Deliverable D5.1.1

Learning Paths for Self-Management Services

Project title:	Support of Patient Empowerment by an intelligent self-management pathway for patients
Project acronym:	EMPOWER
Project identifier:	FP7-ICT-2011-288209
Project instrument:	STREP
Web link:	www.empower-fp7.eu
Dissemination level:	PU (public)
Contractual delivery:	2012-10-31
Actual delivery:	2012-10-30
Leading Partner:	SRFG

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement No 288209, EMPOWER Project.

Document History

Version	Date	Changes	From	Review
V0.1	2012-07-15	Initial Document	SRFG	HMGU
V0.4	2012-09-28	Relevant models, maturity levels and design approaches	SRFG	HMGU
V0.6	2012-10-05	Survey results, reports and trends	SRFG, HMGU	All partners
V0.7	2012-10-17	Update survey results and maturity models	SRFG	
V1.0	2012-10-29	Finale version	SRFG	

EMPOWER Consortium Contacts

Beneficiary	Name	Phone	E-Mail
SRFG	Manuela Plößnig	+43 662 2288 402	manuela.ploessnig@salzburgresearch.at
HMGU	Claudia Hildebrand	+49 89 3187 4182	hildebra@helmholtz-muenchen.de
GOIN	Siegfried Jedamzik	+49 8 41956161	siegfried.jedamzik@googlemail.com
USI	Peter J. Schulz	+41586664724	peter.schulz@usi.ch
SRDC	Asuman Dogac	+90 312 210 13 93	asuman@srdc.com.tr
ICOM	Ilias Lamprinos	+302106677953	labil@intracom.gr
MOH	Unal Hulur MD	+903125851907	unal.hulur@saglik.gov.tr

Table of Contents

Abbreviations

ACM	Access-Competence-Motivation Model
DoW	Description of Work
GP	General Practitioner
GUI	Graphical User Interface
ODI	Outcome driven innovation
ODL	Observation of Daily Living
TTM	Transtheoretical Model

List of figures

1 Summary

Deliverable D5.1.1 “Learning Paths for Self-Management Services” analyses different approaches how EMPOWER services can support users (in particular patients) based on their personal and individual skills and preferences. A starting point is the Access-Competence-Motivation (ACM) model explaining different learning paths in adopting a new eHealth solution. Based on an analysis for the three pillars of the ACM model and on a survey about IT enhanced diabetes self-management a model for maturity levels in EMPOWER is presented. Based on the ACM model the maturity levels comprise several categories for each pillar of the ACM model (access, competence and motivation) and each category covers a spectrum from low to high. Maturity levels in EMPOWER refer to the professional stage having reached by the patient in learning of how to manage his/her diabetes by him/herself.

Learning path and maturity levels in EMPOWER
In EMPOWER the idea of “maturity” considers that diabetes self-management is not a static, but a dynamic learning process. A change takes primarily place within the personal and individual sphere of the patient (“to mature in stabilizing the health outcomes of diabetes with personal self-management”). Moreover, ideally, a patient can also evolve (=“mature”) in his/her use of the EMPOWER services and functionalities. However, in the course of time a person would then be able to follow a “learning path” and develop from the stage of the “novice learner” to the “more experienced” and/or to the “professional learner” of diabetes self-management with the support of ICTs. Possible characteristics and trails of such a learning path in the specific context of learning and knowledge acquisition in diabetes self-management are being described.

Based on the above results, the deliverable analyses interaction design approaches for recommendations how the proposed EMPOWER maturity levels can be supported. Finally, mockups are included into D5.1.1 aiming to illustrate specific aspects of the maturity levels, e.g. typical reports for a novice user and a typical report for an expert user.

2 EMPOWER in a Nutshell

Patient Empowerment involves patients to a greater extent in their own healthcare process and disease management becomes an integrated part of their daily lives. The capability of self-management opens to them the possibility for patients not only to contribute to their own healthcare but also to be more in control of their disease. EMPOWER develops a modular and standard-based Patient Empowerment Framework which facilitates the self-management of diabetes patients based on PHRs and on context-aware, personalised services. EMPOWER focuses the research and development efforts on a patient-centric perspective that also involves healthcare professionals. EMPOWER provides knowledge-based Self-Management Pathways for diabetes patients. This includes

(1) Services for the specification and execution of actions to change behaviour according to diabetes-specific health care needs. Patients can develop personalised action plans which include recommendations from the treating physicians and patients' preferences

(2) Services for monitoring of vital, physical, mental parameters as well as physical and lifestyle activities based on health standards.

EMPOWER semantically integrates multiple information sources (EHR/PHR, diabetes guidelines, patterns of daily living) for a shared knowledge model. The Self-Management Pathways facilitate the specification of recommendations that allow specifying individual goals for the patient. Based on these goals, relevant information and their preferences patients can specify their individual diabetes-specific actions. The Self-Management Pathways are an iterative process where executed actions and reported patterns of daily life can be evaluated. Recommendations, goals and actions can be updated iteratively according to current needs and preferences. Finally, the services in EMPOWER will embrace semantic interoperability based on health standards such as HL7[1] and IHE[2] profiles.

EMPOWER addresses long-term goals and short-term activities in order to facilitate the self-management of patients with diabetes and thus the treatment of chronic diseases. The pilot applications in Germany and Turkey will demonstrate that the holistic and patient-centric approach of EMPOWER can improve disease management by personalised self-management services helping diabetes patients to cope better with their condition.

[1] http://www.hl7.org
[2] http://www.ihe.net

3 Introduction

3.1 Objective and task description

The objective of the task 5.1 Learning Paths for Self-Management Services is to specify different approaches for EMPOWER users when using the EMPOWER services. According to the Description of Work (DoW), the Task 5.1 Learning Paths for Self-management Services aims at:

"Depending on the skills and preferences of a patient EMPOWER will provide different approaches for collecting patterns of daily living and for using services for self-management. An essential aspect in this context is the question what the appropriate level for an individual patient will be. Based on the results of the pre-study conducted in Task 2.1 a concept will be developed which will suggest different approaches for a services (e.g. monitoring physical activities, participating at online communities) on several maturity levels (e.g. basic / advances / expert). One model to be considered will be the ACM model which visualise different profiles regarding eHealth services "Access", "Competence" and "Motivation"."

The rationale behind this task lies in the fact that patients using EMPOWER are a very diverse user group with different and individual capabilities regarding:

- media and IT-tool access and usage preferences,
- experiences and competences in diabetes self-management and
- digital competences, especially e-skills and internet health search behaviour.

As outlined in the proposal, "some patients want to use their smartphone or a tablet PC for collecting ODLs. For some patients it is too cumbersome to collect manually vital data. They may prefer devices with automatic transfer. Some patients may want to print out their medication log file in order to discuss them with their GP. Some patients want to be reminded via a calendar about their actions to be executed. Other patients may prefer to print out the action plan and attach it to their refrigerator door." An essential question for EMPOWER is at which level of "connectedness" an individual patient would like to manage his or her daily life and how EMPOWER can provide appropriate (technology-based) services. These different preferences and levels of competences and skills (e.g. novice or expert) may also change with growing knowledge about the diabetes self-management process and with intensive usage of the IT-based EMPOWER services. Therefore, EMPOWER wants to offer multiple options that allow users to select appropriate services adjusted to their individual preferences, competences and skills. Thus, the Task 5.1 "Learning Paths for Self-management Services" will identify and characterize different EMPOWER "maturity levels" for using the range of EMPOWER services.

3.2 Definitional issues

This section serves to clarify the meaning of the terms "maturity", "learning pathways" and "maturity level", originating from pedagogical and psychological background, and it will discuss its usage in the context of the EMPOWER services:

The *noun* "maturity" refers to "the state, fact, or period of being mature" and the *verb* "mature" means that something "evolves, develops or becomes older" (Oxford Dictionary[3]). Maturity is a common word used for assessing psychological progress (i.e. progress from childhood to the maturity of an adult), for assessing financial developments (e.g. the time when an insurance policy, security, etc. matures) or assessing ICT adoption/ implementation.

[3] See URL: Online Oxford Dictionary: http://oxforddictionaries.com/definition/english/maturity [2012-07-12].

In IT-enhanced education it is common to use e-content for supporting learning and knowledge acquisition processes. In this field the concept of a "*learning pathway*" is well known and widely used, especially in the meaning of a *tutorial based and/or pre-defined guided route/path through an e-learning course or online-content learning modules.* (Clement, 2000) describes learning pathways as "The sequence of intermediate steps from preconceptions to target model form what (Scott, 1991) and (Niedderer and Goldberg, 1995) have called a learning pathway. For any particular topic, such a pathway would provide both a theory of instruction and a guideline for teachers and curriculum developers" (see Clement, 2000: 1041–1053).

"Interactive courseware aids learners to access information and tools by which they can construct personalized transitions between the information to be accessed and their own cognitive structures. The process of navigation enables learners to experience the content of interactive courseware. Learning pathways also reveal the learning trails while learners traverse any interactive environment. Since learners have unique knowledge structures based upon their experiences and abilities, the ways that they choose to access, interact, and interrelate messages in interactive courseware also vary. Studies on pathways help us to explore and explain human behaviours during learning processes" (Jih 1996).

In the context of the computer game industry, "levels" are an important feature for assessing the skills of the player by having to solve specific tasks. "Players advance through an action game by completing a series of levels. Levels are often grouped by theme, with similar graphics and enemies. Each level involves a variety of challenges, whether dancing in a dance game or shooting things in a shooter, which the player must overcome to win the game. Older games force players to restart a level after dying, although action games evolved to offer saved games and checkpoints to allow the player to restart partway through a level" (Rollings, 2006). Following this thinking, **"maturity levels" in EMPOWER would refer to the professional stage having reached by the patient in his learning of how to manage his/her diabetes tasks.**

Summing up, in EMPOWER the aim is to find out what would be an "ideal" way or sequence of ICT-supported learning and knowledge acquisition activities that will lead to proficiency in diabetes self-management in the course of time. The features characterising possible learning stages from an "EMPOWER novice-level" to an "EMPOWER professional-level" of diabetes self-management are focus of this task.

Relevance for EMPOWER

- The above mentioned approaches of stages of learning paths are not easy to be realised within EMPOWER, however, some of its principles may be integrated in designing the route through the system (e.g. a specific route through the EMPOWER services and/or option for using for example the Action Plan).
- In EMPOWER the idea of "maturity" considers that diabetes self-management is not a static, but a dynamic learning process. A change takes primarily place within the personal and individual sphere of the patient ("to mature in stabilising the health outcomes of diabetes with personal self-management").
- Ideally, a patient can also evolve (="mature") in his/her use of the EMPOWER services and functionalities. However, in the course of time a person would then be able to develop from the stage of the "novice learner" to the "more experienced" and/or to the "professional learner" of diabetes self-management.

3.3 Methods and structure of report

This document is based on the results of the pre-study D2.1.1 ”Strategies for Empowering Patients for Web-based Self-management”, especially the Recommendations (D2.1.1, section 8) and the Personas description (D2.1.1 section 7) and includes:

3.3.1 Literature study and desk-research

We have conducted literature and desk-research on

- concepts and interdisciplinary approaches for defining “maturity levels” (section 3.2),
- possibilities to characterise IT-based learning and knowledge acquisition processes in view of eHealth solutions (especially the Access-Competence-Motivation-Model by (Viherä & Nurmela, 2001); adapted by (Gareis, 2005)) (section 4),
- different motivation theories, specifically relevant for diabetes self-management (section 4.5) and on
- various design approaches, useful for meeting the different needs of EMPOWER users being at different ”maturity levels” (section 6).

3.3.2 An explorative survey on EMPOWER maturity levels

We conducted an explorative survey among diabetes patients to find out more about the possibilities to characterise and cluster EMPOWER maturity levels to be useful in designing an IT-based diabetes self-management solution. An exploratory research approach is useful, in a research project, if a problem has not be clearly defined yet (in particular: describing and clustering the EMPOWER maturity levels) and when there is a need to become more familiar with the phenomenon (in particular: actual use of ICT and electronic documentation, measurement and action setting in the context of diabetes self-management).

During the period of late August until the end of September 2012, a questionnaire-based survey was launched in the German EMPOWER test region (managed by EMPOWER partner GOIN), and in Austria, region of Salzburg, within the framework of the Austrian Disease Management Programme (organised by the Paracelsus Medical University of Salzburg). Additionally, the Austrian Diabetes Self-help Association supported the survey with providing access to participant of their online-self-help group portal (Österreichische Diabetikervereinigung[4] and its social network[5].

The purpose of the survey was to find out if, and how in practise, diabetes patients cluster to their different characteristics and needs (e.g. diabetes types, age, gender, media type access, e-skills, diabetes self-management/health literacy and coping strategy). The result of this should lead to a more clear understanding of how to cluster potential EMPOWER users as to their stage of diabetes self-management learning processes and competences with an IT-solution. Moreover, on the basis of these data a “gap-analysis” was conducted to prioritise the needs of the diabetes patients (Performance/Importance) and get insight into “strategically” important and innovative EMPOWER service (either to be realised in the project or beyond in further research work). The survey was launched as online-survey (via a web-based survey software portal SURVEY GIZMO[6]). We succeeded in gathering 66 respondents of which 50 qualitative answered questionnaires could be integrated.

Summing up, the characteristics of the explorative sample were:

- 50 qualitative responded, completely filled out questionnaires;

[4] http://www.diabetes.or.at/)
[5] http://www.facebook.com/pages/Diabetes-%C3%96sterreich-%C3%96DV/210570512305488).
[6] http://www.surveygizmo.com

- 46% female; 54% male respondents;
- 46% respondents with diabetes type 1, 52% with diabetes type 2 and 2% with diabetes type LADA[7];
- 54% respondent s with insulin therapy, with 34% oral anti-diabetics, with 24% diet and with 6% other;
- Mean age average (48,4); mean average of disease diagnosis: 10.9 years
- 56% respondents had never taken part in a diabetes management program; (46% with experience) and
- 80% have experience with a diabetes training (20% no experience)
- 24% from Germany; 54% Austria, 22% unknown.

The figures below illustrate some of the characteristics of the survey participants:

Balanced sample of patients (type 1, type 2; gender):
The survey shows a rather balanced sample of participants of both types of diabetes and female (46%) and male (54%) participants.

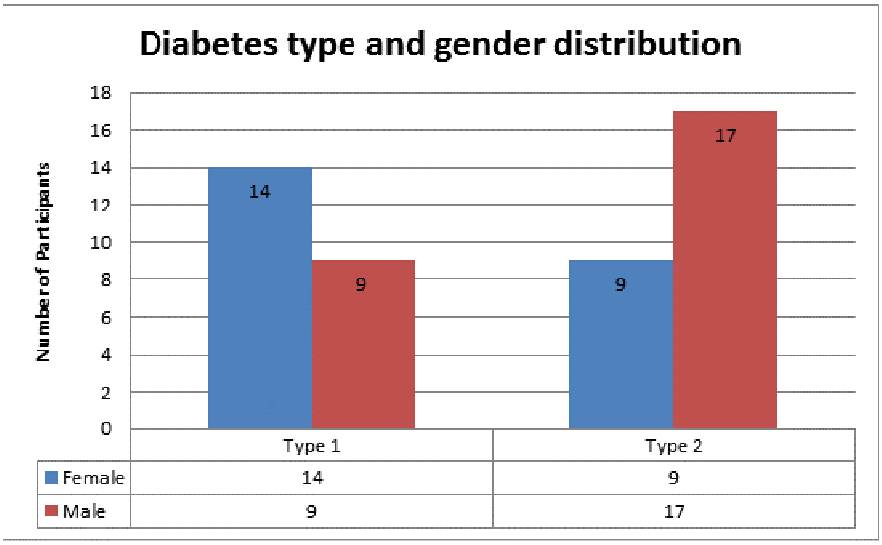


Figure 1 – Sample distribution by diabetes type and gender (n=50).

View on gender differences
Each question was analysed as to respect any significant gender differences. However, it has to be said that no answer showed any significant gender related different result (attention always that the given the small sample was small). Therefore, in the following, survey figures will be presented primarily differentiating by the category of diabetes-type or age, rather than gender-category.

View on situation of diabetes patients at "working age"
As regards the age and length of diabetes diagnosis, the figures show that the participant age ranged from 5 years to 77 years, with a mean age of 48.4. The two participants below 18 years represent the needs of them and their parents as guide to coping with diabetes at a young age. We categorized age into three subgroups, <26 years, 26-64 years and older than 64 years of age in order to distinguish respondents that are in a "working age" and those that are not.

[7] Latent Autoimmune Diabetes of Adults (LADA), also known as Diabetes Type 1.5, is a term coined by Tuomi et al. in 1993 (Diabetes 42:359-362) to describe slow-onset Type 1 autoimmune diabetes in adults. Source: Online Encyclopedia WIKIPEDIA: http://en.wikipedia.org/wiki/Latent_autoimmune_diabetes; text from Diabetes Research Centre, Melbourne, Australia [accessed 2012-09-15]

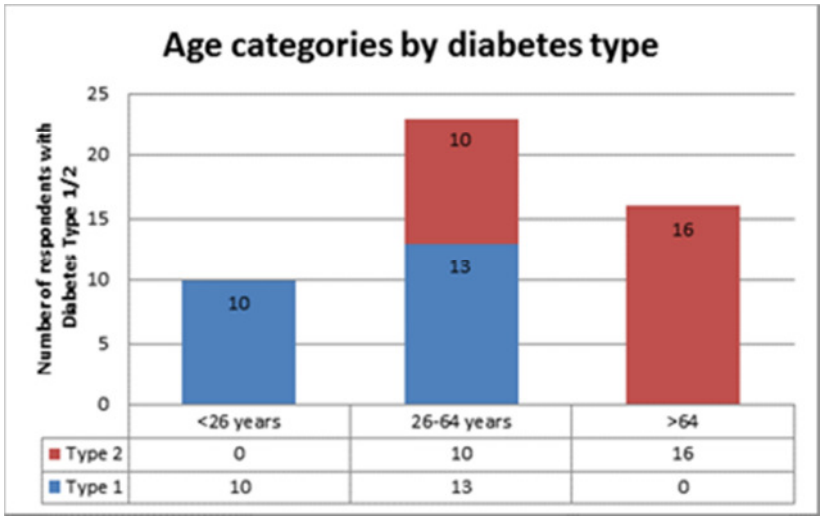


Figure 2 – Sample by age categories and diabetes type (n=50)

In our sample, type 1 diabetes was predominantly limited to the younger age groups, while respondents above age 64 reported only diabetes type 2. This association was statistically significant ($c^2(1, N = 50) = 27.91$, $p = .000$[8]). The youngest respondents with diabetes type 2 were 37 and 50 years of age.

Attention has to be given to the fact, that by conducting an online-survey, a slight bias of respondents as regards their ICT-skills can influence the data. However, the study questionnaires could be filled out on paper as well (approx. 20 questionnaires) and no significant bias could be found.

3.3.3 Paper-based mockups illustrating EMPOWER maturity levels

In order to illustrate how maturity levels can be addressed and realised in EMPOWER this deliverable also includes some digital mockups (see section 7). They serve as examples illustrating specific aspects of the maturity levels, e.g. typical reports for a novice user and a typical report for an expert user.

[8] P=probability; C^2=chi-quadrat test result

4 The ACM-Model in IT-based diabetes self-management

4.1 Introduction

This section will provide insight into the (adapted) Access-Competence-Motivation model (ACM), used for explaining different learning paths in adopting a new eHealth solution. The model will be first explained in general, and, then discussed in more depth, how this can be of use in the case of using an IT-solution in diabetes self-management processes such as implied by EMPOWER.

In the following, the three main components of the ACM model are discussed in the light of what type of access, competences and skills and motivation is specifically needed when using EMPOWER as internet-based software application supporting the personal self-management of diabetes.

- Which different media types would be preferred to access EMPOWER?
- Which different levels of competences can be expected by EMPOWER users?
- What forms of motivation are considered to be helpful to EMPOWER users for using the IT-solution during for a longer period of time?

The topics of access, digital competences and health literacy were already dealt within the EMPOWER pre-study D2.1.1 ”Strategies for Empowering Patients for Web-based Self-management”, especially in section 5.3.” Evidence of digital competence in Europe” and, in section 6, “Conceptual framework of web-based patient empowerment”. Therefore, in this deliverable these issues will be only shortly described in relation to the evidence we found in the explorative survey. The topic of “motivation” has not been worked on yet during the project and, thus, is dealt with more intensively in section 0.

4.2 The ACM-Model and its components

The ACM model was originally developed by (Viherä .1999) and (Nurmela and Viherä, 2001) in order to improve the adoption rate of ICTs, specifically e-services. The basic idea is that the use of ICTs improves the *communication possibilities and interaction of the user.* The ACM model allows to characterize the different user profiles regarding their readiness to adopt eHealth services (Gareis, 2005).

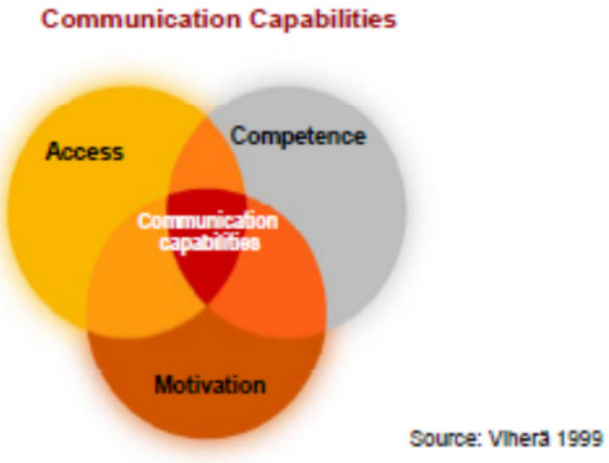


Figure 3 – Overall ACM model

(Source: Gareis, 2005)

- **Access** is the capacity of the user to be electronically connected to Internet services (at home or alternatively sufficiently good access elsewhere), and no existence of barriers to operate the terminal devices and the user interface because of personal limitations or mismatches (accessibility).

- **Competence** reflects the capacity on e-Skills, e.g. the extent to which a person knows how to use computing devices, communication terminals, and Internet at the level needed to use the electronic service. This concept can be extended to include capacity to work with eHealth tools.

- **Motivation** is defined in terms of explicit willingness to use the electronic services in general; and in terms of relative preference for the particular mean for information access (online, face-to-face, postal, phone, mobile)

The figure below shows the components of the ACM model in more detail:

Figure 4 – Components of the ACM model

(Source: Gareis, 2005)

The ACM model allows classifying potential users according to eight possible combinations of the three variables Access, Competence and Motivation. Maximum propensity for using an ICT on-line application is assumed to apply for persons who have all three:

(1) full access to end user devices,
(2) the necessary digital skills and experience to use the e-services, and
(3) the motivation to use the electronic services instead of more traditional ways.

Based on the ACM model improvements for the adoption of eHealth patient empowerment applications are possible in these three areas (see (Monteaguado et al, 2007)).

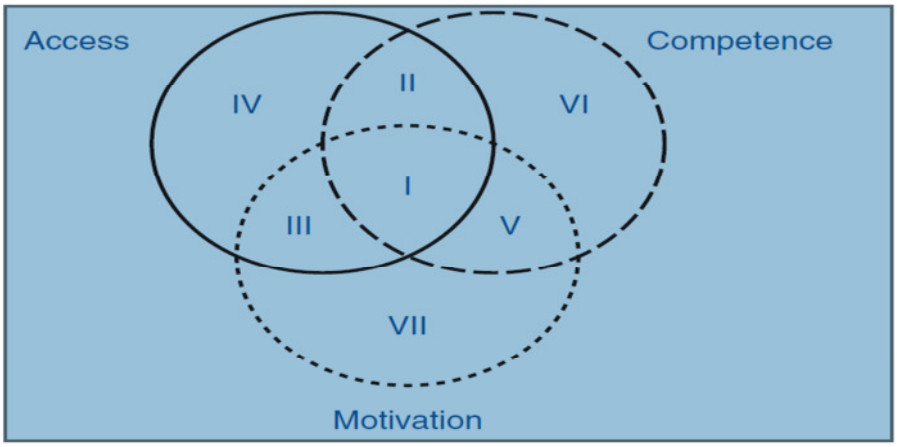


Figure 5 – ACM model: 8 propensity types

(Source: Monteguado et al, 2007, p. 78)

The following table describes systematically the different types of adopting an eHealth-technology. It classifies eight propensity types. This can serve as example for being aware that the adoption of EMPOWER will be easier for one type of patient (e.g. high access, high motivation, high communication skills) than for another (e.g. high access, low motivation, low communication skills). Important is to get a more thorough glimpse on the picture, what specifically influences the needs and adoption of a diabetes-specific IT solution for self-management.

Table 7.1. Characteristics of the eight propensity types according to ACM model

Group	Description
I (ACM)	Has all three factors - access, motivation and competence. Represents the group of potential users ready to adopt the eHealth service
II (ACm)	Lacks motivation but has access and competence. Efforts to increase motivation may be beneficial for eHealth user adoption. A supply of high-value services, coupled with promotional activities, appears critical.
III (AcM)	Has access and motivation, but lacks digital skills. If mainly technical skills are missing, training in necessary skills is likely to be very beneficial.
IV (aCM)	Only has access, but not competence nor motivation; both motivational and training interventions will be needed. Intermediaries can be expected to play a particularly important role for this group, i.e. household members or friends who are able and willing to provide the required technical help in accessing online services and applications.
V (Acm)	Only access is missing; depending on the circumstances different interventions may be needed, such as financial supports, public access points or assistive technology and accessibility measures.
Vi (aCm)	Only has competence. Measures should be taken for providing access and to motivate
VII (acM)	Only has motivation; will require both infrastructural and training interventions. It should be explored if traditional channels are not more appropriate to provide this group with services.
VIII (acm)	None of the three conditions exist; multi-dimensional interventions will be needed

Figure 6 – ACM model: characteristics of eight propensity types
(Source: Monteguado et al, 2007, p. 78)

Relevance for EMPOWER

- The EMPOWER maturity levels are analysed and specified based on the ACM model.
- The preferred ACM group for testing EMPOWER will be group I – patients who have a high level of access, competence and motivation (lead-user).
- A minimum pre-requisite for EMPOWER will be that patients have access to the EMPOWER application.
- Patients can have or lack competence for different criteria (e.g. how to cope with diabetes, using social media, etc.). EMPOWER supports "competence" by an introductory training for the pilot patients and by offering services adapted to the maturity levels.
- Likewise, motivation can occur or be needed on different occasions (e.g. updating the Action Plan weekly, performing ODLs, collecting ODL data). EMPOWER supports "motivation" by taking this into account during the design and implementation phase. Examples are feedback cycles or batches (see also section 6.2). Additionally, including the treating physician into the patient's self-management activities will also be an essential motivational factor.

4.3 Access to EMPOWER services

As stated in the ACM model, one prime precondition for using EMPOWER services is, to have *internet based access* to

- diverse types of ICTs needed for diabetes self-management (e.g. computing and data transmission device, data input/output devices, ODL measuring devices),
- to internet-based communication platforms, and
- to health/diabetes-related information resources for knowledge acquisition (e.g. diabetes training guides).

Observations of the European "Digital Scoreboard"[9] detected that in 2012 in Europe 27, the access rate of a computer and internet at home, has risen almost to 70% on average. In 2010, almost 90% of households in Germany are reported to have access to a computer at home, 45% homes are equipped in Turkey (see EMPOWER deliverable D 2.1.1. Pre-study, section 5.3.. Evidence of digital competence in Europe; 5.3.1.1 General access to computer and internet; 5.3.2 Frequency of computer and internet usage, page: 38-49). Since in EMPOWER we cannot conclude interaction design decisions to be taken from very generalized user statistics, we have collected some exploratory evidence about access to ICTs (media type), to social networks and health information sources in the context of diabetes self-management. The following questions were explored in the EMPOWER survey:

- How do diabetes-patients access ICTs in relation to their diabetes type, age and gender?
- Which media type is used and at what intensity?
- Do diabetes patients have access to social network facilities and use it to communicate (e.g. via online-self-help groups)?
- Do diabetes patients have access to internet-based health information sources? To what extent is the internet a preferred source of information about diabetes self-management?

