goal performance axis and the performance is increasing from left to right. The coloured categorizations shows; Some Achievement (yellow), Medium Achievement (orange) and High Achievement (Green).

From the figure, it seems that most of the patients have some achievement in BG monitoring in this week. The person icon shows the position of the patient in this performance scale with the marked bucket. The motivation states that if patient adheres to the next measurement schedule, he will jump to the next group and leave behind 1600 patients.

These statistics are given below the chart for the motivation. And again, the bottom panel shows the details of the BG monitoring goal for patient and recent and planned actions today to remind him.

3.5.4 Social support/reinforcement

Figure 24 shows the views for social support interventions. The example is about Carbohydrate intake goal and patient has a difficult day and take too much carbohydrates. The specific view will show the message of the system and the details of the goal and performed activities as usual. The view can also include the motivational message stored by the friend/relative. The details of social support

interventions are not ready yet (how to implement and realize), so this view can be changed later according to the context.
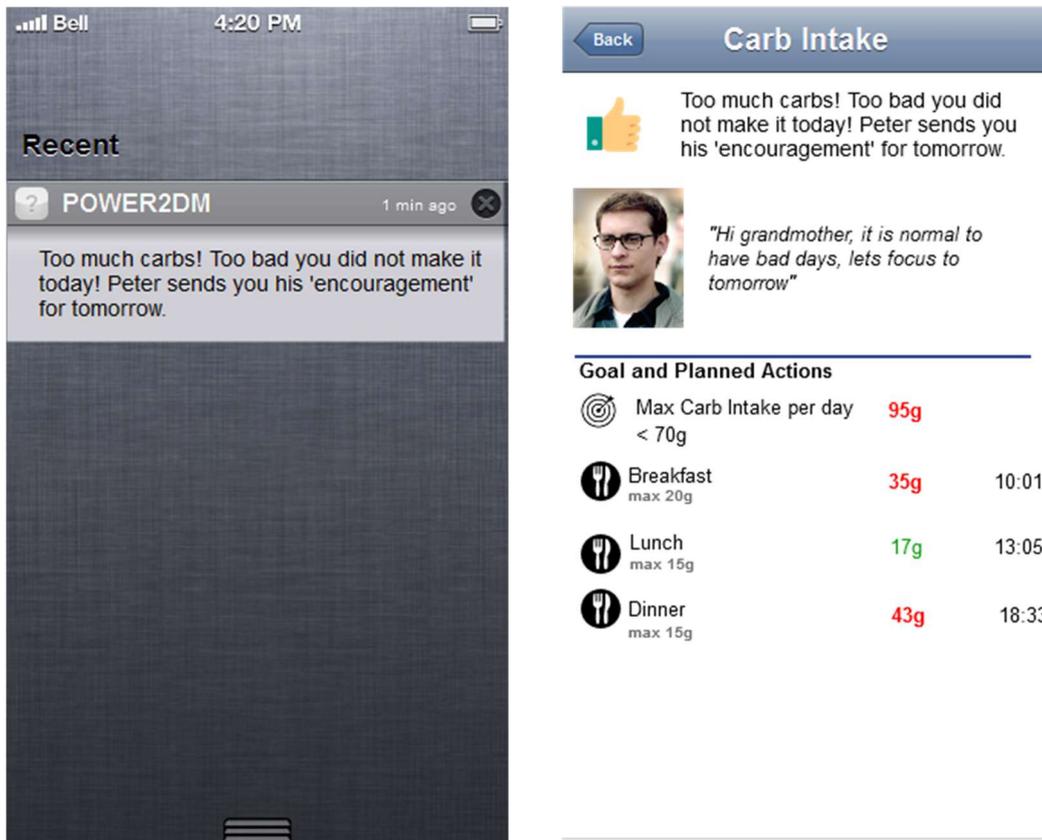
Figure 24 Social support view

3.5.5 Showing general summary of behaviour in past days/weeks/months

Interventions of type "summary of behaviour" navigate patient to corresponding panel of Performance Analysis view as it shows the summary.