[9] European Commission (2011). Digital Scoreboard. http://ec.europa.eu/information_society/digitalagenda/scoreboard/index_en.htm.

4.3.1 Access (media) type by diabetes patients

In our survey more than half of the respondents reported to have access to a personal computer (off/online) (30 responses), to notebooks with internet access (27), to classic mobile phone (14) , to smart phone (20) and to table pc (9). Only a few had only access to a PC without internet (3) or none at all. In total, nine users used often a Tablet PC, 20 person often a smartphone and 38 often a computer with internet connection. Expressed in percentages we can observe that in the survey sample 78% participants have access to PCs, 28% participants use a classic mobile and 47% a smart-phone. Moreover, 20% of the participants use a Tablet PC.

The figure below shows that no differences in the question of how diabetes patients have access to computers (including note-books), *in relation to diabetes type 1 or type 2* could be detected. However, 78%, respectively 80% of diabetes type 1 users reported higher access (ownership) to Tablet PC *and/or* a smart-phone.

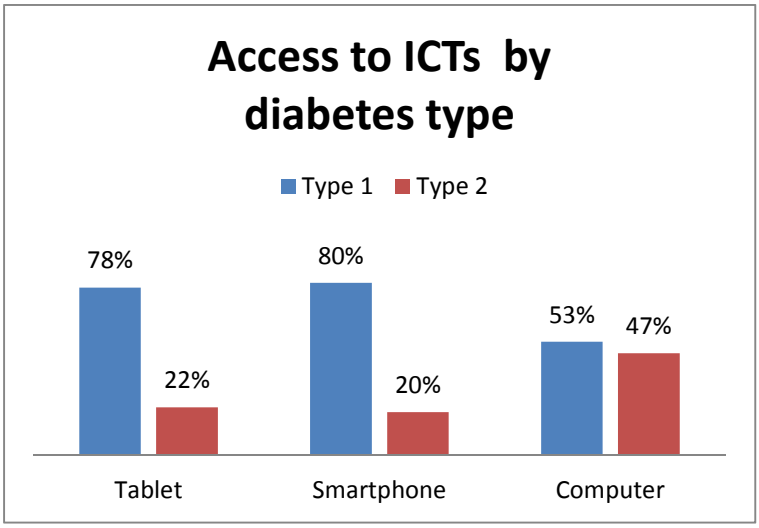


Figure 7- Access to different media types by diabetes type.

Interesting is that diabetes information is accessed almost evenly via three communication channels as depicted by the figure below:

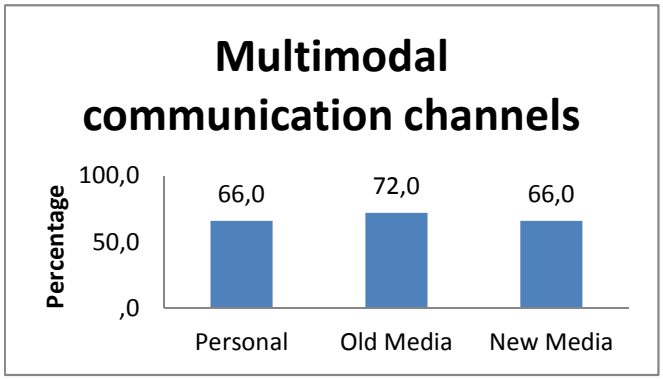


Figure 8 - Media use clustered by media classification: personal, old media and new media[10] (N=50)

[10] In this context, we use the term “old media” for media and media technology, which was invented before the advent of the internet in the early 1990s, such as printed books,

66% of the survey participants prefer personal communication (of which 66% consult often doctors or diet specialist; The advice of a family (25,7) or friends (24,3%) is important and 23,8% visit a face-to-face self-help groups or communicate via new (internet-based/online) media (e.g. of which: 37%,8 often use diabetes specific portals, 27% often use a diabetes forum and 8,8% take part in an online self-help group).

4.3.2 Intensity of use per media type

The survey identified the following preferences for the actual use and intensity of use of the media type.

For all figures below N=50

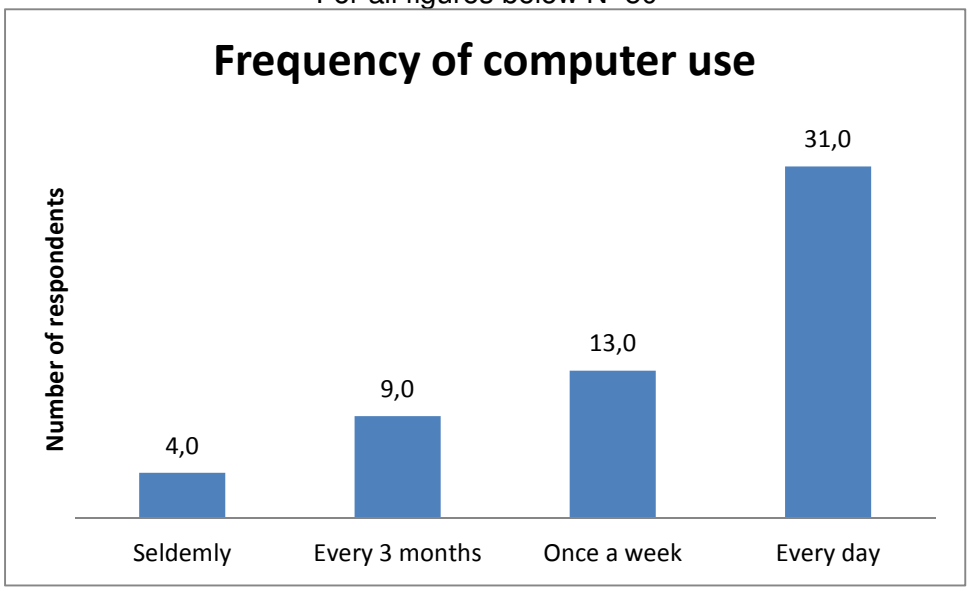


Figure 9 - Intensity of media use

N=216, with 143 answered „never“ 73 answered one of the above

The PC and notebook is used daily only by 15,5 % participants (6,5% once a week). This would imply for EMPOWER services, that a majority of patients are not accustomed to daily use the PC as main documentation instrument.

4.3.3 Access and participation in social media networks

The original ACM model needs to be adapted in the context of the rapidly changing mobile technologies and social media usage. Not only the access to a diabetes internet portal is of importance, but access to a virtual communication space allowing to exchange experiences with the challenges of diabetes self-management. The exploratory survey provides hints that access to social media is *independent* of age and referrer (i.e. whether the respondent was referred to the online survey via a social media site), however patients with diabetes type 1 use social media more than diabetes type 2 patients ([11]b = -.43, t(50) = -1.90, p = .06). That could mean that type 2 patients are not used yet to openly exchange and seek advice with peers as is the case with type 1 patients.

brochures, the television. “New media” relates to computers and internet-based telecommunication including social media.

[11] correlation coefficient b=beta; p= probability;

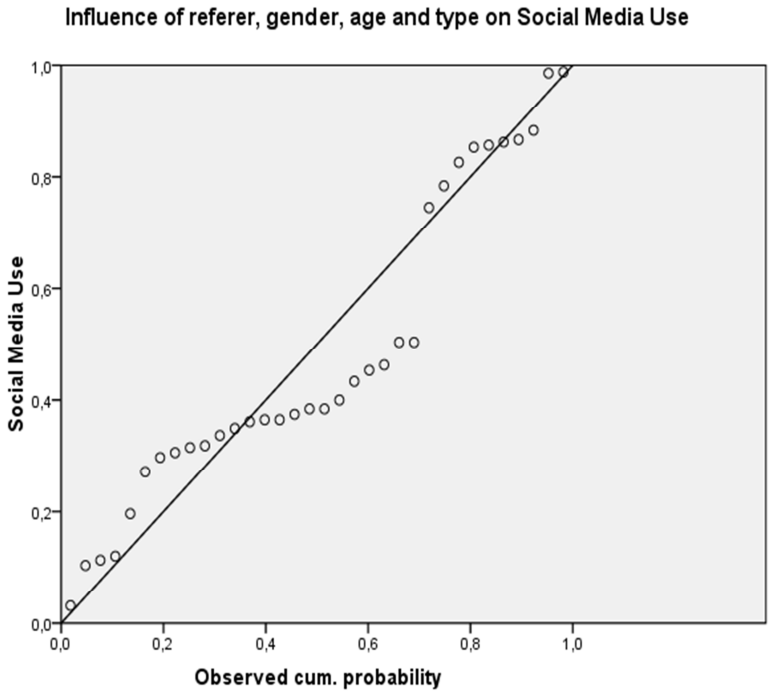


Figure 10 - Influence of referrer, gender, age and diabetes type on social media use

The survey aimed to find out whether diabetes patients use online-information sources (e.g. via diabetes information portal or social networks, like Facebook) to get information or knowledge to manage the illness. The use of informal internet sources for diabetes information and the participation (active/inactive) in social media, is positively related to the diabetes type, and only marginally dependent of age. This means the older a diabetes patient is, the less he or she relies on access to and use of internet-based information providers. This is illustrated with the next figure, with a mean age of 52 years, not using any social media. The social media usage in this sample was on average 41 years.

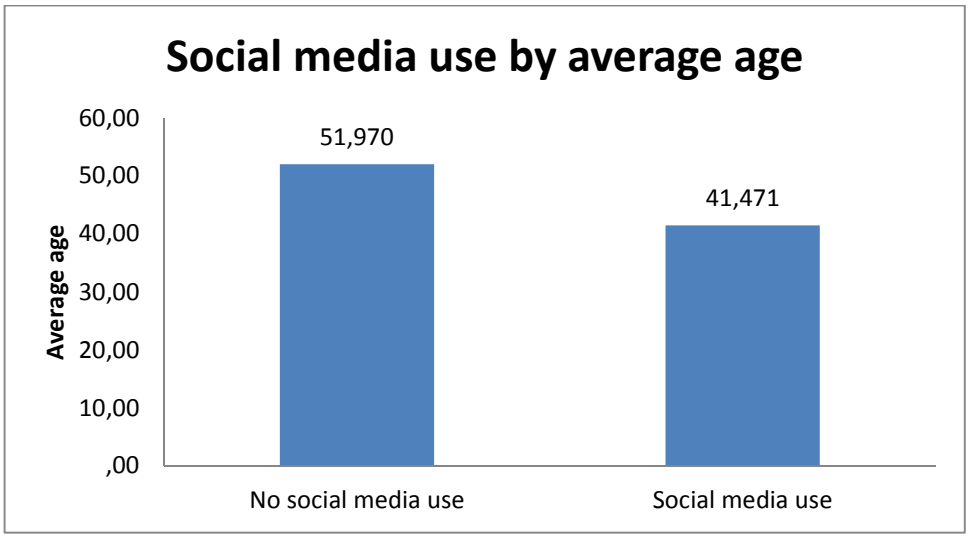


Figure 11 - Social media use in relation to mean age.

Independent of age and referrer (i.e. the website or social media platform that referred the respondent to the survey), the type of diabetes showed to predict social media use for diabetes patients (regression analysis: b = -.43, t(50) = -1.90, p = .06). Accordingly, type 1 diabetes patients are much more likely to access informal internet information and use social media than type 2 diabetes patients are (chi square analysis: $c^2(1, N = 50) = 7.61$, p = .02).

This is surprisingly, because in general a higher age (as is the general type 2 patient) is usually connected with low intensity of social media use.

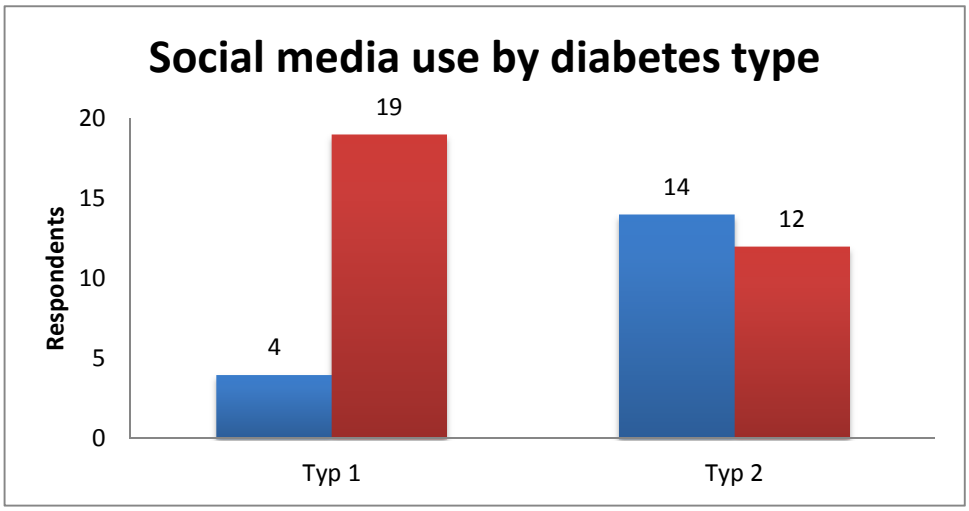


Figure 12 - Social media use by diabetes type ($c^2(1, N = 50) = 7.61$, $p = .02$)

In sum, 66% diabetes patients in the sample reported to be active in social media, with diabetes type 1 outperforming type 2 patients.

4.3.4 Access to sources of EMPOWER information search behavior

The ACM model includes also the parameter, to assess whether and how a person has access to and use of diabetes information material. The survey confirms the assumption of the EMPOWER project that among diabetes patients, the most frequent source of information on diabetes are the *respected medical practitioners (22%!), followed by specific books on diabetes as well as information provided by diabetes related internet sources and free diabetes (often pharmaceutical company sponsored) magazines* that are distributed by chemists. Least popular among diabetes patients surveyed, were online support groups and offers from health insurances.

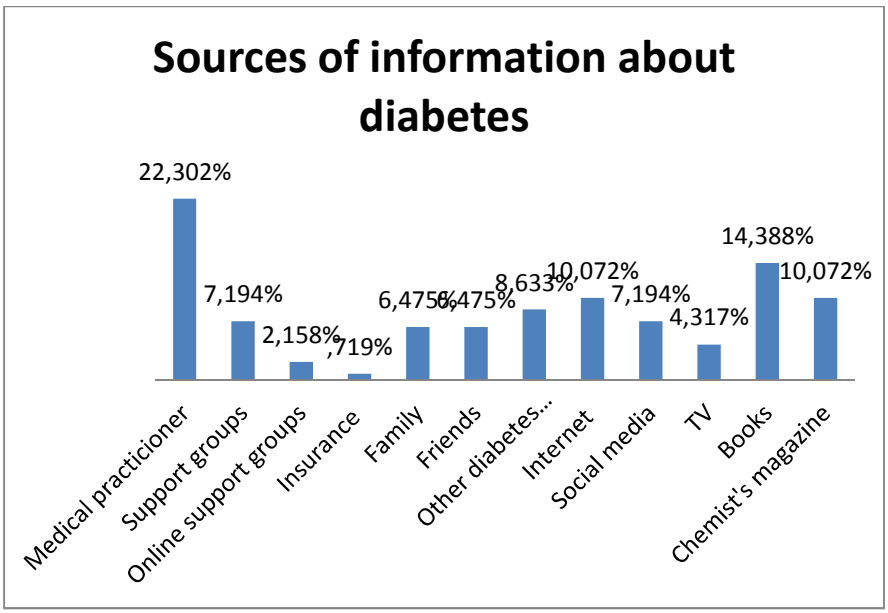


Figure 13 – Distribution of sources used for information about diabetes (N=50)

The distribution of different kinds of information sources, such as personal, old media and new media (for definition see footnote 10) is relatively even among the study sample. Accordingly, 66% seek information through personal, i.e. face to face, contacts, 72 % inform themselves about diabetes through old media outlets, such as books and 66% of the respondents acquire information via new media channels such as the Internet (note: multiple uses are possible and can result in a cumulative percentage above 100).

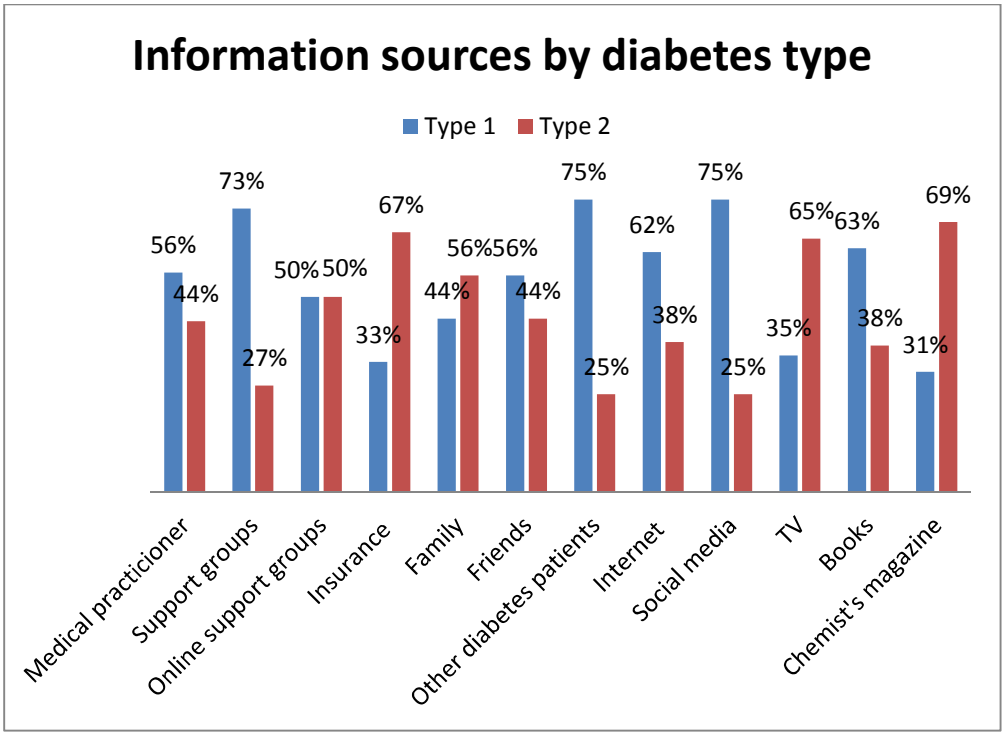


Figure 14 – Information sources by diabetes type (N=50)

Relevance for EMPOWER

- No significant gender difference in access and use of any media type were found, thus no special design efforts needed in EMPOWER.
- Multi-modal use for EMPOWER: generally each participants uses at least one device, with 98% having access (themselves or through a partner) to an online-ready PC or laptop. Tablet PC use was minimal in this sample (20%). Diabetes type 1 users reported also the use of a Tablet PC and/or a smart-phone.
- Access is positively related to E-Mail and Internet use, but not to age. The exception is smartphone use. Accordingly, smartphones are more likely to be used by younger diabetes patients, $r(50) = -.44$, $p < .01$. In addition, smartphone users display a higher, i.e. medium level of E-skills ($c^2(1, N = 50) = 6.46$, $p = .12$), while the group with the highest level of E-skills is the group that uses tablet PCs ($c^2(1, N = 50) = 5.13$, $p = .03$). This is an issue that needs to be further researched on, because late statistics show an increasing diffusion of tablet-PCs (though among a richer consumer group). Elderly people probably benefit from a tablet PC as mobile technology more than from a smart-phone.

4.4 Competences needed for EMPOWER services

4.4.1 Differentiation of competences needed to use EMPOWER

As second important dimension of identifying learning paths or clustering maturity levels, is, according to the ACM model, the "level of competences" needed to use the EMPOWER services. Generally, for eHealth applications, the ACM model suggests to have the capacity of using a computer, communication terminal and internet, thus *digital competences or e-skills.* However, in EMPOWER, which offers a specific device for diabetes self-management, also a special maturity level of *"diabetes literacy" and/or "diabetes self-management competence"* is needed (see EMPOWER pre-study D2.1.1). Since it seems to be important in EMPOWER to consider *both* competence types, rather supporting than contradicting each other, we have explored the possibilities to conceptualise and measure maturity levels of "EMPOWER competences".

4.4.2 Different levels of digital competence (e-skills) for EMPOWER

In the pre-study digital competences were defined in accordance to the Digital Agenda (see D.2.1.1, page 35):
"Digital competence involves the confident and critical use of information Society technology (IST) for work, leisure, learning and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, access, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet." (see Digital Agenda Scoreboard, 2011 cited in EMPOWER pre-study, page 35).

The term e-Skills has been used by the European Commission especially in the context of ICT use in the professional field of work and it refers to three sets of skills:

1. *ICT practitioner skills: the capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems.*
2. *e-business skills: the capabilities needed to exploit opportunities provided by ICT, notably the Internet; to ensure more efficient and effective performance of different types of organisations; to explore possibilities for new ways of conducting business/ administrative and organisational processes; and/ or to establish new businesses.*
3. *ICT user skills: the capabilities required for the effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work. User skills cover the use of common software tools and of specialized tools supporting business functions within industry (see European e-Skills Forum).ICT practitioner skills and e-business skills can be considered as more specialized ICT skills, ICT user skills are closer to the more general concept of digital literacy (for description see Annex, European Commission, Digital Agenda Scoreboard, 2011; cited in EMPOWER pre-study, page 35).*

As reported in the Pre-study the European Digital Scoreboard measures the average e-skills of European citizens by clustering the type of activities users are able and actually doing while using the computer and internet (see EMPOWER pre-study 2012: p.41pp):

- Low level skills: Using a search engine and sending an email with attached files
- Medium level skills: posting a message to a chat site or social platform etc.
- High level skills: producing content and or even creating a home-page (CMS system).

Discussing maturity levels in the context of EMPOWER, other e-skills such as handling a digital scale or using a digital watch or wrist band or blood measurement device would be very essential. However, since little data on such specific competences can be found in

literature, we have explored the possibility of clustering EMPOWER services for diabetes patients with low, medium and high-skills similar to the EU survey. The only changes made were, that, instead of the indicator “creating a homepage (html programming)”, - an expertise not really needed in EMPOWER-, we regard the ability to use a spread-sheet for documentation and calculation purposes of blood sugar values as a more interesting indicator for an ICT-related diabetes self-management competence. Many patients already use spread sheet programmes (e.g. Excel) to document and manage the complex EMPOWER documentation processes (see minutes from interview with Austrian Diabetes Association, CEO Ms. Mayer, March 2012). Also, the ability to search for specific, objective and “trusted” diabetes information might be regarded as a more skilled information search behaviour, than just normal “googeling”. Thus, we regarded it as an indicator for a “medium-skilled” level of digital competence.

In our explorative survey the three maturity levels in e-skills were not evenly distributed among the respondents:

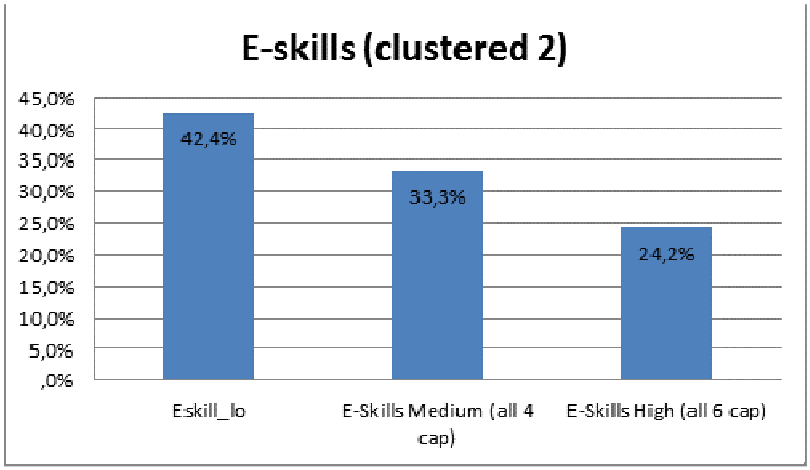


Figure 15- E-skills for diabetes self-management (N=50).

The figure above depicts that the amount of diabetes patients in the survey sample with high e-skills is with 24, 2% relatively high (Respondents were only categorized as having high E-skills when all six capabilities were present). 33,3 % of the respondents had reported medium or advanced e-skills, and, 42,4% of the respondents indicated low levels of e-skills.

With regard to maturity levels in e-skills in relation to type of diabetes, there significant differences have emerged among the sample: Type 1 patients show in all categories a relatively higher level of e-skills, but especially in the category of high skills. This can be traced back to the fact, that in this sample a larger group of patients of a self-help group was participating, which might be trained in using spread sheets and other electronic diaries and diabetes apps.

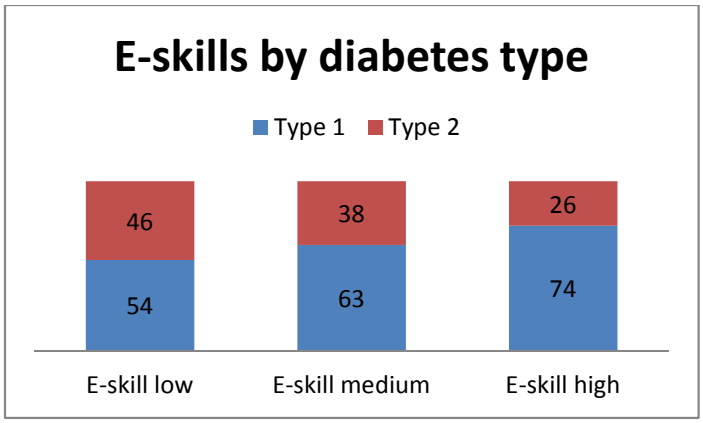


Figure 16 - Distribution of different e-skills by diabetes type (N=50).

With regard to gender-relevant maturity levels in e-skills, there have emerge only little differences between female and male respondents.

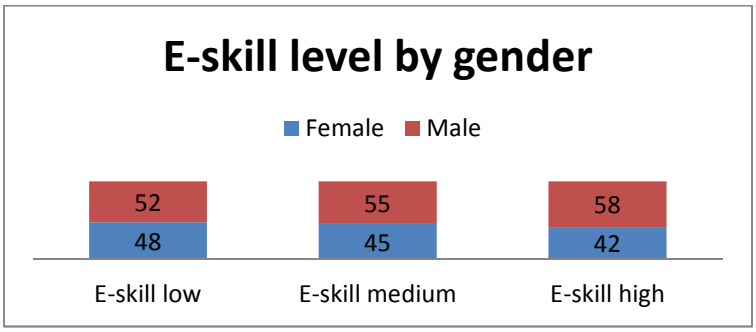


Figure 17 – E-skills by gender (N=50).

With regard to age-relevant maturity levels in e-skills, the present sample showed no explicit clustering effects. The following figures clusters the different skill levels according to the three age groups (in %).

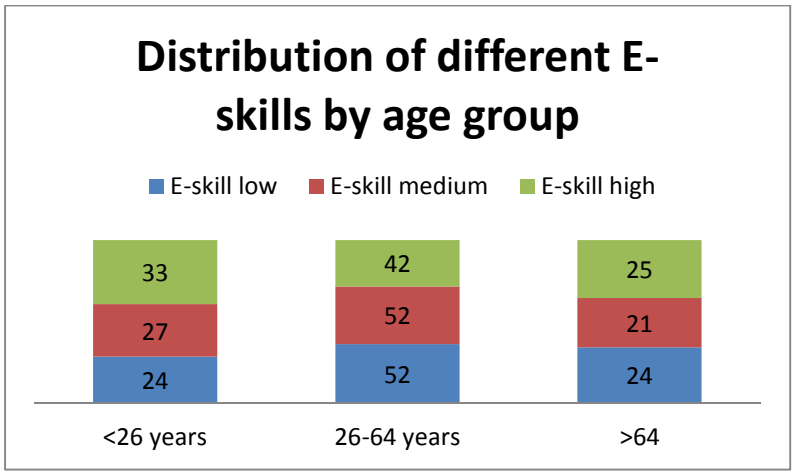


Figure 18 – Distribution of different E-skills by age group (N=50).

Relevance for EMPOWER

Basically, three different levels of digital competences can be identified:

- **Low level skills:** Using a search engine and sending an email with attached files
- **Medium level skills:** posting a message to a chat site or social platform etc.
- **High level skills:** producing content and using spread sheet programmes

Purpose of the survey was to find out whether and how different levels of competences cluster in reality among potential EMPOWER uses. Summing up, we can conclude:

- Lower E-skills are associated with patients of high age and diabetes type 2.
- The use of social media is independently of age, but related to diabetes type. Accordingly, diabetes type 1 patients are more likely to participate in social media as compared to type 2 patients.
- EMPOWER can build minimum on a diabetes patient group with minimum "low level E-skills. With regard to E-skills, i.e. the ability to use electronic devices such as E-Mail or Internet, E-Mail (93%) showed to be the skill that was most frequently indicated.

4.4.3 Different levels of learning support for diabetes-self-management

Besides the digital competences and/or e-skills, the pre-study has discussed the importance of health literacy, as one important factor when dealing with patient empowerment (see EMPOWER study, 2012: 59-60).
"Health literacy stems from the general concept of literacy, which is the ability to read and write (Oxford Dictionaries, April 2012) (…). (Schulz and Nakamoto, 2005) stress the importance of knowledge as part of health literacy. In addition to basic reading and numeracy skills, their multidimensional concept of health literacy comprises declarative knowledge (factual knowledge related to health issues to be able to learn how to approach a health condition), procedural knowledge ("know-how" to apply factual knowledge and use health information in a specific context), and judgment skills (the ability to judge on the basis of factual knowledge necessary to deal with novel situations). In the context of diabetes, declarative knowledge includes, e.g. the knowledge of blood glucose and the availability of tools to measure it. On the other hand, procedural knowledge entails how and when to measure blood sugar level."

The question now is how to conceptualise the different maturity stages in acquiring declarative and/or procedural knowledge for diabetes self-management? By recurring to work of the e-learning field, the concept of "e-maturity" might be of use, because it is applicable to any subject domain. In the context of assessing a learning path, e-maturity is viewed as a process of acquiring knowledge and understanding, skills and personal characteristics by using ICTs (with/without context of subject). The e-learning maturity model identifies these three aspects and groups it in the context of learning strategies (see Staines, J.nn. Study on e-maturity, BECTA Association, UK):

- Guided learner: a guided learner has a tutor and depends on pre-defined learning goals.
- Supported learner: A supported learner is able to select his/her learning material or learning structure to reach the pre-defined goals (however on an individual pace)
- Autonomous learner: An autonomous learner decides himself about the learning goals, material and pace.

A learning pathway is then conceptualised from the stage of guided learning to the stage of self-managed learning as the overall goal. The figure below illustrates the stages of

knowledge progression. This is a process which might take place accordingly, when EMPOWER users learn how to cope with diabetes self-management tasks by the help of an ICT application.

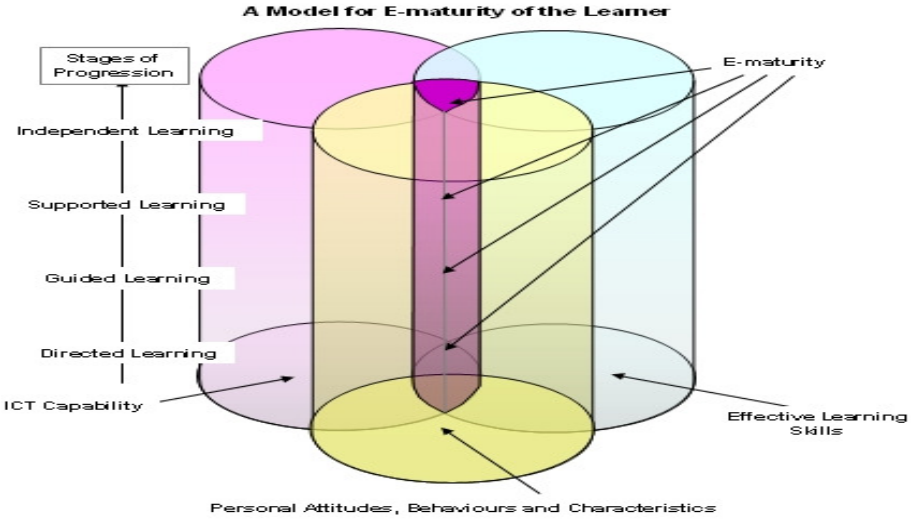


Figure 19 – Model for eMaturity of the Learner

(Source: Staines J. at forum to e-maturity[12])

In our explorative survey, we wanted to explore if and how diabetes patients assess their learning strategy, most often used. We have asked the participants, how they have learned in the past to manage their illness. Three choices were given (question 8 of the questionnaire):

- Option 1 (guided learner): I learn or change my lifestyle only by directives (e.g. doctors).
- Option 2 (supported learner): I learn or change my lifestyle supported by proposals (e.g. doctors, diet consultant, family)
- Option 3 (autonomous learner): I learn or change my lifestyle autonomously.

Respondents could only choose one option and it was a required question to answer.

As can be concluded from the figure below, the sample represents indeed a differentiation among the diabetes patient group, with the autonomous learner (23 in total) at the top rank. This high rank is arguable, because almost a quarter of the Austrian respondents are currently taking part in a disease management programme with focus on self-management (sport).

There is a slight gender difference to be perceived, man are more likely to assess themselves as “guided learner”, when it comes to illness management.

[12] http://e-maturity.wetpaint.com/page/Comments+from+Conference+on+the+Model

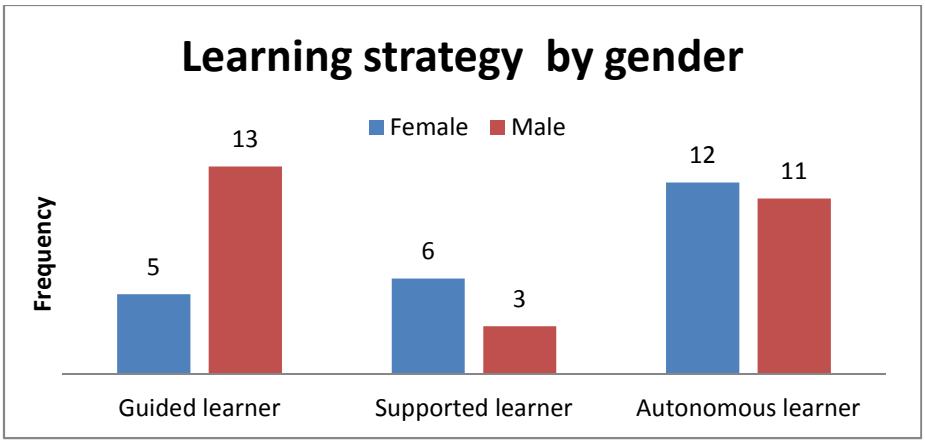


Figure 20 – Learning progression by gender (($c^2(1, N = 50) = 4.31, p = .12$)).

Assessing the different maturity levels in learning progression, then we can report that the *type 1 patient sees him/herself as more autonomous than the type 2 patients*. This can be explained by the fact that the former group needs to change and decide about measuring/ insulin strategies much more than the latter group due to the different illness progression.

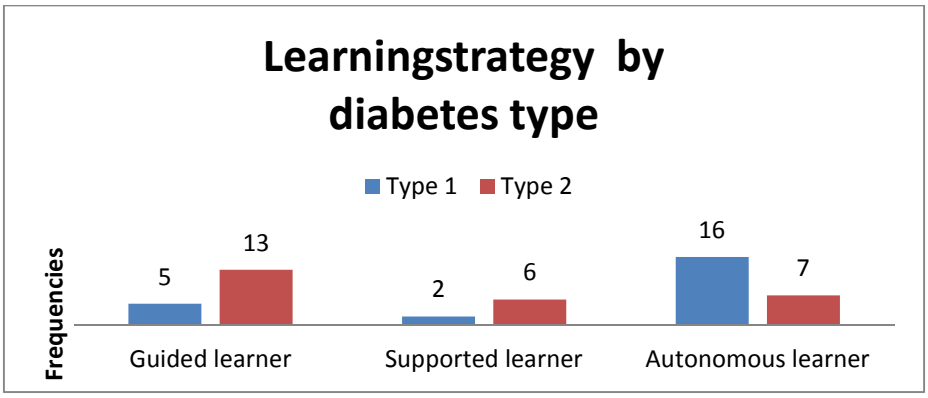


Figure – Learning progression by diabetes type (($c^2(1, N = 50) = 13.58, p = .01$)).

The "middle-agers", people at work, seem to prefer an autonomous learning strategy in coping with diabetes. However, the sample has been only small too conclude precise conclusion here (figure 19).

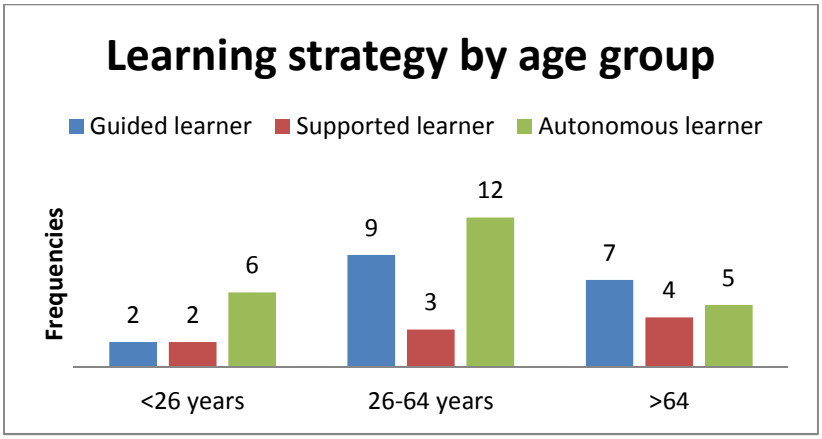


Figure 21 – Learning progression by age group (($c^2(1, N = 50) = 3.12, p = .54$)).

Relevance for EMPOWER

Three different levels of eLearning maturity can be identified:

- **A guided learner:** has a tutor, depends on pre-defined learning goals and is able to change his/her lifestyle only by directives (e.g. from a doctor).
- **A supported learner:** is able to select his/her learning material or learning structure to reach the pre-defined goals on an individual pace and will be able to change his/her lifestyle supported by proposals (e.g. from doctors, diet consultant, family)
- **An autonomous learner:** decides himself about the learning goals, material and pace and will be able to change my lifestyle autonomously.

Based on the survey, we can conclude:

- Assessing the different maturity levels in learning progression, the type 1 patient sees him/herself as more autonomous than the type 2 patients. This can be explained by the fact that the former group needs to change and decide about measuring/ insulin strategies much more than the latter group.
- The "middle-agers", people at work, seem to prefer an autonomous learning strategy in coping with diabetes.

4.4.4 Different approaches to measure and document diabetes information

Since one important process step in EMPOWER is to support the way diabetes patients measure, document and archive their vital data etc., we have explored how (paper and/or electronic), what type of information (a list of possible items were given) and how often diabetes patient note down their illness related values and ODLs.

The figure below shows that the majority of diabetes patients (78%) never documents anything, 19% use a paper-based documentation system and only 3% a combination of paper and electronic system.

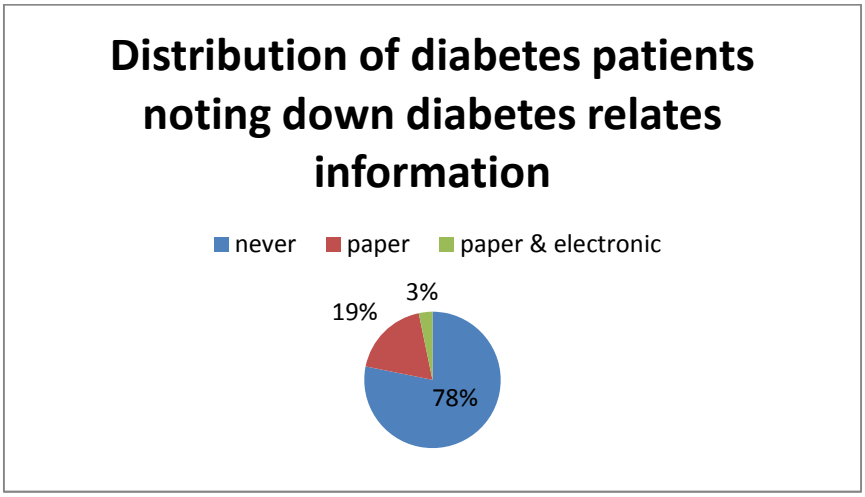


Figure 22 – Distribution of diabetes patients noting down diabetes relates information

If we look at the preference for paper and or electronic documentation, the current sample showed that type 2 patients do document even more than type 1 patients and they do so in a

multi-modal form (58% paper and 56% electronic). It seems that the way of documentation is somehow integrated into daily life with using both forms of documentation (not either or).

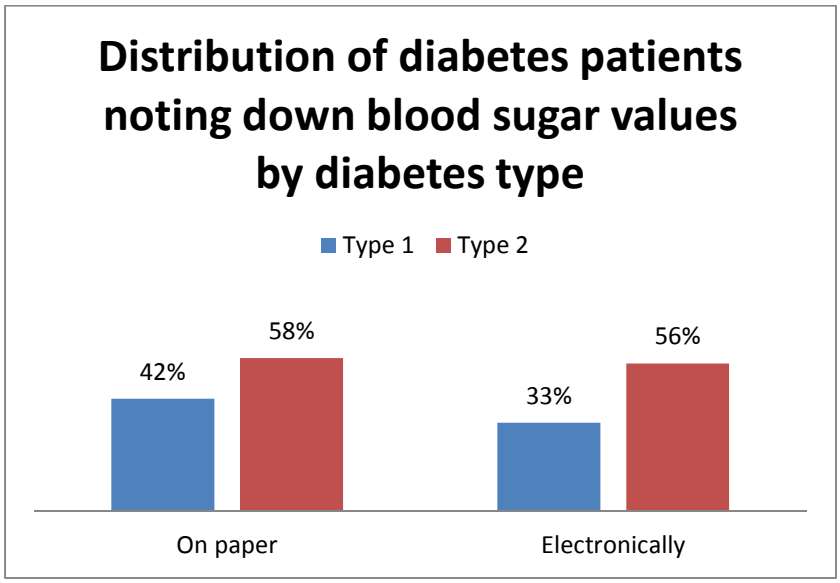


Figure 23 – Distribution of diabetes patients noting down blood sugar values by diabetes type

Those diabetes patients who measure indicate the following average measurement frequencies per day:

- Blood sugar: 4.47 times per day (range: 0.14 – 10)
- Blood pressure: 1.19 times per day (range: 0.14 – 8)
- Weight: 0.69 times per day (range: 0.14 – 1)

The most important obstacle to measuring and documenting diabetes related outcomes is the fact that **many respondents do not see the immediate value of doing so**. The two second most important obstacles mentioned are

- too little contact to persons with whom to talk about results and
- too little knowledge about what to do as a result of the outcomes.

This is a problem which has been discussed already in the focus groups (March 2012), and is now evident again in another age-group and indifferently of diabetes-type (see figures below).

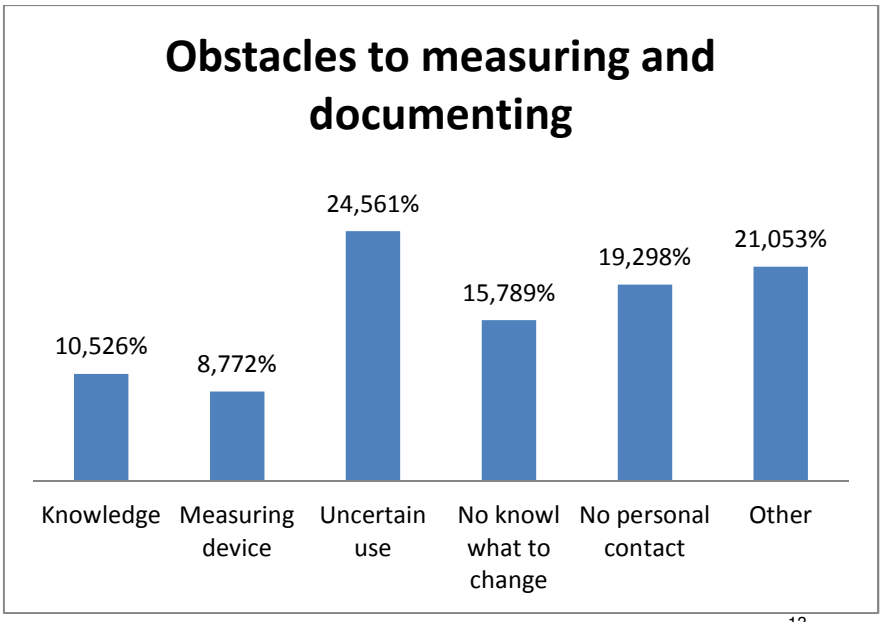


Figure 24 - Obstacles to measuring and documenting (N=50)[13].

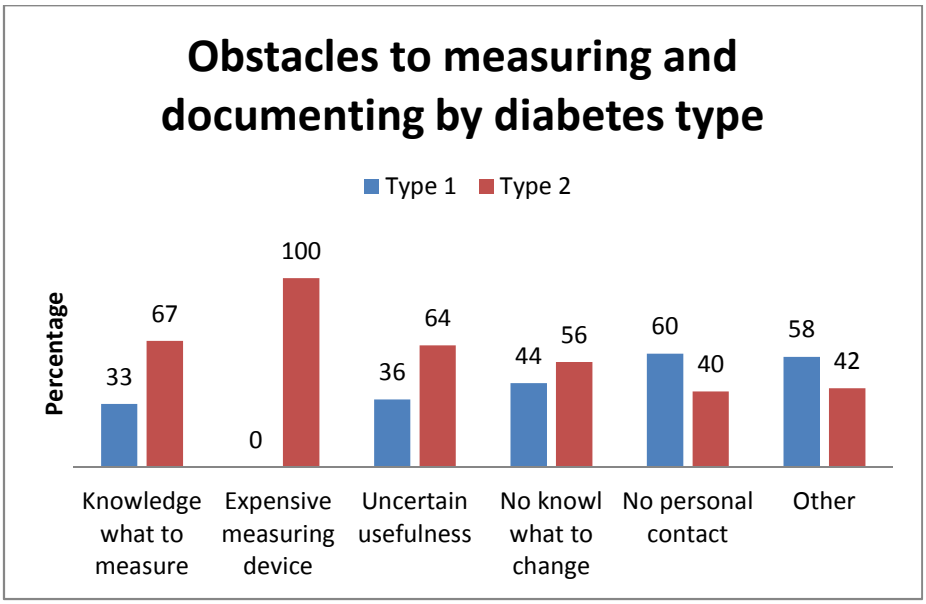


Figure 25- Obstacles to measuring and documenting by diabetes type (N=50).

Relevance for EMPOWER

Documenting ODL results is a prerequisite for using EMPOWER. Based on the survey, we can conclude:
The most important obstacle to measuring and documenting diabetes related outcomes is the fact that many respondents do not see the immediate value of doing so. Connecting activities to treatment and self-management goals in EMPOWER will help that it is always clear why a patient needs to monitor and document ODL results.
Other important obstacles are too little contact to persons with whom to talk about results

[13] The item "uncertain usefulness" relates to the obstacle of not being able to see a benefit and usefulness in measuring vital data (see answer possibility 3 in question 20 of the questionnaire).

and too little knowledge about what to do as a result of the outcomes. EMPOWER will support these obstacles by offering contact to people sharing the same or similar experiences based on social media and by offering additional information material.

4.5 Motivation for disease self-management with EMPOWER

The original ACM-model suggests that the adoption rate of a new ICT-tool is influenced by the level of motivation of potential users (e.g. willingness to use ICTs as information source). In this section, we discuss the forms of motivation in the specific context of self-managing diabetes.

What is motivation in general?
Motivation is the „psychological feature that arouses an organism to action toward a desired goal and elicits, controls, and sustains certain goal directed behaviors."[14] Motivation is a construct usually divided into two types:

- Internal or intrinsic motivation
- External or extrinsic motivation.

The first one refers to motivation driven by an interest or personal excitement in the given task itself, and exists WITHIN the individual diabetes patient rather than relying on any external pressure or control. The second one refers to motivation stirred by the performance of an activity in order to attain an outcome or objective, which then contradicts by intrinsic motivation. In the context of diabetes self-management, the question is whether patients react more to the first or second factors for being motivated of changing the life-style.
Well-known motivation theories are the need hierarch theory (Maslow A.) and the two-factor theory (Herzberg F.). More relevant for EMPOWER could be the self-determination theory by (Deci & Ryan[15]), which focuses on the intrinsic motivation in driving human behavior and behavioral change. Hereby, it is also important to distinguish between volition and intention to change lifestyle.

4.5.1 Motivation in the context of diabetes

Motivation is not like a mosquito.
It's not going to land on you, no matter how long you wait.
You must initiate it and create it by an act of will.
(Milios, 2011)

Rita Milios (Milios, 2011), a psychotherapist working with diabetes patients, points out that motivation is an attitude that is often misunderstood and proposes eight steps how diabetes patients can get their motivation flowing:

(1) **Start with the right attitude** – refers to an attitude of mindfulness (paying attention) really knowing what you are doing when you are doing it. As many actions have become so integrated that we don't really notice them a first step would be to become aware of them. Only if we are aware we can make conscious choice and commitments

[14] Online Encyclopedia WIKIPEDIA: http://en.wikipedia.org/wiki/Motivation
[15] All sources to be viewed at: http://en.wikipedia.org/wiki/Motivation

(2) **Set realistic goals** – it is more motivating to set smaller goals and achieve them than to set unrealistic goals and fall short. Patients should think about what they could easily start with in the near future and enhance their goals and actions after a while.
(3) **Break your goals into smaller steps** - patients may feel so overwhelmed at the idea of all the work that is required. In such instances, they should step back from the big picture and break a goal down far enough. They can almost always find some part of it that they are willing to do.
(4) **Use small successes to get to larger ones** – success breeds more success. Small steps toward a long-term goal are the truest measure of the potential to reach a long-term goal, That can set up a success cycle that reenergizes itself and continually feeds the patient's motivation
(5) **Focus on what you want** – when considering long-term lifestyle changes, it is important to focus on what you do want, and move toward that goal instead of focusing on what you don't want. Using positive self-talk is one way to keep the focus on what a patient wants and to keep moving in the direction of the goal, e.g. whenever a patient makes a choice that supports the goal, the patient can congratulate himself ("Good choice!"). Even if the choice did not reinforce the intent, he should use positive, encouraging self-talk anyway to motivate, rather than punish, himself.
(6) **Reinforce the habit of discipline** – discipline is the key to habits, because discipline is habits that a person creates because he wants to achieve a certain result. Discipline sets up an internal rhythm. They require willpower and mindfulness to carry out, but they will feel less burdensome as they become regular parts of your daily life.
(7) **Remain flexible** – there are times when patients will not able to carry out one or more of their healthy lifestyle habits. At times like these, they should focus on their original intent, review their options, and make the best choices possible under the existing conditions. In this way, they can usually achieve part of their goals.
(8) **Reward and reinforce** – while the goal of a healthier life is a significant reward in itself, patients should also reward their hard work and discipline and take pride in the positive, new attitudes that they created, e.g. they can congratulate themselves with positive self-talk or do something nice for themselves. Mindful motivation begins and ends with attitude, because attitude determines everything.

System-based feedback mechanism to facilitate motivation for patients add at several of the by Milios elaborated steps and shall be described consecutively with reference to the specific step they apply. The feedback may be directly integrated as diagram in the GUI to illustrate the performance and trends in various kinds of diagrams or be delivered as message via the core notification system.

- Step (4) "Use small successes to get to larger ones": The smallest success for the user could be already seen in conforming to the requested monitoring and data entry tasks thereby enabling constant tracking of her/his overall health state. So especially at the beginning short after the diagnosis a first success could be conveyed by awarding her/him through a simple diagram (e.g. smiling smiley) or a notification (e.g. "great, you are a genuine self-managing patient") for adhering to the requested frequency of measurements and entering/importing the results to EMPOWER. Next stage could be a first success in basically controlling her/his glucose value or regularly performing physical activity. Larger successes are considered to be adhering to the set goals over a longer time and sustainably improving her/his overall health state.
- Step (6) "Reinforce the habit of discipline": If after some time the patient will tend towards or actually show a lack of discipline (e.g. by not regularly entering her/his biometrics or loosing multiple times control over her/his blood glucose) a motivating but explicit hint to more seriously following the defines goals and guidelines could be delivered to the patient.

- Step (8) “Reward and reinforce”: Aside of simply providing the patient feedback about his short- and long-time performance via the described mechanisms, elements of gamification could also be integrated as for example described by (Schneier et al, 2012).

No matter at which motivation step and in what way feedback is provided. There are two crucial aspects that should be kept in mind:

- Feedback on basis of medical parameters and goals could be provided but only after careful consideration. Although a patient might do her/his best in conforming to the overall therapy, his diabetes or other factors like multimorbidity may negatively influence the actual outcome. By not providing any or positive feedback we might achieve the contrary and demotivate the patient in continuing to follow her/his goals. So feedback mechanisms need to take the individual state of health and the patient’s background into account and need to adjust the tone of the feedback accordingly.
- Special attention should also be paid on how often and in which regularity feedback is provided. On the long run one might get bored or even annoyed by getting feedback for every performed action and fulfilled goal. So although a regular and immediate response might significantly motivate a patient at the beginning of the participation/therapy, a more fuzzy or irregular feedback pattern should be preferred later on to provided rewards or remind on adhering to the action plan.

Relevance for EMPOWER

- There are a lot of habits we don’t notice and hence, we are not aware of them, e.g. about food, stress, motion. **Diaries** can help to become aware of them and to “work against the mindlessness of habits” (Milios, 2011)
- Reports, graphs and trends visualizing the patient’s success can be **positive feedback**. This can also include encouraging statements and keep him moving towards the specified goals. But feedback should be only provided after careful consideration taking into account the regularity of the feedback and the individual health state of the patient.
- Habits for a new lifestyle supporting a healthier life need attention and discipline until they are set. The **Action Plan** will be the central tool for supporting these changes of behavioural patterns as long they are not yet habituated.
- If patients will not be able to fulfill their goals for some reasons they should keep their focus on their original intent and their long-term treatment goals. Goals in EMPOWER are related to the underlying treatment goals (recommendations). This supports the patient to stay aware about their original intent and purposes behind their self-management goals. Based on that they may also look for options or alternatives to fulfill their goals.

4.5.2 The Transtheoretical Model (TTM)

The Transtheorectical Model (TTM) offers guidance and motivation for people at all stages of readiness for change. The TTM assesses a person’s readiness to act on a new healthier behavior, and provides strategies, or processes of change to guide the person through the stages of change to Action and Maintenance. The TTM is based on the premise that people are at different stages of motivational readiness for engaging in health behaviors and that

intervention approaches are most useful when they are matched to a person's current stage of change (Ruggiero, 2000):

- **Precontemplation (Not Ready)** – not intending to change to the goal level of a behavior (e.g., reduce fat intake to <30% of total) in the foreseeable future;
- **Contemplation (Getting Ready)** – intending to change to the goal level in the foreseeable future (next 6 months), but not the immediate future (next 30 days);
- **Preparation (Ready)** – intending to change to the goal behavior in the immediate future and taking behavioral steps in the direction of change;
- **Action** – has made a change to the goal level of the behavior in the recent past (6 months);
- **Maintenance** – has been at the goal level of the behavior for 6 months or longer.
- **Termination** – "Individuals have zero temptation and they are sure they will not return to their old unhealthy habit as a way of coping.[16]

People may move forward and backward in these stages of change. When matching intervention approaches with stage of change, it is important to help people focus on the benefits of the goal behavior in the early stages and help them reduce the cons or costs of engaging in the goal behavior. For example, when trying to help an obese woman with type 2 diabetes increase her activity or exercise level, it may help to ask her to generate a list of benefits of this behavior that are relevant for her (Ruggiero, 2000). To be aware of the pros and cons is important in the decision-making process for behavior change. This growing awareness that the advantages (the "pros") of changing outweigh the disadvantages (the "cons" is called the **decisional balance** in the TTM.

Another aspect is **situational self-efficacy** helping people gaining the confidence they need to be successful and that they can make and maintain changes in situations that tempt them to return to their old, unhealthy behavior. This TTM construct is based on self-efficacy based on the work of Bandura (Bandura,1977) and the coping model of relapse described by Shiffman (Shiffman, 1986).Research has shown a specific pattern of changes in self-confidence and temptations across the stages of change. Specifically, people report greater temptations and less confidence in the early stages. For example, when individuals are trying to reduce their dietary fat intake, they may be tempted to eat high-fat foods in a number of situations, such as when at a party, during a coffee break at work, when dining out, or when feeling stressed or depressed. To help people move through the stages, it is important to help them identify and manage their situational temptations or to build their confidence in following their plan across situations (Ruggiero, 2000).

The TTM identifies 10 strategies that can help them make and maintain change and call them **processes of change**. The ten processes include:

1. Consciousness-Raising – increasing awareness via information, education, and personal feedback about the healthy behavior.
2. Dramatic Relief – feeling fear, anxiety, or worry because of the unhealthy behavior, or feeling inspiration and hope when they hear about how people are able to change to healthy behaviors
3. Self-Reevaluation – that the healthy behavior is an important part of who they are and want to be
4. Environmental Reevaluation – realizing how their unhealthy behavior affects others and how they could have more positive effects by changing
5. Social Liberation – realizing that society is more supportive of the healthy behavior
6. Self-Liberation – believing in one's ability to change and making commitments and recommitments to act on that belief

[16] http://en.wikipedia.org/wiki/Transtheoretical_model

7. Helping Relationships – finding people who are supportive of their change. It also involves changing the environment to promote the healthier behavior and/or avoid the undesirable behavior.
8. Counter-Conditioning – substituting healthy ways of acting and thinking for unhealthy ways
9. Reinforcement Management – increasing the rewards that come from positive behavior and reducing those that come from negative behavior
10. Stimulus Control – using reminders and cues that encourage healthy behavior as substitutes for those that encourage the unhealthy behavior.

Prochaska et al (Prochaska & Velicer, 1997) state in their research that interventions to change behavior are more effective if they are "stage-matched," that is, "matched to each individual's stage of change (see Figure 26)

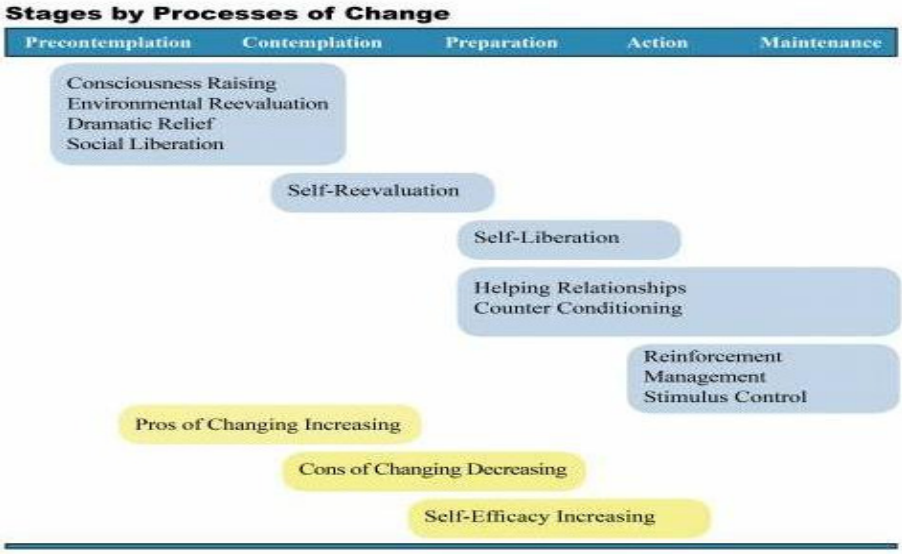


Figure 26 - Stages by process of change[17]

Relevance for EMPOWER

Various suggestions can be derived from the TTM:

- Offering relevant **information material** is a basic approach for increasing the awareness. Information material may also include examples e.g. regarding changing dietary patterns (Consciousness-Raising).
- Supporting awareness about "pros" and "cons" can supported by appropriate structured information material such as **decision aids** helping people thinking about choices and benefits. An option would be to link this information with the goal setting task.
- **Diaries** can help people to record and to analyse their behaviour patterns and hence, to identify and manage their situational temptations (Self-Reevaluation). Keeping a diary can also help identifying unhealthy behaviour (Reinforcement Management)
- Using an **Action Plan** can be a tool for Self-Liberation and facilitates the commitment for changing behaviour patterns.
- Exchanging information and experiences with people in similar situations e.g. in **self-help forums** or based on other social media can be an additional support for healthier behaviour and positive changes (Helping Relationships).

[17] http://en.wikipedia.org/wiki/Transtheoretical_model#cite_note-ProchaskaAJHP97-24

4.5.3 Becoming an active self-manager

Chronic diseases such as diabetes are inevitably related with self-management and regularly self-management needs continuous motivation. The first responsibility of a chronic disease self-manager is to understand the disease and to observe how the disease and the treatment affect him. Lorig (Lorig et al, 2006) describes as key success factors firstly, deciding what to do, secondly, deciding how to do it and finally, learning a set of skills and practicing them until they have been mastered. These skills should cover the following three categories of self-management tasks:

(1) To take care about the disease – such as taking medicine, changing diet, exercising, going to the doctor
(2) To carry out normal activities – such as chores, employment, social life, etc.
(3) To manage emotional changes – brought by the illness, such as anger, uncertainty about the future, depression, changed expectations and goals

Lorig (Lorig et al, 2006) state that self-management is always a decision – a decision to be active or a decision to do nothing. Hence, it's up to the patient to decide what they want to accomplish, looking for alternatives, making and carrying out an action plan, checking the results and make changes as needed. Once a patient has decided what he wants to accomplish (his main goals), the next step would be to turn his goals into short-term plans. These Lorig calls action plans and suggests to specify a set of actions that the patient can realistically expect to accomplish within the next week. Using an Action Plan successfully Lorig gives some recommendations:

- First, the patient should decide what he wants to do this week. It should be something he feels is realistic.
- Actions should be behaviour-specific. Losing weight is not a behaviour, not eating after diner is.
- In the next step the patient should make a specific plan taking into consideration the following steps:
    - Exactly what I'm going to do?
    - How much will I do?
    - When will I do this?
    - How often will I do the activity?
- Writing the action plan the patient should start where he is or start slowly. If the patient wants to lose weight, he should set a goal based on his existing eating behaviour.
- Once the patient have written his action plan, he should himself "one a scale of 0 (totally unsure) and 10 (totally certain), how certain am I that I can complete this plan?" If the answer is ≥ 7 this is probably a realistic plan. If the answer is below 7 the patient should look again to his action plan and ask himself why he is not confident.
- Once the action plan is written the patient can post I where he will see it every day.
- The patient should check things off as they are completed. That will give him guidance how realistic the planning was and will also be useful in making future plans. Additionally, daily notes may help for better understanding.
- Patients should reward themselves frequently, e.g. for jobs or healthy activities well done

Relevance for EMPOWER

Lorig (Lorig et al, 2006) summarizes a lot of useful hints what chronically ill patients would

need and help to become active self-managers. In EMPOWER, it will help to setup the **Action Plan** as a supportive self-management tools for diabetes patients based on these recommendations. Additionally, a lot of suggestions from the book (Lorig et al, 2006) can be integrated into the **information material** in EMPOWER or be additional hints e.g. for EMPOWER novice users how to use the Action Plan properly.

4.5.4 Different self-care coping strategies for diabetes

One possibility to measure on what level a person can call himself an active self-manager is to look at the chosen diabetes coping strategy of this person. In literature, studies found out three types of relevant self-care coping strategies, namely a

- Pro-active manager
- Passive follower
- Active follower

“Patients' perceptions of their self-care varied on a spectrum, displaying differences in self-care responsibilities such as competence with dietary planning, testing blood sugar and regular exercise. The prescribed regimen and to a lesser extent gender may also account for some the differences across the patient types. To help describe our patient's self-care coping strategies we will use the health belief, health value, self-efficacy, and locus of control frameworks.” (Collins et al. 2008):

Collins et al. describe their classification and survey results found on them as follows (Collins et al. 2008, pages 5-8):

Proactive Manager
“A proactive manager is a patient who independently monitors blood glucose and adjusts his/her self-care regime to maintain metabolic control. Although the numbers were small, it is important to acknowledge there were more male proactive managers and most were using insulin or a combination of oral medication and insulin. Previous studies have reported that men with diabetes experience less disease impact and more treatment satisfaction than women possibly due to the different roles that men and women occupy in society. Women have multiple role responsibilities and may find the diabetes regimen difficult to fit into their busy lives. Men on the other hand, are typically more narrowly focused with their roles and responsibilities and possibly less likely to let the diabetes regimen interfere with their life.

Proactive managers believe their self-care is successful which is consistent with one aspect of the health belief model; belief of treatment effectiveness. They mentioned the feedback they received from their blood glucose readings told them how they were doing; therefore, testing, recording and assessing their blood glucose were self-care coping strategies that gave them some reassurance about the management of their diabetes self-care. Acceptance of personal responsibility for most aspects of diabetes self-care was another attribute that the proactive managers shared and is consistent with the construct of internal locus of control where an individual believes his or her own self-care behaviour determines or influences an outcome. The proactive manager accepts a high degree of responsibility for their health and believes there self-care actions will positively influence their metabolic control. The combination of personal self-care responsibility and high health value may explain why the proactive manager engaged in so many health-protective behaviours .

The inclusion of insulin in the prescribed regimen of most of the proactive managers may trigger more complex glycaemic control behaviours like assessment of blood glucose records and adjustment of self-care in some individuals. The proactive manager's ability to self-regulate or assess and adjust patterns of self-care is a coping strategy that sets them apart

from the passive followers and the nonconformists. Bandura found that the strength of individuals' self-efficacy or belief in their ability to perform a behaviour is directly related to how they cope with the new behaviour and may also impact their willingness to perform additional health-protective behaviours. (..) . (Collins et al. 2008: page 5-8).

Passive Follower

"*A passive follower is a patient who follows his/her prescribed self-care regime, but does not react autonomously to changes in metabolic control. The passive follower does not share the proactive manager's propensity for flexibility and prefers structure with no variation in medication or meal times. Most of the passive followers had type 2 diabetes and used diet or oral medications to control their diabetes. Passive followers tended to rely more on powerful others to help them make self-care decisions, such as a partner or family member for help with their diet, or the health professional for help with their self-care regimen; following the regimen was very important to the passive follower. This behaviour is consistent with external locus of control where individuals believe their health may be controlled by outside forces that are independent of their actions. Parry and colleagues also found when patients identified the main cause of their condition as outside of their control like genetic factors; they placed responsibility for disease management with health professionals. Furthermore, the passive followers reliance on powerful others may have indirectly affected their health value and in turn negatively influenced their adoption of health-protective behaviours like making changes to their lifestyle when their blood glucose readings indicated there was a problem. Since most of the passive followers were on diet only or oral medications, they may not be aware how to react to blood glucose problems, unlike the proactive managers who are able to match insulin to food or make lifestyle changes when their assessment of blood glucose records imply self-care change is needed. This finding is important for both patients and health professionals, as passive followers may need more support to help them make appropriate lifestyle changes, especially when their blood glucose readings show corrective action is needed. It has been noted in the literature both internal and external powerful other health locus of control were associated with regimen compliance using the Multidimensional Health Locus of Control scales. The fact that passive followers may be regiment compliant should not imply they do not need further training to adopt new behaviors which would allow them to make self-care changes independently. The passive followers may benefit from self-care decision support. There is real opportunity for the passive follower to acquire more health-protective behaviours which may help them to maintain better metabolic control.*" (Collins et al. 2008: page 5-8).

Nonconformist

"*The nonconformist is a patient who does not follow most of his/her prescribed self-care regimen. The nonconformists felt things like their future health were not within their control; their coping strategy was one of denial. This finding concurs with Parry et al. who identified a similar group of patients (labeled as 'up to them') who regard the cause and management of their condition as outside their control. The nonconformist did not follow many of the activities of their self-care regimen, especially prescribed dietary and activity changes. Since the nonconformist believed their future health was outside of their control they did not engage in health-protective behaviours which is linked to low self-care health value. The nonconformist accepted minimal personal responsibility for their self-care which may indicate they did not believe preventative health actions like positive lifestyle changes would impact their future health. Many of the nonconformists were in denial of the seriousness of their condition, which may also explain why they suffered from more complications than either the passive followers or the proactive managers. It is interesting to note, like the proactive managers, most of the nonconformists were on insulin or a combination of oral medications and insulin. Previous work has shown insulin treated patients reported the most negative diabetes impact compared to patients on oral medication or diet only regimens. The nonconformist may believe that the burden of diabetes is insurmountable, and that adopting positive lifestyle behaviours is too difficult. Previous work however suggests that the nonconformist may*

benefit from group education where they are exposed to other patient's self-care success stories" (Collins et al. 2008: page 5-8).

4.5.4.1 Exploring different self-care coping strategies

In order to get an idea how we can cluster and measure the different levels of a self-care coping strategy, the participants had to assess themselves in their way of coping (question 9 of the questionnaire). Options given were:

- Option 1 (active follower): I observe my diabetes always autonomously. I implement/comply with my therapy plans and related activities almost always on my own.
- Option 2 (passive follower): I observe my diabetes only with support of my family, doctors and diet consultants. I implement/ comply with my therapy plans and related activities almost always with their help.
- Option 3 (non-conformist): I observe my diabetes only sometimes on my own. I implement/comply with my therapy plans and related activities irregularly.

In our sample the patients clustered into the following groups of different levels of self-care coping strategy, most of them assess themselves as active follower. Here we have to be careful in interpretation, because of a slight bias of more active participants, already in the sample due to their participation in a disease management programme.

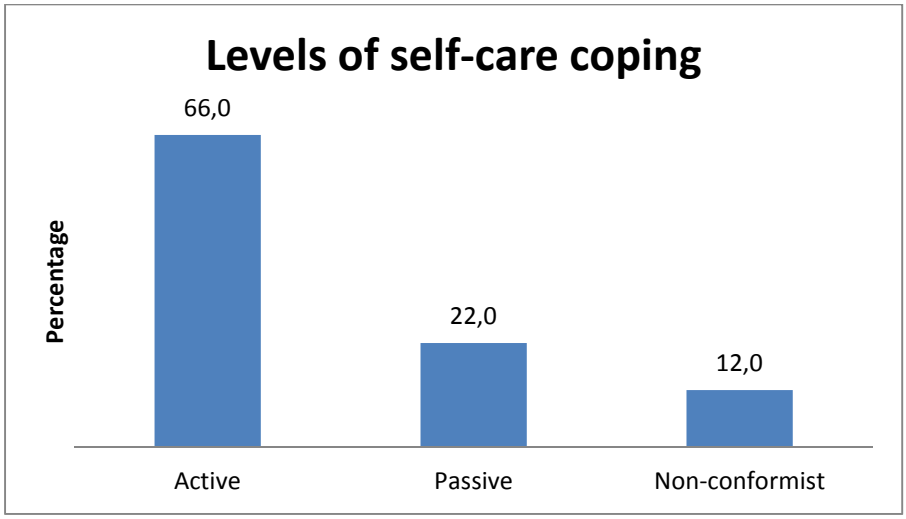


Figure 27 - Distribution of self-care coping strategies in the sample

Not much differences beome evident by diabetestype.

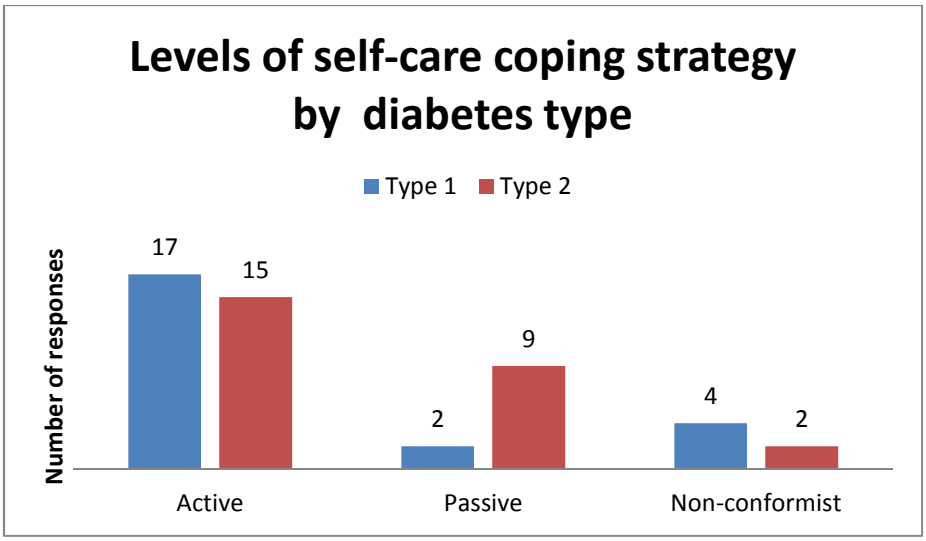


Figure 28 - Levels of self-care coping by diabetes type.

Not much differences beome evident by gender.

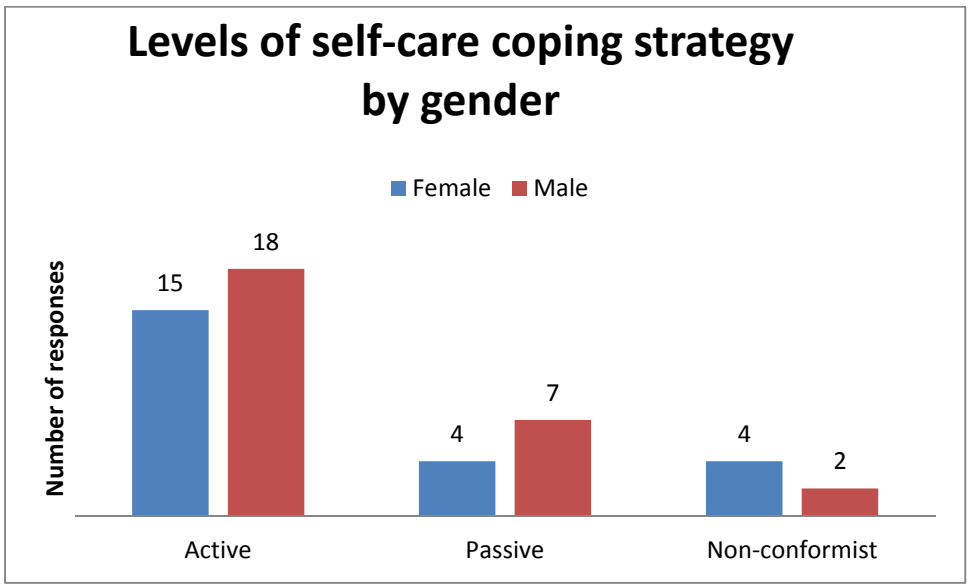


Figure 29 - Levels of self-care coping strategy by gender

4.5.4.2 Exploring different goal-setting and feedback mechanisms

The following figures show what therapy goals diabetes patients follow and what difficulties they have with being compliant.

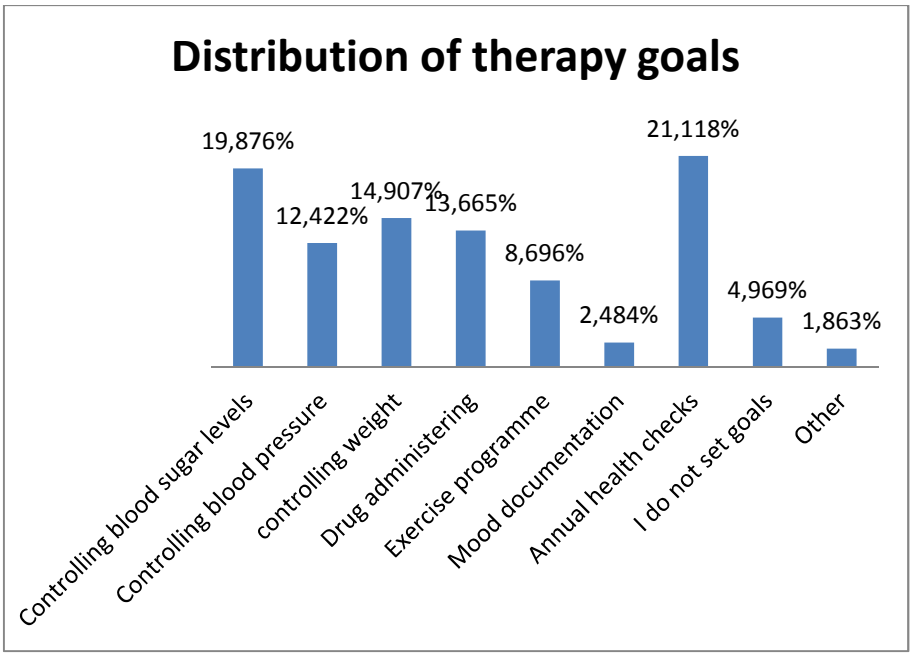


Figure 30 – Distribution of therapy goals (N=50).

The most prominent goal is to achieve the quarterly set goals of the medical expert (34%). However, second most important goal is to learn how to better cope with diabetes. Patients seem to be highly aware of this goal, but do not know how to follow (see figure 30).

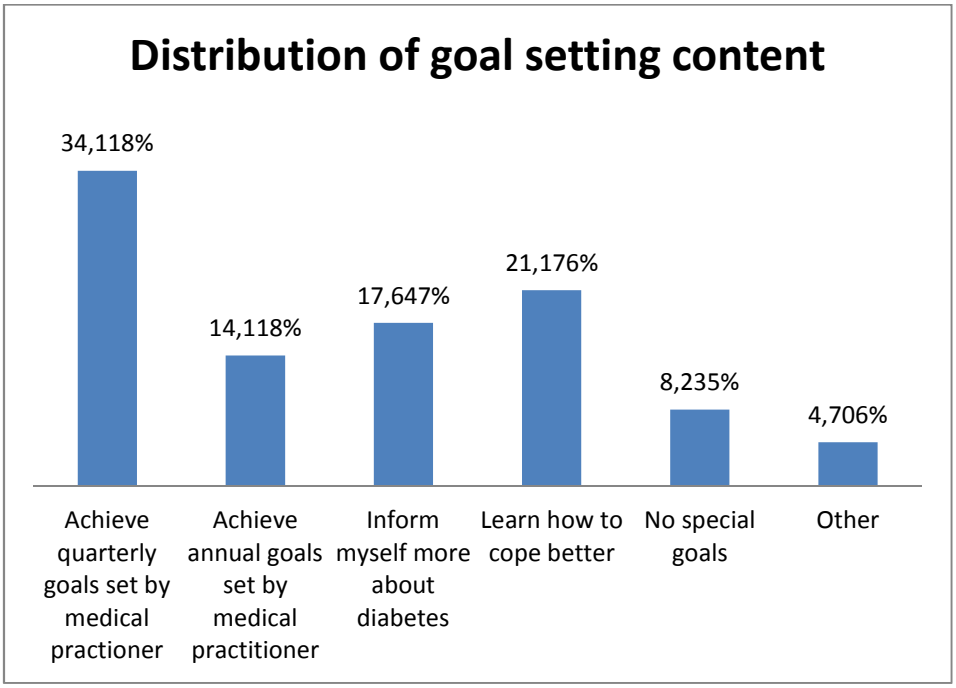


Figure 31 – Distribution of goal setting content (N=50).

Documentation is perceived as most difficult task (21%), followed closely from how to change a diet and mental training (17%) and physical training (15%).

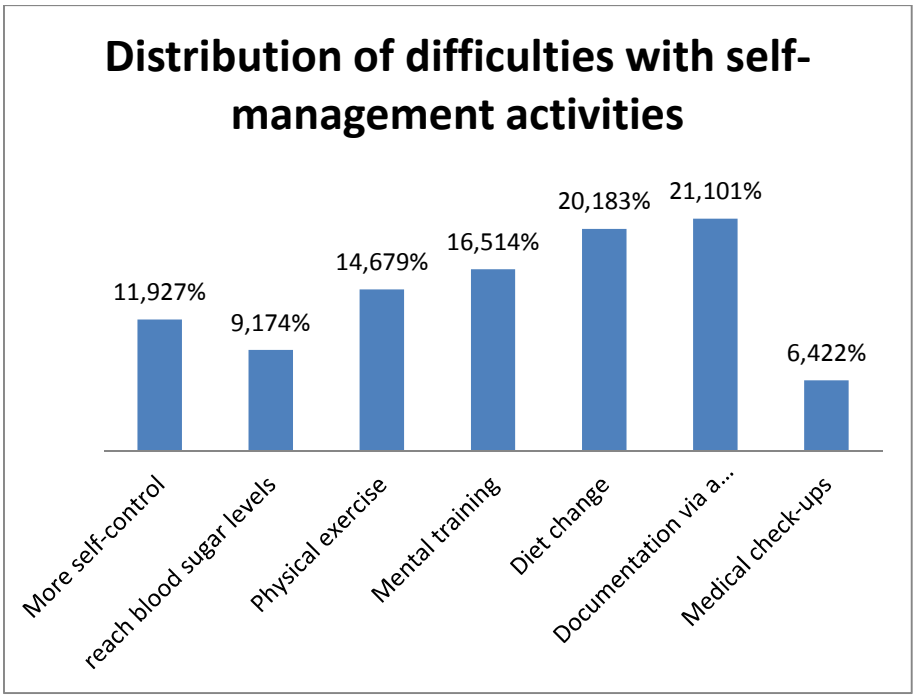


Figure 32 – Distribution of difficulties with self-management activities (N=50).

Most interesting for EMPOWER is the tendency of patients of ignoring their problem and that they do not want to be reminded about complying with their therapy goals (33% do not want to be reminded at all. This is something very human, but EMPOWER could respond to this fact with “friendly” and supportive reminders. Interesting is that the rather impersonal way of sending via PC/e-mail as reminder (29%) is more attractive than a phone-reminder (9% telephone; 24% mobile phone).

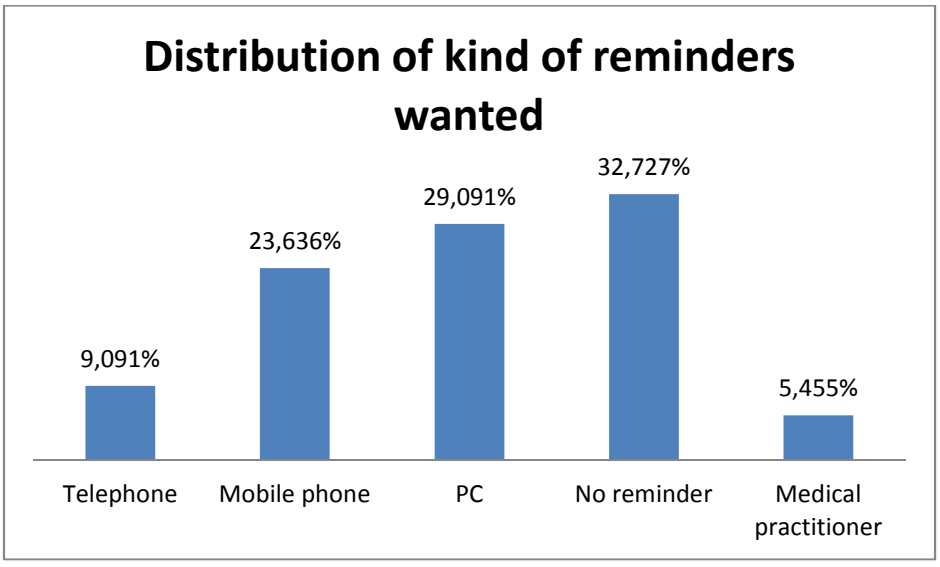


Figure 33- Distribution of kind reminders to therapy goals.

Relevance for EMPOWER

The following self-care coping strategies can be identified:

- **Nonconformist** – is a patient who does not follow most of his/her prescribed treatment goals. They accepted minimal personal responsibility for their self-care and often deny the seriousness of their condition.
- **Passive Follower** – is a patient who follows his/her prescribed treatment goals, but does not react autonomously to changes in metabolic control. They prefer structure with no variation in medication or meal times. Passive followers tended to rely more on powerful others to help them make self-care decisions and they may need more support to help them make appropriate lifestyle changes.
- **Proactive Manager** – is a patient who independently monitors blood glucose and adjusts his/her self-care regime to maintain metabolic control. They accept a high degree of responsibility for their health and believes there self-care actions will positively influence their metabolic control

Based on the survey, we can conclude:

- Man and women do not follow different self-care strategies. No special action needed by EMPOWER design.
- The type of diabetes does not have a significant influence what self-care strategy is followed by the patients. Not too much effort is needed to find out specific EMPOWER USPs for type 1 and type 2 patients. However, the more patients assess themselves as e-skilled, the more likely they are to assess themselves as following an active self-care strategy.
- The most prominent goal followed is to attend the appointment with the doctor (34%). However, second most important goal is to learn how to better cope with diabetes. Patients seem to be highly aware of this goal, but do not know how to follow it. Documentation is perceived as most difficult task (21%), followed closely from how to change a diet and mental training (17%) and physical training (15%). EMPOWER needs to provide more hints and information on the added value of measuring and documentation.
- Most interesting for EMPOWER is the tendency of patients of ignoring their problem and that they do not want to be reminded about complying with their therapy goals (33% do not want to be reminded at all. This is something very human, but EMPOWER could respond to this fact with “friendly” and supportive reminders. Interesting is that the rather impersonal way of sending via PC/e-mail as reminder (29%) is more attractive than a phone-reminder (9% telephone; 24% mobile phone).

4.6 Summary: EMPOWER maturity levels

4.6.1 Criteria for EMPOWER maturity levels

This section presents a matrix for defining the EMPOWER maturity levels and summaries the results and findings about the ACM model described in the previous sections of chapter 4.

EMPOWER maturity levels				
		Novice level	**Advanced level**	**Expert level**
Access	Media type	Mobile / Tablet	Mobile / PC / Tablet	Handy/ PC / Tablet / Smartphone
	Social media participation	No member of social community	Observer of social communities	Active community member
	Information search	Basically offline training and paper-based material	Internet search	Social media for exchanging information and experiences
Competences	Digital competences	Low-level	Medium-level	High level
	Diabetes self-management competences	Guided learner	Supported learner	Independent learner
Motivation	Self-care coping strategy	Non-conformist	Passive follower	Active follower
	Feedback and hints from EMPOWER	High need	Depending on the situation	Occasionally or depending on the situation
	Mindfulness regarding habits	Occasionally / low awareness	Partly aware	Continuously aware
Source: Salzburg Research Team (vhp, mp)				

Table 1 – EMPOWER Maturity Levels

The three categories of user professional levels (low level (novice), medium level (advanced) and high level (expert)) are to be understood as ideal typical categories based on theoretical grounds. The maturity levels comprise several categories for each pillar of the ACM model (access, competence and motivation) and each category (e.g. the media type or disease coping strategy) covers a spectrum from low to high. Maturity levels in EMPOWER refer to

the professional stage having reached by the patient in his learning of how to manage his/her diabetes by him/herself. A real patient may be described by characteristics from two or even from all three categories depending on his/her competences, needs and preferences. Table 1 shows the characteristics of the EMPOWER maturity levels. Whether and how these idealistic levels can be found in practical evidence has been explored in the EMPOWER survey.

4.6.2 Explorative evidence for EMPOWER maturity levels

This section presents the first exploratory empirical evidence from the survey on the EMPOWER maturity levels.

		Novice	Advanced	Professional
Access	Media type (ownership)	28% classic mobile	78% computer	47% smartphone 20% tablet pc
	Social media participation	66% not active		34% active
	Information search/ sources	66% personal contact	72% old media	66% new media
Competence	Digital competences (e-skills)	42% only send and receive e-mails or text message (low level)	33% in addition, search the internet and/or participate in social media (medium level)	24% in addition, shop online and work with spreadsheet software (high)
	Diabetes self-manage-ment learning strategy	37% guided learners	16% supported learners	47% independent learners
	Documentation style (example: blood sugar)	17% do not document at all	54% document on paper	29% document electronically
Motivation	Self-care coping strategy	12% non-conformists	22% passive followers (type 1: 18%; type 2: 82%)	66% active followers
	Feedback (reminder)	33% do not want to be reminded 9% want to be reminded via telephone	29% want to be reminded via computer (e-mail)	24% want to be reminded via mobile (sms)

Table 2 - Results of the survey based on the maturity levels

Ad access:

Access to ICTs is positively related to the e-skills level, but not to age! (exception: smartphone use, more likely to be used by younger diabetes patients).

- Media type ownership and usage
  - Each participant uses at least one device, with 78% having access (themselves or through a partner) to an online-ready PC or laptop.
  - Tablet PC use was minimal in this sample (20%) and related to high e-skill levels.
  - More diabetes type 1 users reported both the use of a PC and a smart-phone and/or a Tablet PC.
  - Frequency of PC use: 31% use daily, 13% once a week, 9% every three months.
- Social media participation
  - Only 34% of diabetes patients are active social media users (mean age 42)
  - Type 1 diabetes patients and younger patients are more likely to participate in social networks.
- Relatively even distribution for access to diabetes relevant sources
  - Prime sources are old media (72% TV, books, brochures)
  - Second: personal contacts (66% total; of which 22% view the medical expert as prime source);
  - Third new media (66%: internet portals, online-fore and social networks)

Ad competence

- Digital competences: In this sample 42% patients perceive having “low level e-skills”. Lower e-skills are associated with patients of high age and diabetes type 2.
- Diabetes self-management learning strategy
  - Type 1 patients regard themselves as more autonomous than the type 2 patients. This can be explained by the fact that the former group needs to change and decide about measuring/ insulin strategies much more urgent than the latter group.
  - The “middle-agers” (26-64 years), seem to prefer a more autonomous learning strategy for managing their diabetes tasks.
- Measuring and documentation style (Barriers)
  - In this experienced sample 83% patients measure and document the blood sugar level often. Electronic documentation is rare (29%).
  - Barriers: no understanding about immediate value of doing so; too little contact to persons with whom to talk about measuring results and too little knowledge about what to do as a result of the outcomes. (EMPOWER could provide useful hints here!?)

Ad Motivation

- Diabetes self-care coping strategy
  - General: this sample was minimal biased in perceiving diabetes self-management competence (46% patients followed a DMP program; thus 66% regard themselves as active followers)
  - Man and women do not seem to follow different diabetes self-care strategies.
  - Basically there is no significant relation between the type of diabetes and the followed self-care coping strategy. (Exception: 82% of the 22% total passive followers are type 2 patients!).

  - Patients with high e-skills regarded themselves more likely as ACTIVE FOLLOWERS.

- Feedback awareness/ reminder needs
  - In total more patients do not want to be reminded about complying with their therapy goals.
  - EMPOWER could respond to this fact with “friendly” and supportive reminders.
  - Interesting is that the rather impersonal way of sending via PC/e-mail as reminder (29%) is more attractive than a personal phone-reminder (9% telephone) or via SMS (24% mobile).

5 Different needs in EMPOWER process depending on maturity levels

This section aims at prioritizing the needs of potential users during the main steps in the EMPOWER process (monitoring, documentation, activation and sharing information). How can EMPOWER prioritize the different needs of the diabetes patients (Performance-Importance-Ratio) and what can we conclude for interaction design and EMPOWER services.

5.1 Methods used

In order to ***prioritize the needs of diabetes patients in mastering the EMPOWER process*** of measuring, documenting, archiving, acting and communication on their diabetes goals and actions, we used the analysis method of the 'Outcome-Driven Innovation (ODI) approach, developed by Anthony Ulwick, founder and CEO of the strategy and innovation management consulting firm Strategyn, US (www. http://strategyn.com). As described in the Salzburg Research Handbook of Methods (G. Geser, 2011, page: 200-202), Ulwick emphasises that in order to capture und use customer needs in the innovation process, companies must firstly understand the job the customer is trying to get done and, secondly, they must understand how customers measure the successful execution of a job, i.e. the criteria people use to judge the value of a product or service in getting the job one.

The basic ODI methods
ODI takes the "jobs-to-be-done" as the main reference point of user needs and requirements capture. Rather than capture requirements on a product or service the jobs that the product or service is intended to support is the basis. In order to identify such jobs, first in-depth interviews are conducted where a practitioner works with customers to deconstruct a job or activity to unearth the intended outcomes. Thus, instead of asking customers about how to improve a product or a service, the researchers try to deconstruct the customer's jobs into process steps. Moreover, they try to determine what criteria and metrics customers use to measure the successful execution of the job. Next the researchers compile a comprehensive list of the intended outcomes that participants rank in order of importance and the degree to which they are satisfied by existing products. Finally, using a simple mathematical formula they identify the relative attractiveness of improvements which provide key areas of opportunity (therefore the mathematical formula is called the "opportunity algorithm").

Definition of customer needs statements
An important element in the ODI method is to define and capture user needs in a consistent way so that they become a reliable input into the innovation process. Ulwick and his co-researchers figured out what the standard structure, content and format of a "customer needs statement" should be. Actually they developed a set of over 40 rules that define the structure, content and format of such statements (Bettencourt and Ulwick 2008). Such precision allows for removing variability from the process of capturing customer needs and arrive at proper metrics of what ODI calls "customer desired outcomes", i.e. the metrics that customers use to measure success when executing tasks or activities they are trying to get done. These outcomes can be prioritized to reveal which are highly important and poorly satisfied (underserved) – thus presenting the best opportunities for improvements and innovation customers welcome. Using these customer desired outcomes as inputs into the innovation process can eliminate much of the factors that typically derail innovation projects. (Geser, 2011).

Based on the results of the EMPOWER focus groups and interviews with experts in diabetes self-management, we have identified 23 EMPOWER process steps. Needs areas in relation to the main process steps in diabetes self-management (see survey in section 9.1, Questions 27-30):

- Monitoring, collecting and documenting data,
- Defining, deciding and modifying goals,
- Executing activities and
- Sharing information and participation.

To each of this process steps we can now identify how important this steps are for patients and how satisfied they are already with a present solution. The result of such an analysis is the priorisation of needs and hints on what to focus in future design of a new product, such as EMPOWER.

The table below provides the list of classified needs in the EMPOWER process, expressed by patients in the focus groups (March 2012) and as known from the pre-study. This needs were then rated and prioritized by the patients as to their satisfaction with the individual process step and as to how important they see this step. A comparison of this two dimensions will help us to identify the most wanted needs and service to be fulfilled by EMPOWER now or in future innovative development cycles.

Nr.	Diabetes patient needs	EMPOWER process steps
1	Measuring of vital values	Monitoring, collecting and documenting
2	Support for assessing relevance of values	Monitoring, collecting and documenting
3	Automatic transfer of vital values	Monitoring, collecting and documenting
4	Avoid mistakes when measuring vital values	Monitoring, collecting and documenting
5	Find location for measuring vital data	Monitoring, collecting and documenting
6	Self-control of diet	Monitoring, collecting and documenting
7	Self-control of personal physics/sport	Monitoring, collecting and documenting
8	Find diabetes information quickly and save time	Monitoring, collecting and documenting
9	Automatic transfer of bread units	Monitoring, collecting and documenting
10	Support activity program	Defining, deciding and modifying goals
11	Simple overview of documentation	Monitoring, collecting and documenting
12	Support of activity goals	Defining, deciding and modifying goals
13	Reminder for goals	Defining, deciding and modifying goals
14	Reminder for tasks	Defining, deciding and modifying goals
15	Planning of meals	Executing activities
16	Find diabetic friendly restaurant	Executing activities
17	Planning of sport activities	Executing activities
18	Compliance to sport activities/goals	Executing activities

19	More consultancy of experts	Sharing information and participation
20	Exchange information among diabetes patients (peers)	Sharing information and participation
21	Support by family	Sharing information and participation
22	Contact to diabetes selfhelp-group	Sharing information and participation
23	Find diabetes friendly vacation spots	Executing activities

Table 3 – List of needs in the EMPOWER process expressed by diabetes patients.

The following box describes how to interpret the graphics then: Information Box 1:

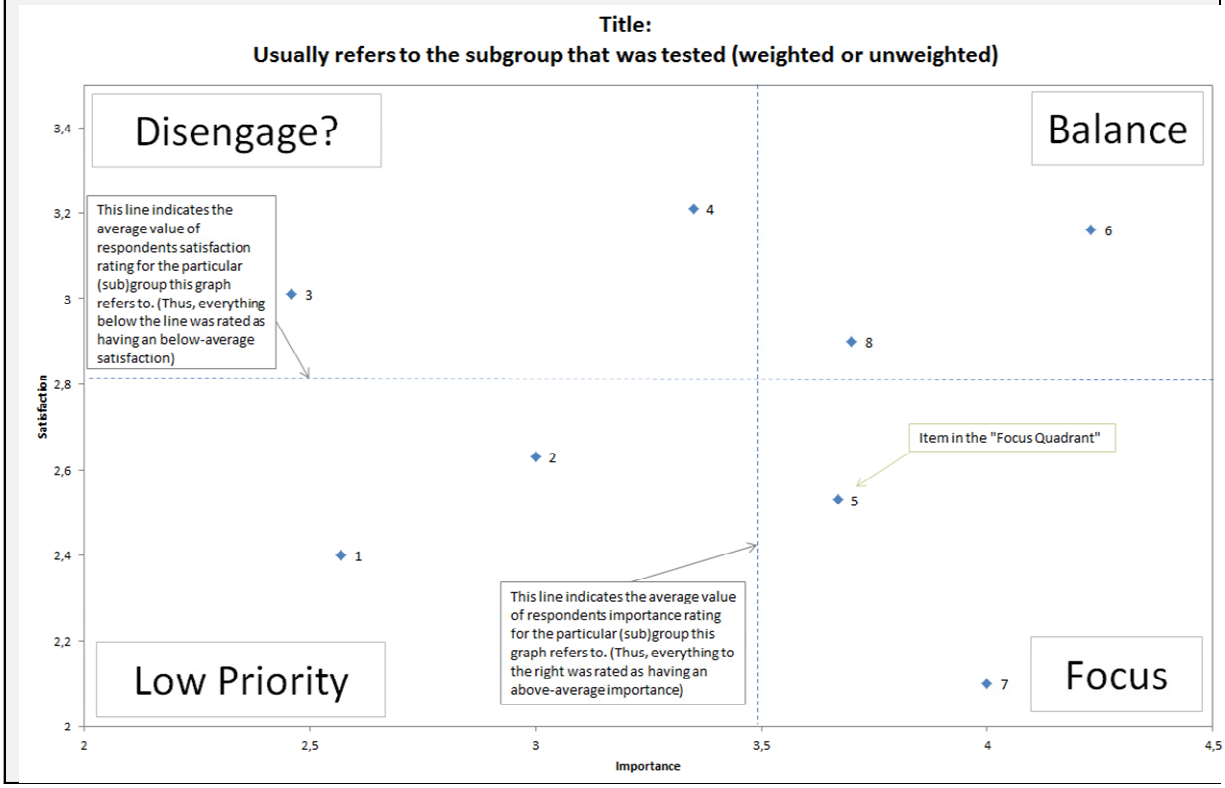
In general, each graph is divided by two dashed lines into four quadrants: The “Disengage(?) Quadrant”, the “Balance Quadrant”, the “Low Priority Quadrant” and the “Focus Quadrant”. Each dashed line represents the sample’s average for the specific dimension, i.e. importance and satisfaction. An intercept to the lower right indicates stronger needs within the sample. Needs situated on the diagonal (from lower left to upper right) represent needs that do not require action as they are either unimportant or well covered.

The “Disengage(?) Quadrant”: This quadrant includes items that respondents rated as above-average in terms of satisfaction and below-average in terms of importance. Thus, these might be activities that could be considered as over-satisfied and (RDI) resources might be used better.

The “Balance Quadrant”: This quadrant includes items that respondents rated as above-average in terms of satisfaction and above-average in terms of importance. These might be activities that are relatively balanced with respect to the importance and satisfaction.

The “Low Priority Quadrant”: This quadrant includes items that respondents rated as below-average in terms of satisfaction and at the same time below-average in terms of importance. These items might be activities that respondents are not satisfied with, but that are not regarded as overly important either. Therefore, one might think of improving them, but with low priority only.

The “Focus Quadrant”: This quadrant includes items that respondents rated as below-average in terms of satisfaction and above-average in terms of importance. These might signify opportunities for improvement.



Interpretation of gap analysis: Source: Geser, 2011. Handbook of methods (pp. 200-202), Salzburg Research and SMARD survey report 2012 (forthcoming; internal report of the EU project: http://www.smard-project.eu/).

5.2 Survey results on needs in the EMPOWER process

As mentioned in the introduction, the survey carried through in this task has been an exploratory survey with the minimal required sample of 50 participants. Therefore results should be interpreted with care. Identified patterns serve as first hints, which might need further investigation in future projects.

5.2.1 Prioritized needs of all study participants

The figure below shows the overall result for the gap-analysis without any differentiation of the sample as to their maturity levels. It shows that the issues of

- “find location for measuring blood sugar levels” (number 5; quadrant focus),
- “planning meals” (number 15, quadrant balance) and
- “exchange information” (Number 20; quadrant focus)

is of utmost importance for patients and needs special attention in interaction design.

On the other side there a two issues with both a remarkable low importance and satisfaction level:

- “measuring of vital values” (number 1; quadrant low priority) and
- “Avoid mistakes when measuring vital values” (number 4; quadrant low priority)

The low priority relates to the most important obstacle that many respondents in the survey do not see the immediate benefit of measuring and documenting diabetes related outcomes. This can be due to a low awareness level of why this is important, or, due to uncomfortable and non-satisfying methods and measuring practices. This result is independent of diabetes type, age and/or e-Skill levels. An important task in EMPOWER will be therefore to find suitable mechanisms and/or support material to raise the awareness and satisfaction level of measuring vital data.

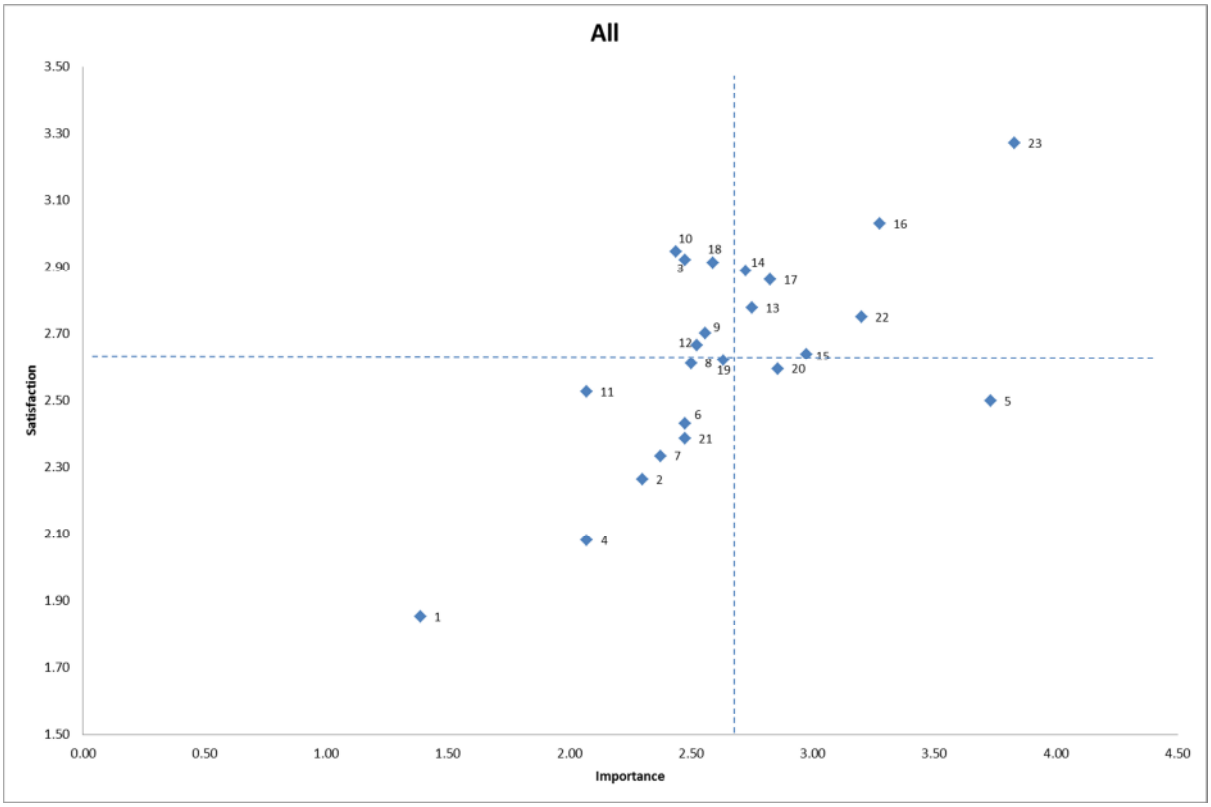


Figure 34 - Prioritization of user needs in IT enhanced diabetes self-management in total

Related to the main process steps in EMPOWER, the following results – concluded from figure 34 (if not indicated otherwise) - are interesting:

- Monitoring, collecting and documenting:

Patients are very interested in solutions that support their need for finding a location for measuring vital data (need nr. 5 focus quadrant). Type 2 patients expressed slightly more demand for these solutions than type 1 patients, especially, also for automatic transfer of vital data (need nr. 3; focus quadrant; figure 36). As will be seen later on, patients characterising themselves as supported learners are also more interested in solutions for the needs 6 “self-control of diet” and need 8 “find diabetes information quickly and save time (see figure 42) than others.

- Defining, deciding and modifying goals:

Patients are content with current solution providing them with information on the purpose and content of activity goals (e.g. examples how to do what), (need nr. 12; quadrant disengage), but would be interested in innovative solutions for reminder for goals (need nr. 13, quadrant balance) and for reminder of tasks (need 14, quadrant balance). EMPOWER could support the action plan with relevant and specific information material. Supporting the need for reminding is more relevant for supported and guided learners than for autonomous learners (see figure 42 and 43 versus figure 44).

- Executing activities:

Patients expressed overall concern and demand for focusing for innovative solutions support “meal planning” (need nr. 15). Finding a diabetes-friendly restaurant (need nr. 16), planning sport activities (need nr. 17) and finding a diabetes friendly vacation (need nr. 23, quadrant balance) seem to be also of interest although the participants seem to be satisfied with the current non-IT solutions (e.g. organized peer groups in disease management programs).

- Sharing information and participation:

Patients express demand for more exchange with other diabetes patients as peers (need nr. 20; quadrant focus) and for more information and exchange with any sort of “diabetes consultancy” (need nr.19 quadrant disengage/corner to quadrant focus). Patients seem to be interested in improving contact to self-help groups (Need nr.22, quadrant balance), but are satisfied with already existing offers, such as face-to-face peer groups. However, focus in EMPOWER can be laid on integration of social media and access to (online) self-help groups.

Differences can be detected, if we distinguish between user needs of patients with type 1 (figure 35) and type 2 diabetes (figure 36). Whereas the first want to find a better solution in finding a place for measuring their vital data (see Figure 35, number 5; right quadrant bottom line; figure 35), the others would like to improve their communication in an innovative way (number 20; right quadrant bottom line; figure 36). See the following two tables in comparison:

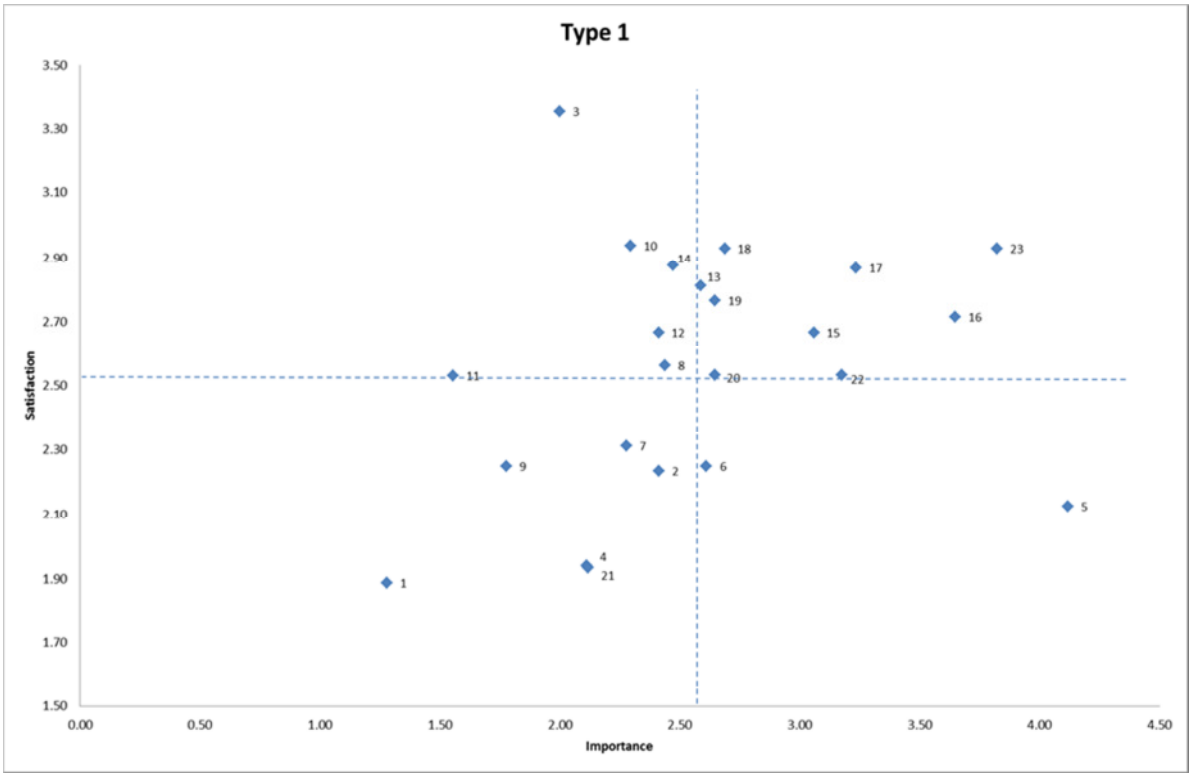


Figure 35 - Prioritization of user needs in IT enhanced diabetes self-management – patients type 1

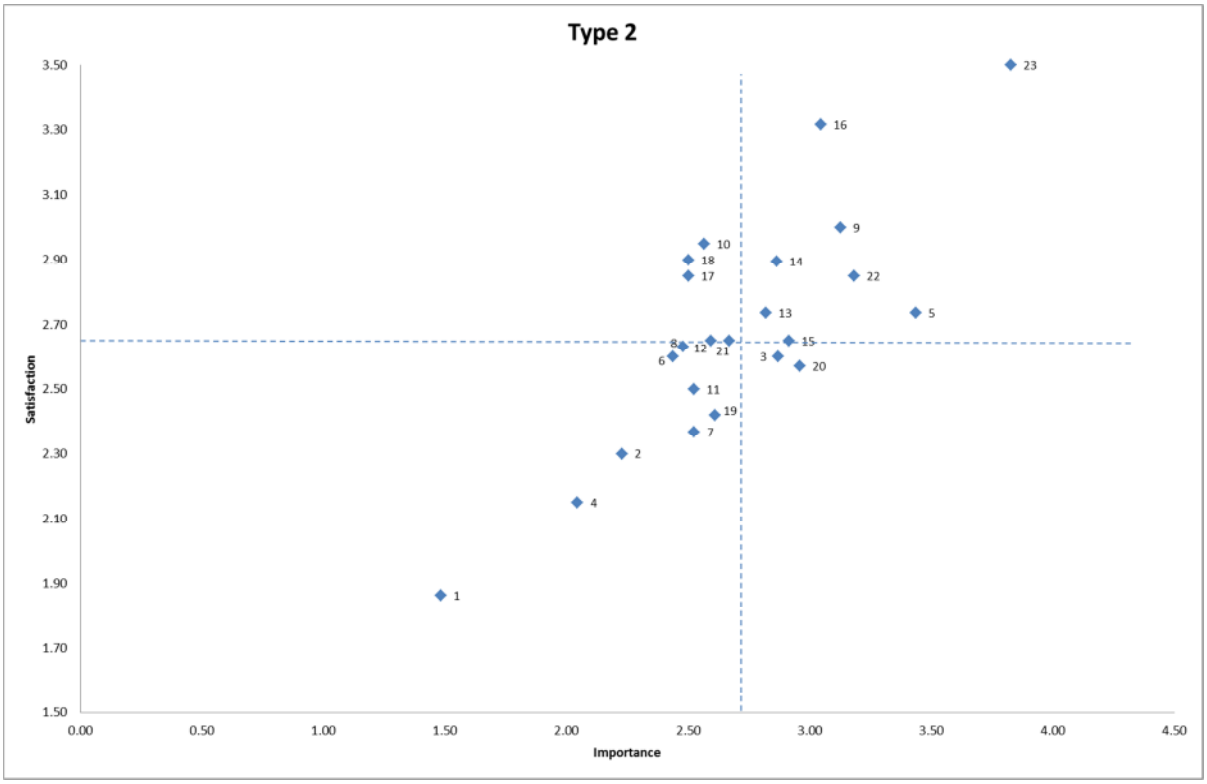


Figure 36 - Prioritization of user needs in IT enhanced diabetes self-management – patients type 2

5.2.2 Prioritized needs of users in relation to their EMPOWER maturity levels

In relation to the specific EMPOWER maturity level matrix the following most important needs can be summarized.

5.2.2.1 Access (via PC and smartphone)

As can be concluded from the analysis, the needs of patients having access to ICTS via online computers for documenting the EMPOWER process data do not differ a lot form those accessing via a smart-phone. Both would be interested in focusing on a solution to find a place for measuring their blood pressure and blood sugar (number 5 right hand, lower quadran, figure 37).

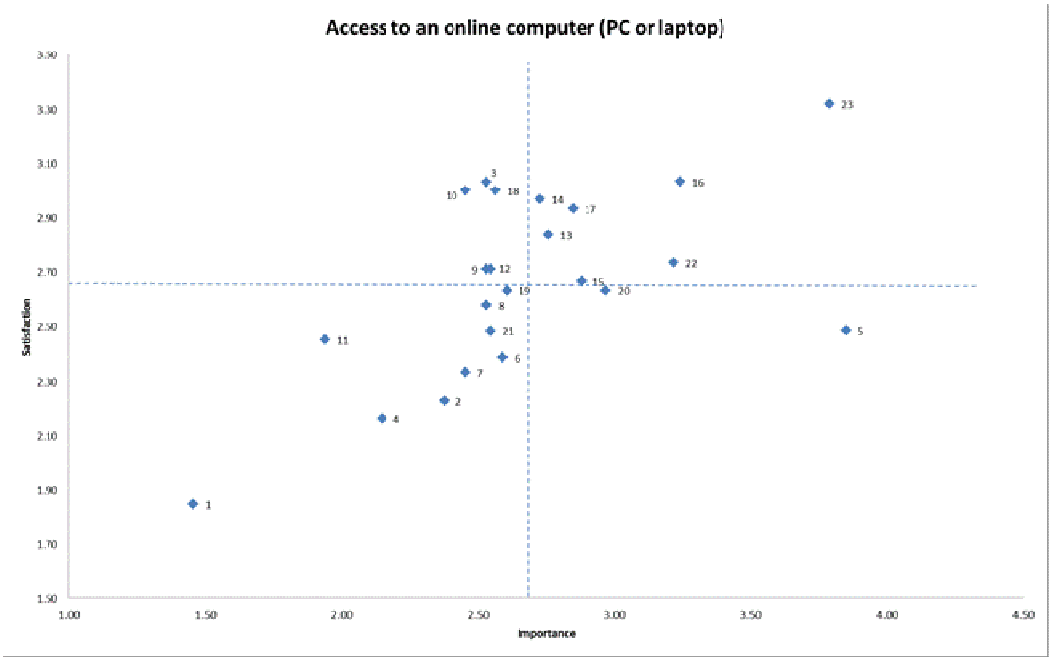


Figure 37 - Prioritized needs of patients having access to PCs

Whereas PC owners seem to favour solutions supporting their meal planning (Nr.15) and the information exchange with peers (other patients, Nr.20; see figure 37)), smartphone owners seem to be more interested in self-control the diet plans (Nr. 6; quadrant focus) and exchange information with consultants. The needs for peer-exchange might be satisfied using more social media tools already with a smart-phone (see figure 38).

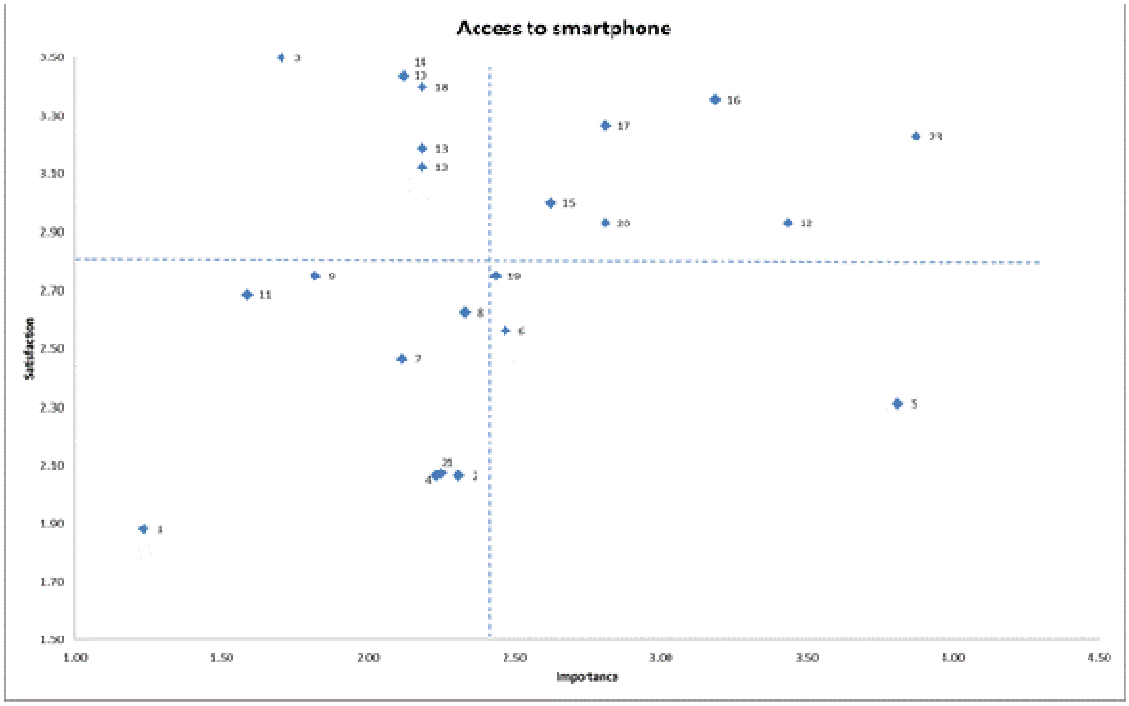


Figure 38 - Prioritized needs of patients having access to smartphones

Tablet PC owners are also interested in support for meal planning (Nr. 15, quadrant focus) and favour a quick and time-saving monitoring and documentation process (Nr.8, quadrant focus) (see figure 39).

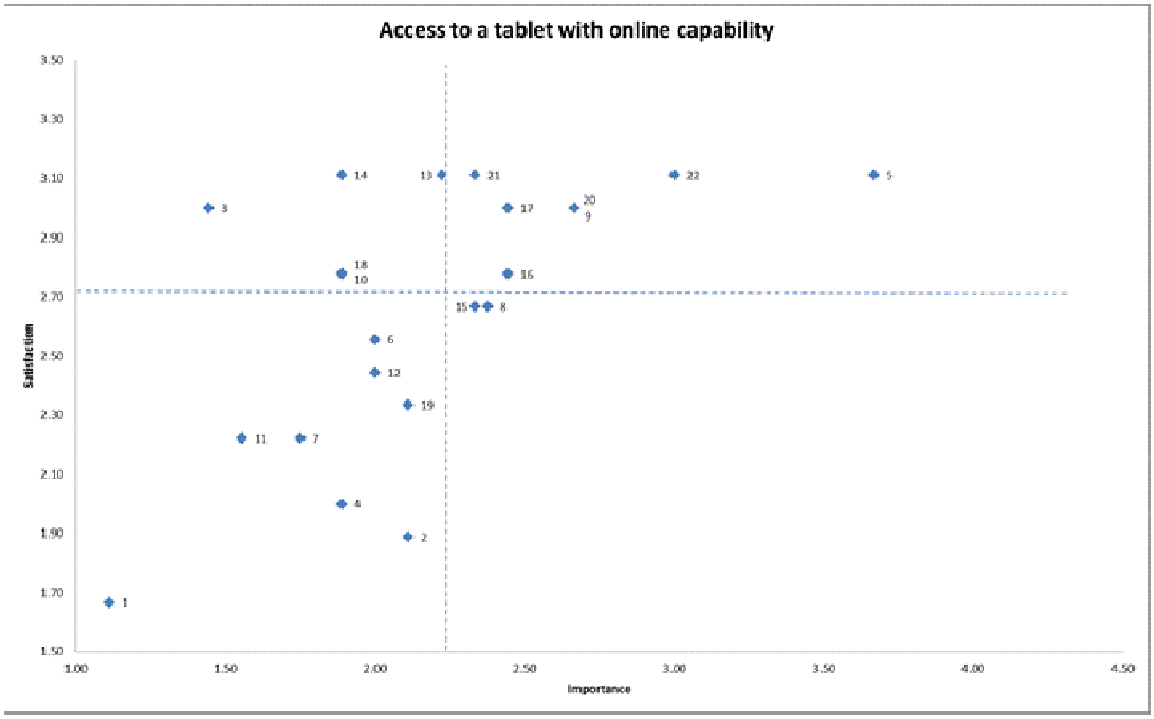


Figure 39 - Prioritized needs of patients having access to Tablet PCs

5.2.2.2 Competences: digital competences and e-skills

Patients with low e-skills only perceive a need with respect *to finding a location to for measuring blood sugar levels*. Patients with a medium level of e-skills do not perceive any particular needs at the time being (see figure 40).

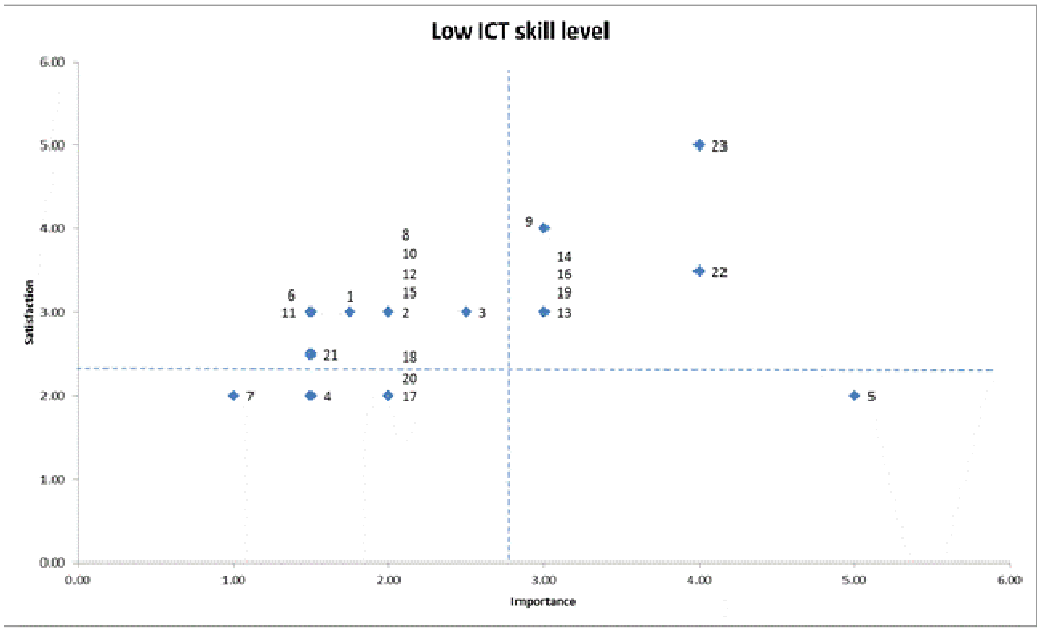


Figure 40 - Prioritized needs of patients with low e-skills level

Those patients with high levels of e-skills, in contrast, see a need for improving the ability to *find a location for measuring blood sugar levels, planning meals and for active family support* (see figure 41).

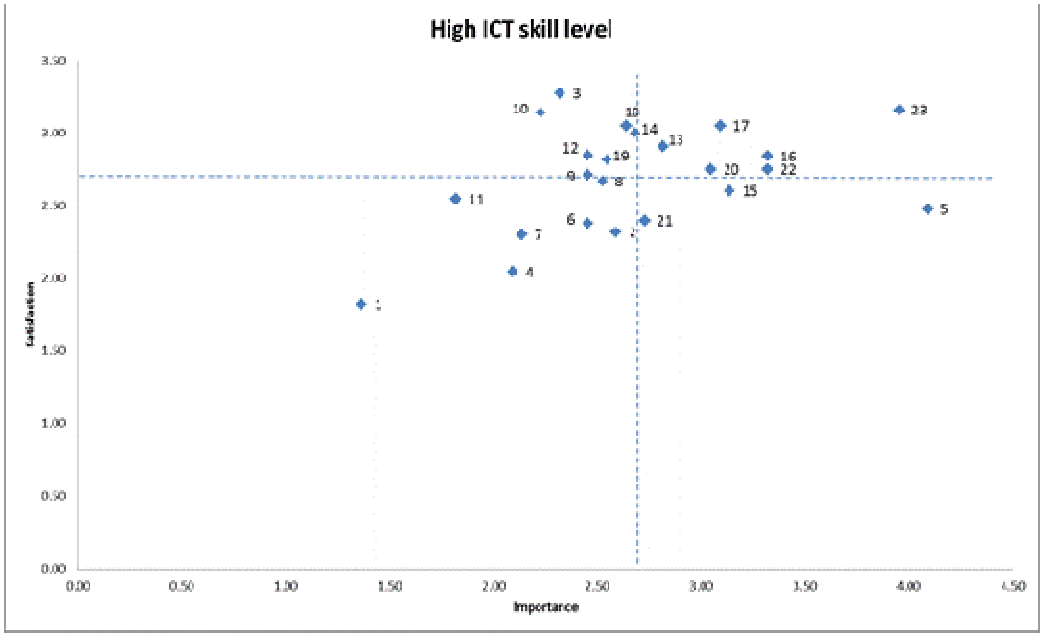


Figure 41 - Prioritized needs of patients with high e-skills level

5.2.2.3 Competences: diabetes management competences

Supported learners are the subgroup of diabetes patients with most expressed needs (14 needs) that include support in determining and adhering to goals, support for activities such as sport or diet, reminders for tasks as well as information exchange with experts and peers (see figure 42).

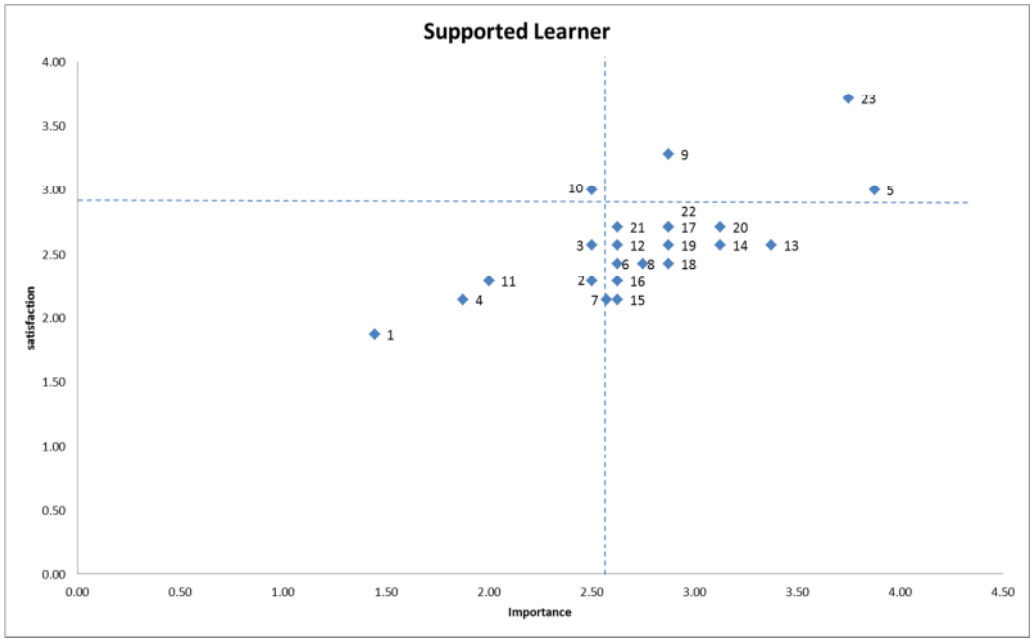


Figure 42 - Prioritized needs of supported learners

Guided learners voice fewer expressed needs (4) that for instance pertain to information exchange with other diabetes patients, expert consultation and reminders for set goals (see figure 43).

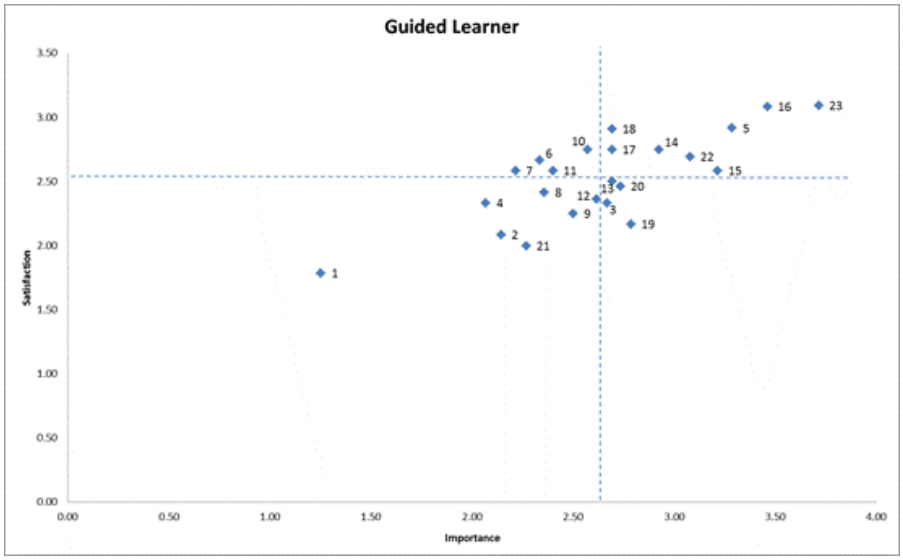


Figure 43 - Prioritized needs of guided learners

Independent learners have the least concerns and needs (2), which again relate to finding a location to for measuring blood sugar levels and to information exchange with other diabetes patients (see figure 44).

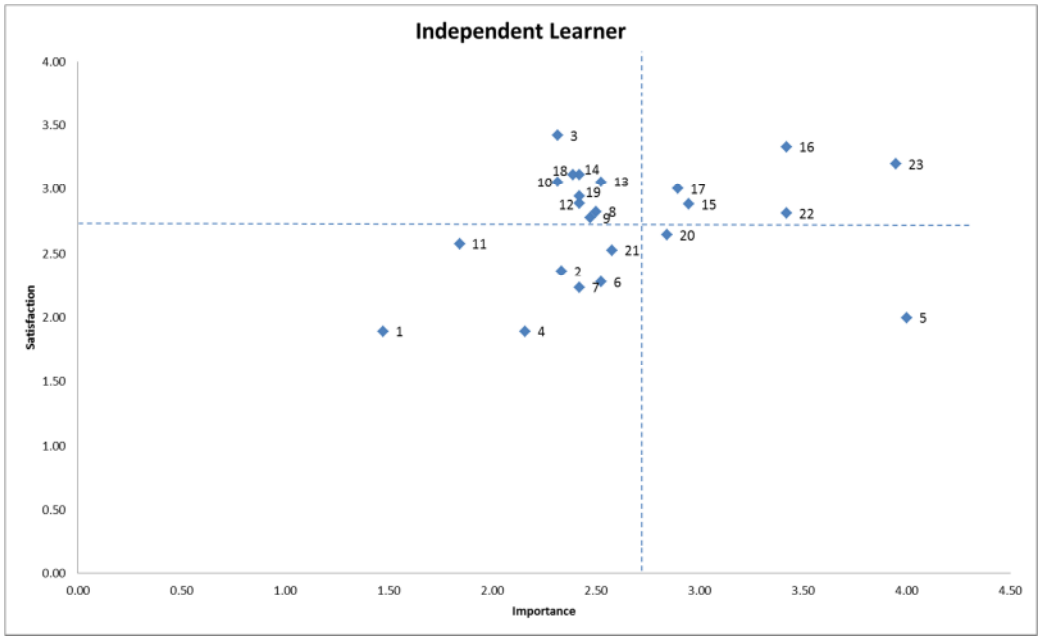


Figure 44 - Prioritized needs of independent learners

5.2.2.4 Motivation: self-care coping strategy

Active followers have only one need (i.e. finding a location to for measuring blood sugar levels; see figure 45).

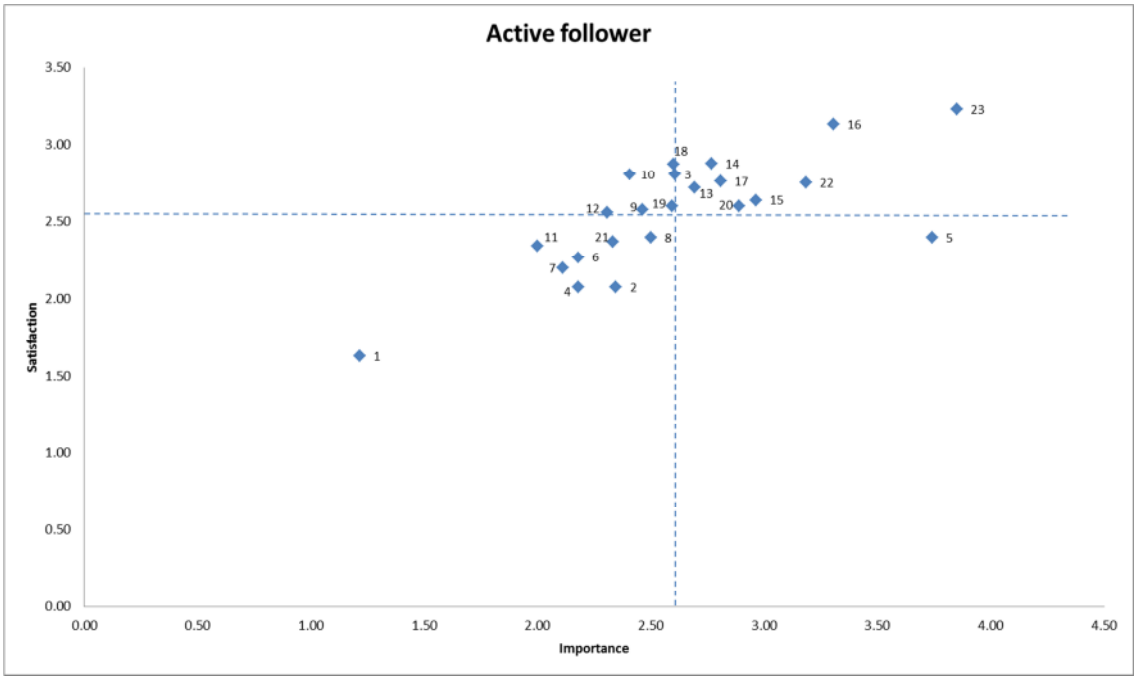


Figure 45 - Prioritized needs of active followers

In contrast, passive followers have multiple needs relating to for instance support for planning meals, information exchange with other diabetes patients and to peer support groups (see figure 46[18]).

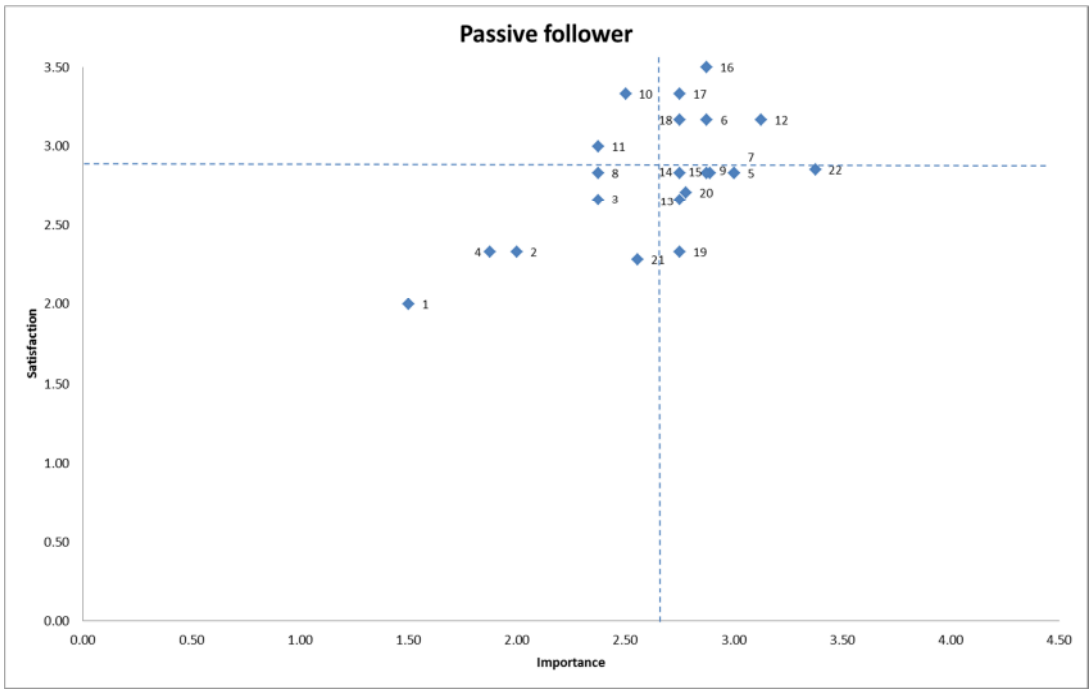


Figure 46 - Prioritized needs of passive followers

Relevance for EMPOWER

The survey carried out in this task has been an exploratory survey with the minimal required sample of 50 participants. Therefore results should be interpreted with care. Identified patterns serve as first hints, which might need further investigation in future studies. Summarising the needs for an innovative solution in relation to the four categories for the EMPOWER process steps (quadrant focus), we can conclude the following:

- Monitoring, collecting and documenting

Patients are very interested in solutions that support their need for finding a location for measuring vital data. Type 2 patients expressed slightly more demand for these solutions than type 1 patients, especially, also for automatic transfer of vital data. Patients characterising themselves as supported learners are also more interested in solutions for "self.control of diet" and "find diabetes information quickly and save time" than others.

In general, all patients – regardless of diabetes type, age and/or eSkills - expressed low satisfaction and low importance of measuring vital data at all. Therefore. EMPWOER needs to develop specific mechanisms or support material providing better understanding and awareness of the "measuring task" for the benefit in future health outcomes of a diabetes patient.

- Defining, deciding and modifying goals

Patients are content with current solution providing them with information on the purpose

[18] The data for "non-conformist" are not shown due to the low number orf respondents for this category.

and content of activity goals (e.g. examples how to do what), but would be interested in innovative solutions for reminder for goals and for reminder of tasks. EMPOWER could support the action plan with relevant and specific information material. Supporting the need for reminding is more relevant for supported and guided learners than for autonomous learners.

- Executing activities

Patients expressed overall concern and demand for focusing for innovative solutions support “meal planning”. Finding a diabetes-friendly restaurant and planning sport activities seem to be also of interest, although the participants seem to be satisfied with the current non-IT solutions (e.g. organized peer groups in disease management programs).

- Sharing information and participation

Patients express demand for more exchange with other diabetes patients as peers and for more information and exchange with any sort of “diabetes consultancy”. Thus focus in EMPOWER can be laid on integration of social media and access to self-help groups.

6 Design Approaches for maturity levels

6.1 Usability fundamentals

Rigidities and inconveniences in software applications are quite likely to cause negative attitudes towards ICT. Usually users start feeling stupid in usage scenarios in which they are not able to accomplish a certain goal by administering the user interface of a software. This is the point of friction for which usability research tries to find solutions for.

Basically usability is a quality attribute that assesses how easy user interfaces are to use (Nielsen, 1994). Usability is defined by five quality components:

- **Learnability**: Is it easy for users to accomplish basic tasks the first time they use a software?
- **Efficiency**: How quickly can users perform their tasks?
- **Memorability**: How easily can users reestablish proficiency when they use the software again after a period of not using it?
- **Errors**: How many errors do users make? How severe are these? Can users solve them easily?
- **Satisfaction**: How pleasant is it for users to use the UI?

Another important quality criteria is utility. Utility takes into account whether users can do what they want with a software. Both usability and utility combined make an application useful: It provides the features users need (utility) and these features are easy and pleasant to use (usability).

Nielsen took these fuzzy definitions and merged them into ten general principles for user interface design. These so called *Usability Heuristics* are regularly used by usability engineers to conduct heuristic evaluations in which they analyze whether a user interface follows or disregards Nielsen's Usability Heuristics. They are called heuristics because they are more in the nature of rules of thumb than specific usability guidelines:

1. Visibility of system status
2. Match between system and real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognise, diagnose, and recover from errors
10. Help and documentation

6.2 Playful Design

The idea of using game elements in non-game contexts to motivate users and to increase user activity and retention has incrementally found more and more advocates among the user experience design community. Practitioners and researchers refer to this topic by the use of a couple of parallel terms, such as "productivity games", "surveillance entertainment", "funware", playful design", "behavioral games", "game layer", or "applied gaming" (Deterding et al., 2011). However, "gamification" and lately "playful design" managed to institutionalize themselves as the common household term. Actually the mashup of different design disciplines has a rich tradition in the human-computer-interaction research field.

Gamified applications can be distinguished from real games by the characteristic that they use only a subset of design elements from games, whereas serious games have to fulfil all necessary and sufficient conditions for being experienced as a game. Furthermore, designers that intent to create a gamified application use elements of games for purposes other than entertainment, for example with a view to a user's behaviour modification. It is important to understand that gamification is an approach that is supposed to help people to get from A to B in their lives rather than making an application fun.

Especially adding game mechanics to software applications is a central method to assist people on reaching their goals. According to (Ferrera. 2012) and gamification.org [19] there exist several powerful game mechanics. Fundamental to the concept of gamification are actions and rewards. The simplest form of rewards is coins. Key question for game designers is what actions or milestones should be points awarding. Beside these mentioned game mechanics there are several others more: Achievements, Appointments, Countdown, etc.

Achievements. For example a user could be rewarded with a so-called batch (e.g. a gold-medal) if he has tracked his food consumption regularly during one week. Other achievements could be granted for entering ODL's or achieving long-term goals. Achievements mostly come together with **status**. If a patient collected a couple of batches the system levels him up, for example to the community rank of a „diabetes master". Patients with a high status can be proud about themselves and might appeal as role models to novices.

A pretty good example for the application of game mechanics to the diabetes context is the Bayer project named "Didget". Didget is a Nintendo DS game in which children are rewarded virtual coins for maintaining good testing habits: With these rewards for example they can access new characters, unlock mini-games or trade for new items within the game.

Figure 47 - Bayer Didget Screenshot[20]

[19] http://gamification.org/wiki/Game_Mechanics#Game_Mechanics
[20] http://www.bayerdidget.ca/

Relevance for EMPOWER

- Game mechanisms can help diabetes patients to learn, adapt and improve their disease skills and abilities to manager their lives even better.
- Several game mechanics can be applied to the diabetes domain to change the patients' behaviour (e.g. sports activities, food consumption etc.) for good.
- Goals to which the patient has to commit to, in combination with status levels, can assist the patient to stay motivated and to retain focus.
- Status levels like "Diabetes Expert" can enhance user profiles of the EMPOWER forum. Furthermore, achievements of the user like "weight goal accomplished" can also be integrated into the user's profile.
- Game mechanics strongly support the motivational part of the ACM model that we apply to EMPOWER.

6.3 Responsive Design

When we aim to create applications, devices and systems that are easy to use, understanding the context of use is essential. This is the use case at which responsive design reveals its power. Responsive design is a term that articulates how to adapt a layout of a web service for multiple screen resolutions and input devices. The technical perspective is quite simple and rather not a challenge at all: the system selects the corresponding style sheet depending on the user's device's screen width.

However, designing for multiple devices and contexts is a huge challenge in regard to interface design. Hence, the user interface becomes typically more complex as the number of contexts in which the system will be used increases. Therefore, the understanding of the user and his needs has to be extended by the understanding of the context in which a user interacts with an application. A designer needs to consider if the use cases differ among the different scenarios, such as usage via mobile phone on the move, usage via tablet computer on the balcony or usage via desktop computer at work. It is crucial to think about the priority a specific content should have in each of the use contexts.

EMPOWER users will be able to access the application via different types of devices such as smartphones, tablet PCs and desktop PCs. The interface of EMPOWER for a tablet device needs to be adapted to the finger/thumb as main input device. Basically, this relates to larger buttons and interactive elements in general. Touchable elements need to be not smaller than 9.2mm wide according to a study that examined one-handed thumb use on small touchscreen devices (Parhi, Karlson & Bederson, 2006). Use of high contrast colors is highly recommended because a user might be using the app outside in the sun. Interaction sequences should be reasonable in their length for the reason that the environment of the user might be distracting and frequently changing.

Relevance for EMPOWER

- It is important to mind the constraints of varying mobile devices that might have a different level of sophistication.
- Fundamental for a superior user experience is to obey mobile device guidelines like the iOS user experiences guidelines

6.4 Configuration and Personalization

People like to change things around to suit themselves. Cooper et al. (2007) refer to the terms *personalization* and *configuration* as two ways of enabling users to put their own personal stamps on a program.

Lightweight modifications of persistent objects, for example like color changes or different font faces, are described under the term *personalization*. Both beginners and perpetual intermediates use personalization functions in applications to make the appeal of the UI more human and pleasant for them. Furthermore, personal color codings can work as navigation aids for the user. Especially the elderly group among EMPOWER users are quite likely to need special color and font adjustments.

Think for example about people with color blindness: The colors red and green are often used in applications for the purpose of giving status feedback to the user whether user input had been processed or had been validated as false input by the system. People with red-green color blindness will expect severe disadvantages and suffer from negatively effected usability if color schemes are not available.

The second term Cooper et al. (2007) refer to is *Configuration*. It describes moving, adding or deleting persistent objects and therefore has a stronger impact than personalization on the actual usage of software applications. If users get more and more familiar with a system and transition from beginners to expert, they are likely to desire configuration possibilities that make functions, which they frequently use, easier to select.

Relevance for EMPOWER

- EMPOWER should offer the possibility for users to change colour schemes, font faces and font sizes.
- Menu structure and paths to specific tasks (favourites) should be configurable.
- The amount of hints about how to operate the application should correspond to user's maturity level.

6.5 Scaffolding

Scaffolding is a design approach that promotes autonomous learning by employing actions that encourage users to develop their own cognitive, affective and psychomotor (touch input) skills (Wigdor & Wixon, 2012).

Scaffolding is powerful in its ability to move users from novice to expert status. This is achieved by breaking down bigger challenges into small steps. Tasks need to be deconstructed into small self-evident steps. Fox example, a big challenge for a user at EMPOWER would be to understand how the whole application works. By contrast, achieving knowledge about how to use a specific function of the Action Plan properly facilitates the usage of the EMPOWER system. Scaffolding provides supportive learning paths that encourage active exploration. The latter is more likely to reduce user frustration caused by endless trial and error cycles.

In summary, scaffolding focuses on learning by doing and uses a step-by-step approach. Rather bad ways to guide users, who are having troubles with accomplishing a specific task,

references in the help sections or video tutorials. Help sections like *wikis* are a good possibility when it comes to providing users facts about diabetes.

Relevance for EMPOWER

- EMPOWER will use wizards to break down complex tasks into smaller steps, e.g. guide users at entering tasks for the action plan.
- An adaptive interface will appear lean and simple to the novice whereas it reveals power features to the expert user.
- Small hints will context-dependently tease unused features to the specific users.

6.6 Persuasive Design

ICT that focuses on self-management of chronic diseases will be effective only if users can utilize those applications properly. For this reason, applications such as EMPOWER must be developed to be persuasive.

User experience (UX) experts use persuasive design techniques to draw users' attention to certain kinds of information in an attempt to change what the users think or do, but without making use of coercion and deception. In non-commercial contexts, such as eHealth, the emphasis is on changing habits and motivation to improve an individual's wellbeing through different design principles. Many of the eHealth challenges of the western society can only be solved by motivating people to make long-lasting lifestyle changes. Therefore, persuasive technologies are an emerging buzzword in this domain.

Mukhtar et al. (2012) suggest a framework for persuasive healthcare that follows without any doubt a holistic approach. It consists of the elements context, behaviour modelling, social interaction, rule-based analysis, expert's intervention & recommendations and persuasion profile.

Context. Data regarding user activities and behaviour should be collected on a regular basis. In order to be able to learn about user behaviour and to reason on them, one needs to know additional information like the users surrounding environment, vital signs, time etc.

Behaviour Modelling. Personalized recommendations and persuasive strategies for behaviour change demand higher knowledge about a user. Such a model can be built using user's preferences, health profile and their social profile.

Social Interaction. Interactions of a person with other persons play a key role in the health self-management context. The first reason for this is that social interactions allow a person to learn from experiences of others. Furthermore social norms and people close to a person significantly determine and control a person's behaviour.

Rule-Based Analysis. Human-like selection of proper information to persuade a patient can be accomplished by rule-based inferencing. Various clinical guidelines or other domain knowledge is needed to generate persuasive strategies.

Expert's Intervention and Recommendations. Expert's input is mandatory to keep the knowledge base maintained and verified. Mukhtar et al. provided clinical expert with an interface for adding, updating and deleting rules.

Persuasion Profile. Depending on individual factors such as user preferences, behaviour model, social profile and target behaviour the authors form a unique persuasion profile. Thus, each patient can be persuaded differently and therefore results are quite likely to be better than by applying a one-fits-all-approach.

For instance the car manufacturer Ford developed a quite sophisticated car dashboard for the latest model of the Fusion Hybrid: they integrated something akin to a Tamagotchin into the car, which is supposed to promote economic driving. Ford displays a plant that grows if a user drives economically and withers when one doesn't. Because nobody likes dead plants the appearance of the visualizations persuades the driver to do anything he can to grow a healthy, green plant.

Figure 48 - Ford Fusion Hybprid Dashboard[21]

All together form a persuasion strategy that is used for matching target behaviours with solutions for achieving those.

Relevance for EMPOWER

- Different approaches like reminders, quotes from experts, social support or social pressure will be applied to EMPOWER to change patient's attitudes or behaviours.
- Assessment of user's interactions with the system (logging) will be crucial to evaluate persuasion strategies.

EMPOWER aims to apply some or all of the following persuasion strategies to EMPOWER (Brox et al., 2011):

- Using visual metaphors instead of abstract, unemotional medial data to display status and progress to the user (e.g. a blooming flower)
- Recording and displaying users' past behaviours
- Using positive reinforcements to improve behaviours (this means no punishments!)
- Designing an aesthetic and friendly user interface (this also means usable)

[21] http://vhirsch.com/blog/wp-content/uploads/2010/03/Ford-Fusion-Hybrid-dashboard1.jpg

- Providing information at opportune moments
- Using social influence (e.g. social facilitation)

6.7 Reports and Trends

A good way to provide users with an overview of relevant and available information within a system is a **dashboard**. A dashboard is actually a metaphor that derived from automobile and aircraft design. For example, in a business corporation a dashboard is used to provide the top management with a quick overview of an organization's "health" (Pappas & Whitman, 2011). Dashboards can be evaluated as successful if they deliver right data, in a reliable manner and make it easily accessible and perceivable to users. In that case chances are high that users can distil information into actionable intelligence and make fact-based decisions.

Customizable dashboards allow organizing and presenting information in an easy to read manner to users and to present data not in its raw form, but as understandable information that provides a means for the patient to undertake action. The challenge in EMPOWER will be to explore differences in needs, goals and expectations among users' different levels of maturity in regard to how they deal with their disease and technology in general.

The central goal of using visualization techniques is to provide an intuitive graphical representation of trends of specific biometrical parameters that are used as indication of the patient's health state and the efficiency of the underlying diabetes therapy. Thereby the self-awareness of the patient should be fostered so that she/he is able to develop a systematic understanding of how nutrition, medication, physical activity and other diabetes relevant factors influence her or his overall state of health and at the same time that she or he receives a graphical feedback on how well she/he is conforming to the goals and overall therapy. By that and the continuous monitoring and visualization of these data, the patient shall be fully enabled and adequately supported in self-managing diabetes and in realizing the required behavioural changes.

The diagrams utilized in EMPOWER are of various kinds and may reach from very simple more symbol-style illustrations like for example smileys, "5-star rating" scales to more advanced graph-style diagrams like line- or area-plots and may even include sophisticated statistical graphs like box-plots and mean-standard-deviation-charts. The right kind of diagram that is used to illustrate data is chosen on basis of three determinants:

- The **data to be illustrated** itself – meaning the range of values, scale basis, number of data series, etc. For example a visualisation of the mood that could be represented on a scale of five values requires just a basic rating scale. A visualisation of the glucose values compared to the insulin injections within the last month could best be done in a detailed line-plot.
- The **users maturity level** – for example to a user with low digital competence only simple (1-2 included data series), static (no interactivity) graphs should be displayed. In contrast a user with high digital competence may expect a graph to be interactive and offer functionalities to include/exclude additional data series or to adjust the range of the x-axes during runtime. Furthermore a user could be familiar with basic statistics and so be able to understand also more sophisticated diagrams, scales and key-values and vice versa.
- The **terminal/end-device** – used to access and display the visualized data. So a smartphone has a quite limited size of display compared to a desktop computer with a big screen attached. Naturally it would not make any sense for example to simply

print a wide-range plot of various series of data on a smartphone whereas on a desktop computer's screen it would suite quite well.

Diagrams – mostly independent of their actual type – will be integrated in the GUI of EMPOWER in three different ways:

- In **"thumbnail-style"** – small or medium size; always integrated in surround GUI elements that define the context; no title or additional features like legend, interactivity offered; shall provide the user with a rough idea of the overall trend (like value is going up/down or remaining constant over time) and indicate that a more detailed visualization is available.
- In **"embedded-style"** – medium size; integrated in surrounding GUI or aside of other embedded-style diagrams; title and limited additional features like in-figure legend offered; shall provide the user a general glance at the value(s) and its current trends or help in comparing those to other trends of values
- In **"full-page-style"** – full page/screen size; no surrounding GUI elements beside those required to interactively adjust the diagram and illustrated data to fully focus the users attention to the diagram; title and various additional features of adjustment of the display style, data range and inclusion/exclusion of additional series are offered; shall provide the user a detailed view of trends and additional data that are relevant to visualise a certain issue/correlation.

An illustration of some of these concepts is provided in section 7.

Relevance for EMPOWER

- EMPOWER should use collections of multiple visual components, such as charts, KPI's etc.
- EMPOWER should use established visualization frameworks like Google Charts or InfoVis
- A dashboard can communicate current health state, personal goals and necessary actions appropriately to users
- EMPOWER should aim an uncluttered interface to quickly guide patients and medical experts to the answers they seek

6.8 Designing Technologies for Maturity Levels

Technologies designed for use at home pose a very complex design challenge: designing technologies that fit into the practical aspects of everyday life. Therefore, developers of applications in the eHealth domain have the general requirement to take account of the huge complexity and diversity of lived experiences at home (Fitzpatrick, 2011).

People suffering from diabetes can be described as very heterogeneous. On the one end is an adolescent suffering from diabetes type 1 and on the other end is a 60+ senior with diabetes type 2. But both are willing to use ICT to maintain quality of life. For this reason, we need to find design approaches and patterns that are appropriate to provide different user groups with adapted user experiences that feel natural to them.

Depending on the skills and preferences of a patient EMPOWER will provide different approaches for collecting and using services for self-management. EMPOWER can be adapted to the patients' needs, self-management competences and preferences by offering multiple services on different maturity levels.

In conclusion, all EMPOWER services will be designed to support a specific level of maturity better than the other. Furthermore, EMPOWER will follow a set of different design patterns and guidelines for each maturity level:

High-level design guidelines
for different EMPOWER maturity levels

		Novice level	Advanced level	Expert level
Access	Media type	Support at least tablet PCs and mobiles	Additionally support desktop devices	Additionally support smartphones
	Social media participation	Do not promote/offer social media features	Offer social media features	Strongly integrate social media features
	Information search	Offer printable views/stylesheets Offer printable and downloadable brochures	Offer diabetes related information online Support platform search	Offer advanced diabetes related information online Integrate social media content into search results Promote social media for information exchange
Competences	Digital competences	Stick to standard interaction patterns and use UI elements in a standard way, Strongly follow usability heuristics Offer SMS and eMails for reminders	Rather stick to standard interaction patterns and rather use UI elements in a standard way, Follow usability heuristics	Consider developing new interaction patterns if appropriate, Consider usability heuristics Offer additional features or links for more complex tasks Offer semantic search
	Diabetes self-management competences	Provide (peer) guided learning paths and material	Provide adaptive and configurable learning paths in a guided manner	Provide adaptive and configurable learning material Provide sophisticated features that enable

				disease analytics (e.g. graphs)
Motivation	Self-care coping strategy	Strong usage of persuasive design techniques to activate any coping strategy	Medium usage of persuasive design techniques to support any coping strategy	Support patient specific coping strategies individually
	Feedback and hints from EMPOWER	High level of context sensitive help High frequency of helpful system feedback Assume few diabetes and self-management knowledge	Medium level of context sensitive help Medium frequency of helpful system feedback Assume basic to intermediate diabetes and self-management knowledge	No or low-level of context sensitive help Low frequency of helpful system feedback Assume expert domain knowledge
	Mindfulness regarding habits	Enforce and facilitate disease and self-management awareness	Enforce and facilitate disease and self-management awareness occasionally	No support for awareness is needed
Recommended Level of Usage of Design Approaches	Playful Design	High	Medium	Low
	Responsive Design	Medium	Medium	High
	Scaffolding	High	Medium	Low
	Persuasive Design	High	Medium	Low
	Configuration/Personalization	Low	Medium	High
Source: Salzburg Research Team (ck, mp)				

Table 4 - Interaction design guidelines for EMPOWER maturity levels

7 Examples for maturity levels in EMPOWER

Based on the findings in the previous chapters this section presents some considerations how the concept of maturity levels could be integrated in the EMPOWER prototype.

The desktop research, the survey and the analysis in the previous chapters have shown that the support of maturity levels can be seen on multiple stages. In particular, the suggested concept of maturity levels can influence the design and architecture of EMPOWER in several ways:

(1) Considering maturity levels can be an **integrated part of the workflow model** (in particular of the Self-Management Pathways) – Section 0 exposes that motivation should be an integrated part of an effective self-management and has to support and facilitate the process of diabetes self-management and care from the beginning. Users on a novice level may need more information, hints and explanations about diabetes and fostering self-management and in EMPOWER the workflow of planning goals and actions, of checking completed/not completed actions and of results should consider that accordingly. In contrast, it can be assumed that a user on an expert level already has learned a lot about diabetes and how to cope with the diseae and he will not need extensive hints or explanations. On contrary, it can be assumed that he would prefer a quick and efficient usage of EMPOWER services.

(2) Maturity levels can be supported by offering **tools** needed in a specific context – one example are diaries such as a food diary allowing a diabetes patient to become (more) aware about "unhealthy habits" and supporting in this way an user on a novice level for becoming mindful regarding habits, Another example are wizards allowing to break down complex tasks into smaller steps. By guiding users step by step e.g. through the process of specifying goals or actions for the Action Plan wizards foster the self-management cself-management competences of the user

(3) Configuring parameters for **user settings** will also allow users to adjust the appropriate level for him/her – one example are graphs and trends. One the one hand they can be pre-configured visualisations of significant vital signs or other ODL results ease to understand for users on a novice level. On the other hand users on an advanced or an expert level may be interested on a more detailed or comprehensive analysis of their recorded data. In these cases they want to configure their own individual reports.

(4) Based on the user settings and in context to the workflow the **Graphical User Interface** (GUI) can be adapted by using appropriate interaction design patterns – some examples are presented as mockups in the following sections. These mockups comprise examples for both for the low end (the novice level) as well as for the high end (the expert level) of maturity level categories.

7.1 Action Plan

Changing behaviour patterns and setting up new habits according to diabetes recommendations need discipline and should become a regular part of a person's daily life. The Action Plan is the central tool in EMPOWER for supporting these changes and should be used at least as long as patients are not yet habituated.

As stated in Deliverable D2.1.1 "Strategies for Empowering Patients for Web-based Self-management" patients want to make sense out of what they are doing. In the context of the Action Plan this is important when they are defining their goals and when they are specifying their activities. The survey also reveals that there is still a gap because patients don't see a benefit for their diabetes care in the monitoring of vital signs. Supporting awareness of individual treatment goals EMPOWER relates specified self-management goals with the recommendations and hence, the treatment goals behind explaining why a goal is relevant. In the next step, activities are related to self-management goals indicating the patient the

purpose of an activity. Making an action meaningful to patients they might need additional information. In particular, novice users might need more information and explanations than advanced or expert patients. EMPOWER supports this requirement by describing the purposes of recommendations and goals and links to more detailed descriptions.

7.1.1 Specify goals

The EMPOWER Action Plan starts with the specification of long-term self-management goals. Most of the goals to be set will be based on the physician's recommendations and the previously defined treatment goals. Referring a self-management goal to the physician's recommendations and to treatment-goals facilitates the patient's awareness why a goal is important.

At the beginning patients should think about goals they can easily start with. Sometimes it would help to break a goal in smaller sub-goals with a high likelihood to be achieved. Hints will help novice users or users who seldom specify goals through the goal setting procedure in EMPOWER.

7.1.2 Specify activities

Based on the self-management goals the patient should decide what he wants to do this week. These activities should be both realistic and behaviour-specific. If it is not possible for the patient to satisfy a goal he should look for alternatives to meet at least the goal partly. Planning an activity should be as concrete as possible (what to do, when, how much, how often) and if applicable an sctivity should be related to a goal. Reminders may remind people of an appointment (e.g. a consultation with their general practitioner) or can help them not to forget performing an activity that foster a new behaviour.. In this way reminders help to retain newly learned behavioral patterns. Figure 49 illustrates how a user on the novice level could be supported by a wizard when he specifies actions. The wizard guides the user step by step and supports him to specify an action as concrete as possible. Hints at each step give additional information and conducts the user to specify realistic and behaviour-specific actions. In this context a wizard can be seen as a tool supporting guided learning.

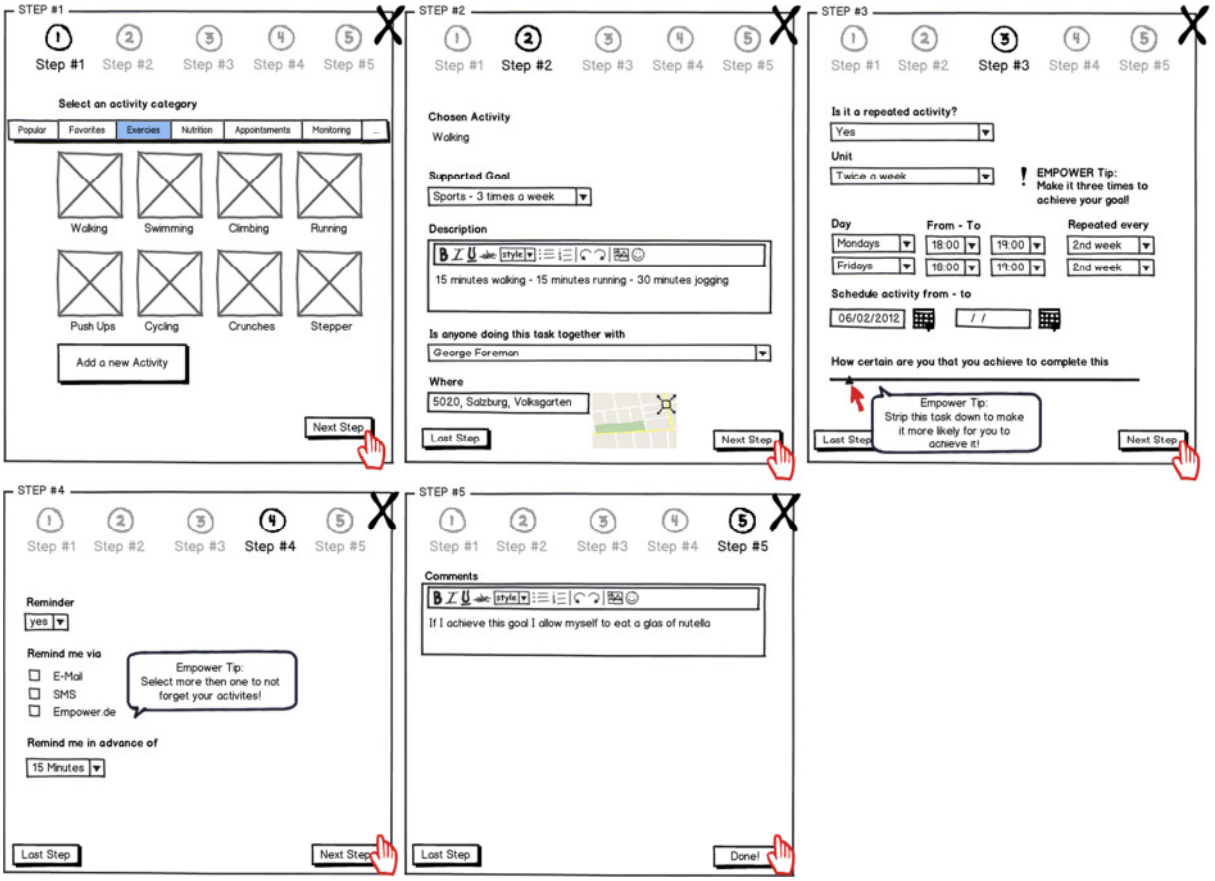


Figure 49 – Specifying actions supported by a wizard

Once the patient have specified an activity for the next week, he should ask himself on a scale of 0 (totally unsure) and 10 (totally certain) how certain he is to complete this activity. If the answer is ≥ 7 this is probably a realistic plan. If the answer is below 7 the patient should look again to just specified activity and ask himself why he is not certain.

Users on an advanced or on an expert level may prefer a quicker and more compacted way for inserting activities without additional hints as presented in Figure 50.

.

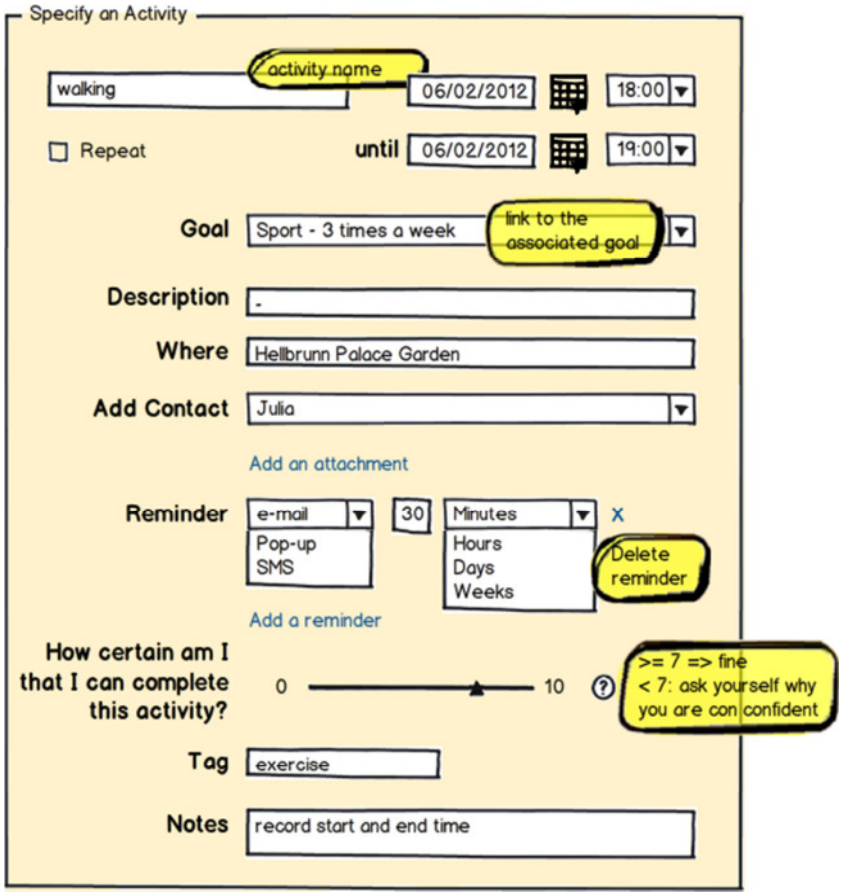


Figure 50 - specifying actions on a compacted basis

As soon as all activities for the upcoming week are specified, the patient can view all activities of the week on a calendar basis. Basically, the activities are associated to a goal indicating the patient why an activity is important. The patient can also print the weekly overview of the Action Plan e.g. in order to post it where he can see it every day.

7.1.3 Weekly Feedback

Checking activities whether they are done and completed gives a patient guidance how realistic the planning of the activities was and to which degree they satisfied the goals behind. This is useful for a better understanding what is realistic and possibly how activities and goals should be adapted.

Depending on the type of ODL results can be inserted automatically or manually, as soon as the ODL results are available or as part of the weekly review and depending on the type of device. User on the novice level may use their PC or tablet PC for recording ODL results. User on a higher level may use their smartphone recording ODL results independent of the location or they may use a glucose monitor with an interface for exporting the vital data to EMPOWER electronically. If ODL results are still missing EMPOWER will ask for them as part of the weekly review. If meaningful, diaries (e.g. regarding food, mood, symptoms or sleep) can also be a part of the weekly review.

Figure 51 presents an example for a Weekly Feedback on an expert level. In thjs example it is assumed that the user is familiar with Weekly Feedbacks. He already knows to what he should pay attention and hence, he needs less or no additional hints. He is also able to

configure reports and trends based on his needs and requirements autonomously. The figure below is an example for a user with high diabetes self-management competences (independent learner) and on a high level of self-coping strategies (active follower).

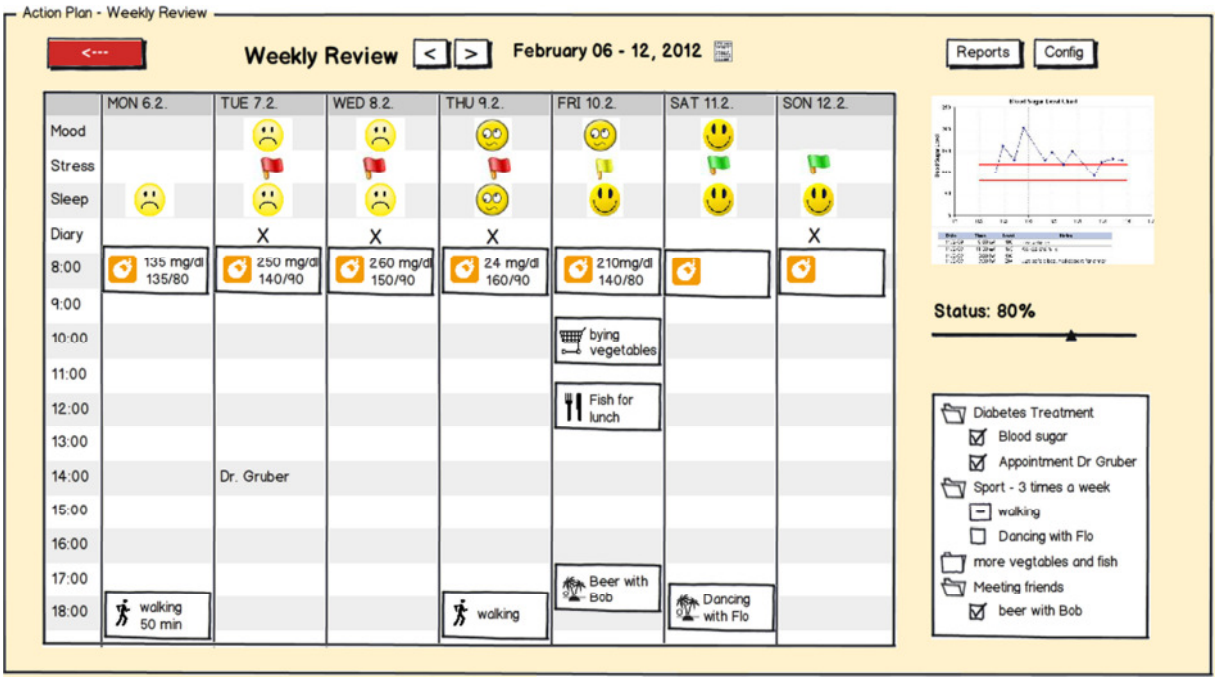


Figure 51 - Weekly feedback

For a user on the novice level the Weekly Feedback as presented in Figure 51 might be too overhelming. He would need more guidance and hints for this process step and a wizard can guide him in the following way step by step:

(1) Checking whether results for all actions of the past week are available and if applicable asking the user for inserting still missing ODL results
(2) Giving the user feedback about collected ODL results and how successful he achieved his self-management goals. For this purpose batches, graphs and trends can be used (see also section 7.3)
(3) Based on the feedback and if applicable the user can update his goals
(4) The user will plan his actions for the next week

7.2 Observations of Daily Living (ODLs)

Observations of Daily Living (ODLs) are “patterns and realities of daily life” and they are cues that people attend to in the course of their everyday life, that inform them about their health. EMPOWER offers ODL services that help diabetes patients tracking aspects relevant for diabetes such as monitoring and recording glucose values, vital signs, eating behaviour or physical activity. Two examples for ODLs are described in the following – the food diary as an example for a tool that can be used by a user on the novice level and an exercise ODL as an example for the expert level.

7.2.1 Food diary

Recording food behaviour and being aware of a good distribution of the nutritional content of a meal is one of the essential tasks for many persons with diabetes in particular for those

who are not (sufficiently) aware of their eating behaviour and those people who are just got a diabetes diagnosis for the first time.

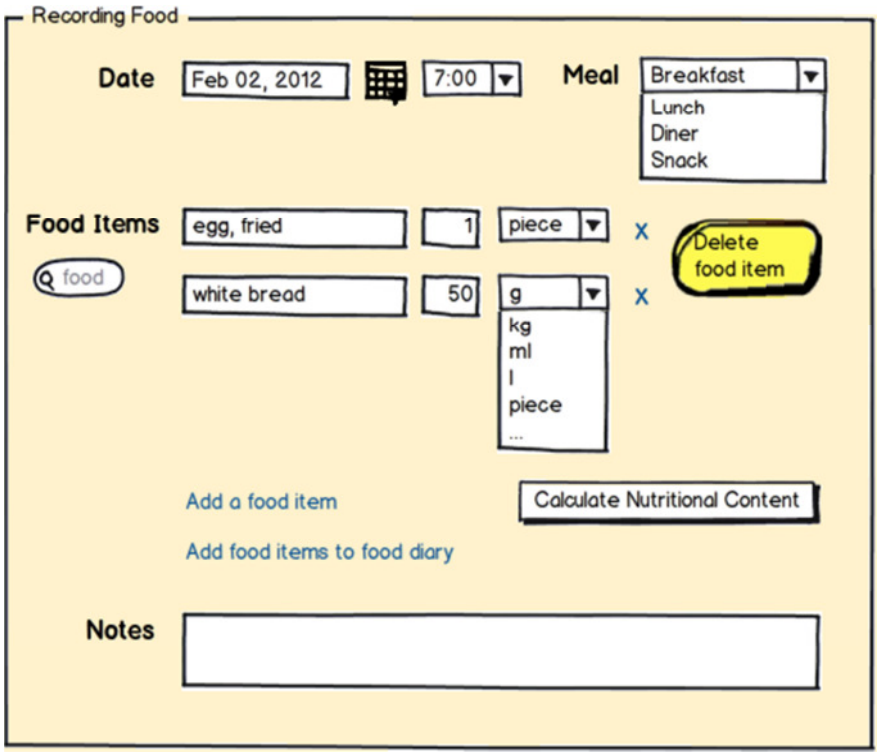


Figure 52 – Recording food

Figure 52 presents how food items for a meal (e.g. for the breakfast) can be recorded. A food diary may help a person becoming aware about what he is eating. With the help of a diary a person records and analyses his eating behaviour and habits and may identify unhealthy eating patterns. EMPOWER can give hints whether a meal is diabetes-compliant or not (see Figure 53). A person can use a food diary for different purposes. He may use a food diary for a dedicated time period, e.g. for a week, recording everything he is eating and drinking, Based on that the person will be able to analyse his eating behaviour and can specify behaviour-specific goals for changing eating habits. Such a food diary can be useful right after diabetes was diagnoses when a person should identify unhealthy eating behaviour. Again, additional hints may guide a novice user through the food acquisition process and feedback about a diabetes compliant distribution of food items increases the patient's awareness about the "right" food.

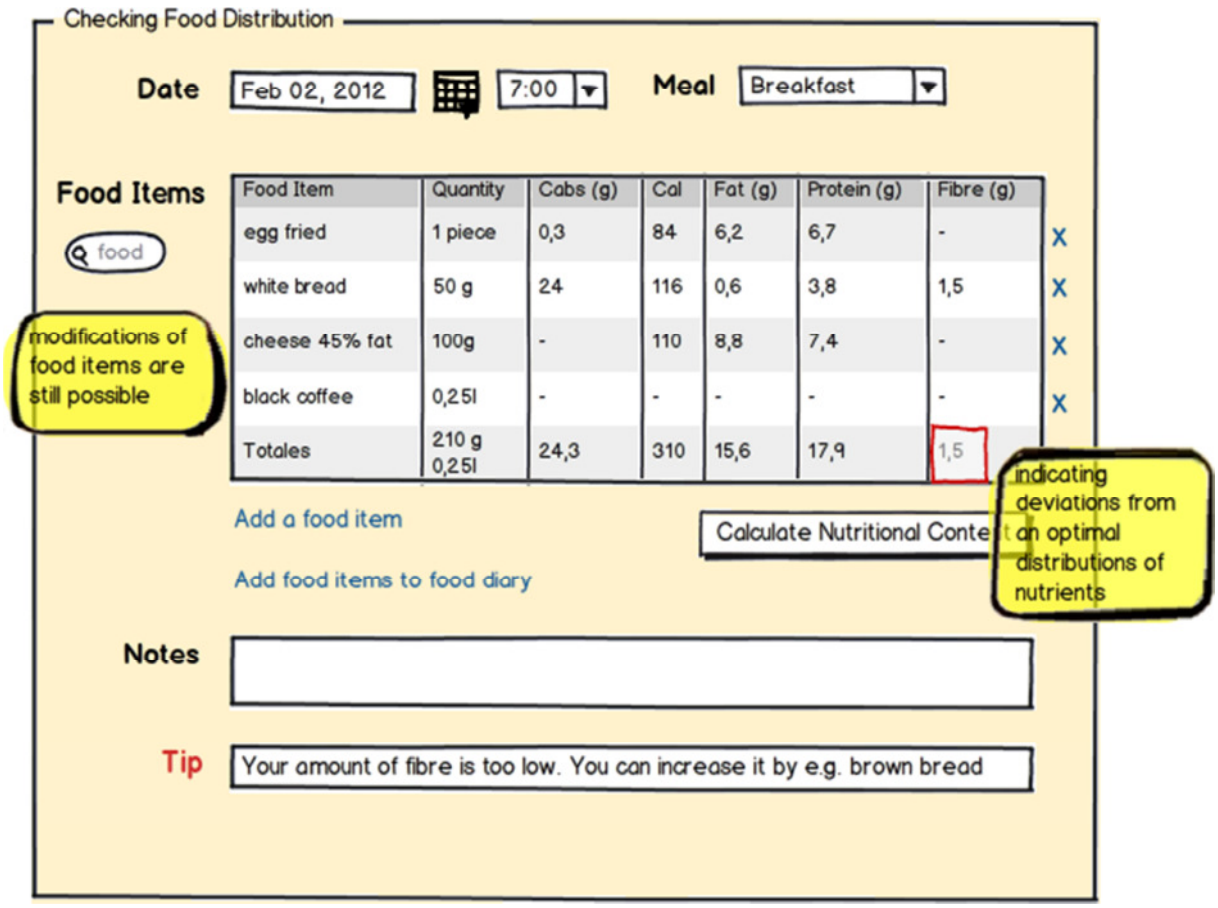


Figure 53 – Checking diabetes-compliant food distribution

A food diary can also be useful for checking e.g. after 2 years whether a person's eating behaviour is still in line with eating recommendations for diabetes or because the diabetes medication has changed (e.g. a higher dosage or another drug).

7.2.2 Record exercises

Mild to moderate physical activities on a regular basis can have positive consequences for diabetes patients. It is not only essential for losing weight, it can also decrease the need for insulin, can lower blood glucose levels both during and after exercise and reduces cardiovascular risk factors (Lorig et al, 2006).

Smartphones are predestinated for recording exercises such as biking, hiking or walking at the point of need. Figure 54 presents an example for recording the results of an exercise on a smartphone.

Figure 54 – Record exercises on a smartphone

7.3 Graphs, Trends and Feedback based on ODL results

The succeeding figures demonstrate the implementation of the concepts and strategies described in the previous chapters. These mockups are not meant to represent a complete sketch of the overall GUI but to highlight in which ways and for what purposes diagrams may be integrated in the overall GUI.

In Figure 55 the integration of diagrams in thumbnail-style is shown. In our example we assume that the glucose values of a week are given in textual form at prominent place in the center of the GUI. As additional information and general trend indication, a line plot is shown in thumbnail-style next to it. Moreover, as illustrated a smiley in thumbnail-style is used to visualize the compliance of the user to the current therapeutic and documentation task.

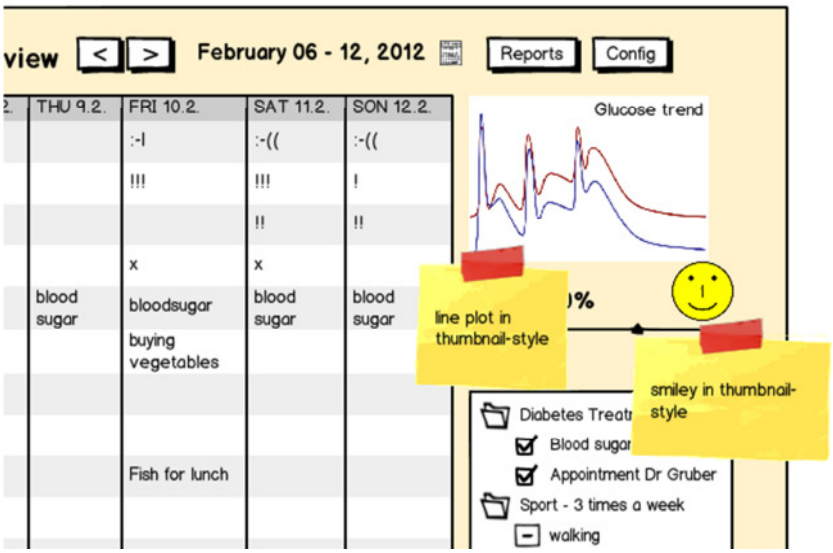


Figure 55 – Partial GUI with diagrams in thumbnail-style

In Figure 56 a small list of four predefined sets of data that could be visualized is shown. It is meant for novice users that may feel uncomfortable in interactively modifying the view options within a diagram and need a simple and straightforward way of choosing the data to be visualized. After clicking on a given set a plain full-page style graph of the corresponding data will be shown as illustrated in Figure 57. Important to note is that only a minimum of possible data and diagram elements are shown in order to offer a clean view and not to flood the novice user with too much information at once.

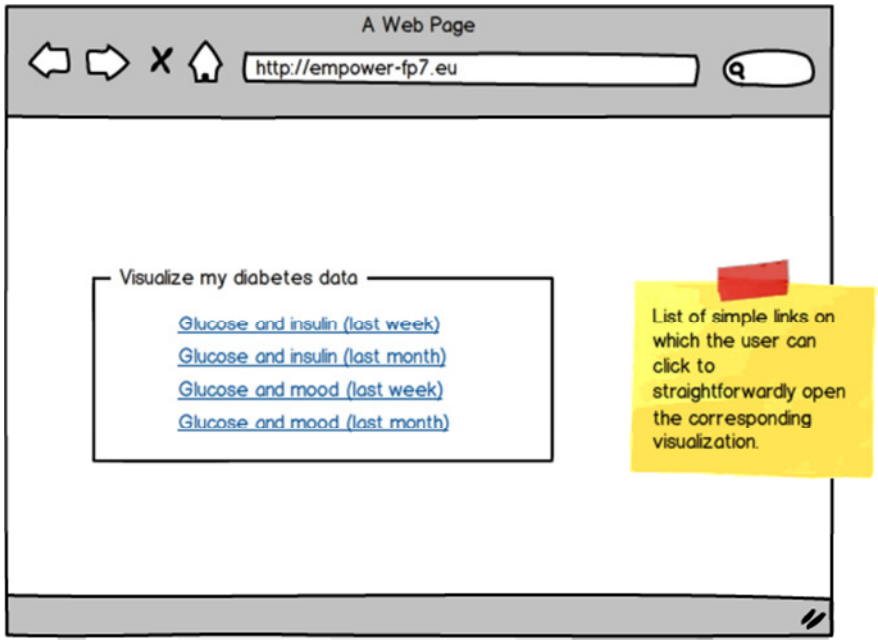


Figure 56 - Selecting a predefined set/combination of data to visualize.

Figure 57 - Full-page view of a plain graph

In contrast to the previous two mockups, Figure 58 shows a full-page view of an advanced graph that is primarily meant for expert users. By using the checkbox fields below the actual graph they can interactively choose which data series to be included in the diagram and dynamically adjust the observation period via the given date selection fields. It is meant to offer the expert user a range of tools to quickly optimize the view according to her/his interest. Additional diagram elements like marks (in this example: day/night, meals) are used to include additional relevant information.

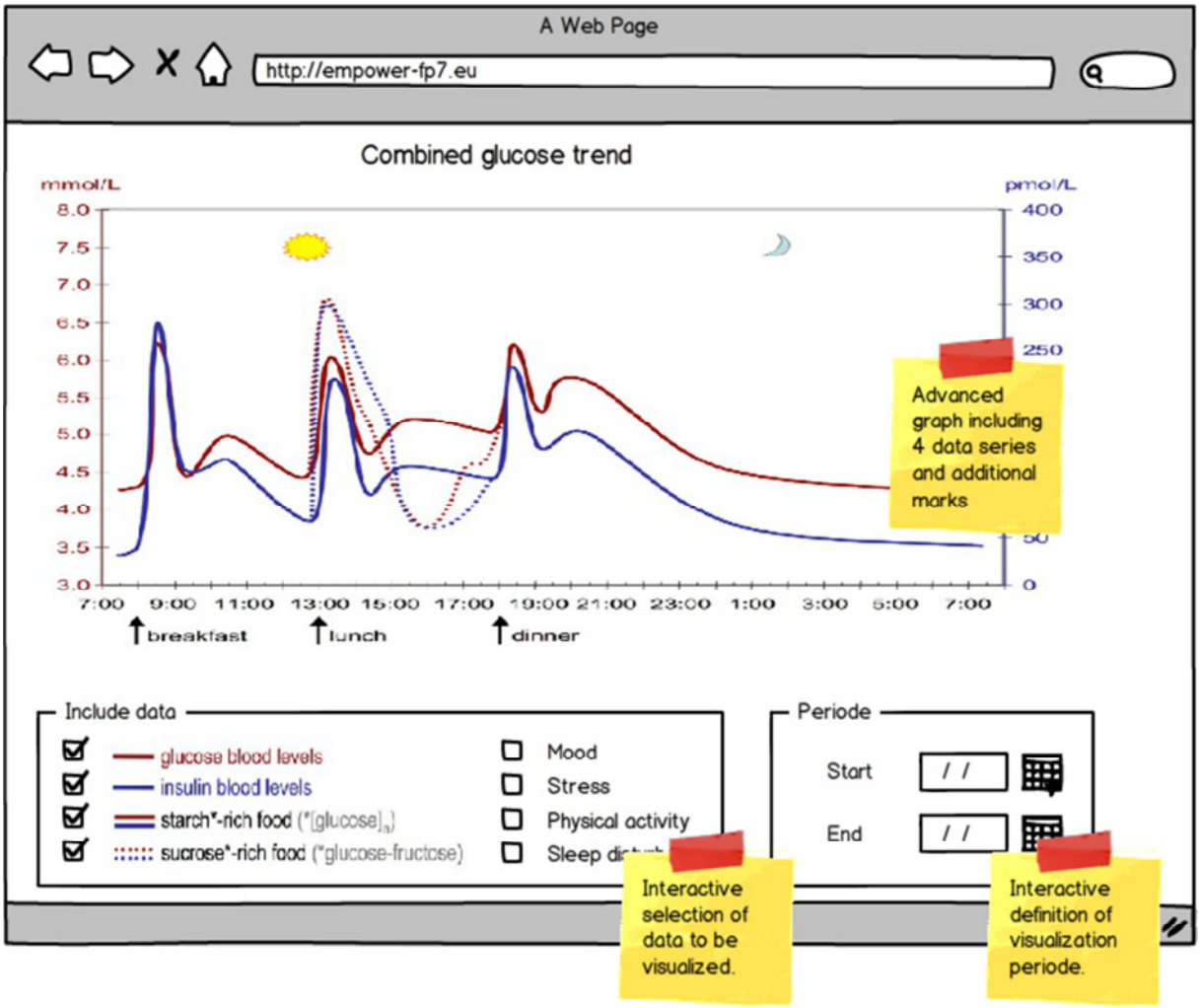


Figure 58 - Full-page view of an advanced graph

8 Literature

Austrian Diabetes Association, Minutes of interview with CEO Ms. Mayer, 27th of March 2012. Internal report Salzburg Research.

Bandura A (1977): Self-efficacy: toward a unifying theory of behavior change. *Psychol Rev* 84:191215, 1977.

Bettencourt, Lance (2009): Debunking Myths About Customer Needs. MM (American Marketing Association), January/February 2009,http://www.marketingpower.com/Resource Library/Publications/MarketingManagement/2009/18/1/MMJanFeb09Bettencourt.pdf

Brox, E., Luque, L.F., Evertsen, G.J., Hérnandez, J.E.G. (2011). Exergames for elderly: Social exergames to persuade seniors to increase physical activity. 5th International Conference on PervasiveHealth, 546-549.

Clement, J. (2000). "Model based learning as a key research area for science education". International Journal of Science Education 22 (9): 1041–1053.

Collins M., Bradley, C., O´sullivan & T.Perry (2008). Self-care coping strategies in people with diabetes: A qualitative exploratory stude. BioMed Central LTD.

Cooper, A., Reimann, R., & Cronin, D. (2007). About Face 3: The Essentiels of Interaction Design. 3rd rev edition. Indianapolis: Wiley Publishing Inc.

Deterding, S., Dixon D., Khaled, R., and Nacke, L. From game design elements to gamefulness: defining "gamification" (2011). Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, ACM, New York.

Ferrara, J. (2012). Playful Design: Creating Game Experiences in Everyday Interfaces. Rosenfeld Media.

Fitzpatrick, G. (2011). New challenges for Health IT – design fit for life. Proceedings of the First European Conference on Design 4 Health 2011, 13 - 15 July 2011, Sheffield UK

Gareis, K. (2005).eLearning for Work: The Role of Access, Motivation and Competence in Explaining Uptake. ITA conference 2005. University of Central Lancashire, UK.

Geser, G. (March, 2011). Salzburg Research Handbook of Methods, Version 1, March 2011; section: Methods for application development (pp.192-229). Available outline at: http://ilab.salzburgresearch.at/wp-content/uploads/srfg_handbook-of-methods_gg_201103011.pdf
Jih, H. J. (1996). The impact of learners pathways on learning performance in multimedia Computer Aided Learning. Journal of Network and Computer Applications 19 (4).

Liezl van Dyk & Corne Schutte (2012). A Maturity Model for Telemedicine Implementation TELEMED 2012 : The Fourth International Conference on eHealth, Telemedicine, and Social Medicine.

Lorig K., Homan H., Sobel D., Laurent D., Gonzalez V., Minor M. (2006). Living a healthy life with chronic conditions: self-management of heart disease, arthritis, diabetes, asthma, bronchitis, emphysema & others. 3rd ed. Boulder, CO: Bull

Milios R. (2011). Demystifying Motivation How to Take Action — Even When You Don't Really Feel Like It, http://www.diabetesselfmanagement.com/articles/emotional-health/demystifying-motivation/

Monteagudo J.L., Moreno O. (2007). Towards the Establishment of a European Research http://ec.europa.eu/information_society/activities/health/docs/publications/eh_era-patientempower.pdf [accessed 2012-08-27]

Mukhtar H., Ali A., Lee S., Belaïd D. (2012): Personalized Healthcare Self-management Using Social Persuasion. ICOST 2012, 66-73

Nielsen, J. (1994). Heuristic evaluation. In Nielsen, J., and Mack, R.L. (Eds.), Usability Inspection Methods, John Wiley & Sons, New York, NY.

Parhi, P., Karlson, A. K. & Bederson, B. B. (2006) Target size study for one-handed thumb use on small touchscreen devices. Proceedings of the 8th conference on human-computer interaction with mobile devices and services, Helsinki, 12-15 September 2006, 203-210. New York: ACM.

Pappas, L., Whitman, L. (2011). Riding the technology wave: effective dashboard data visualization. Proceedings of the 2011 international conference on human interface and the management of information, Vol. 1, 249-258.

Prochaska JO, Velicer WF: The Transtheoretical Model of health behavior change. *Am J Health Promo* 12:38-48, 1997.

Rollings, Andrew; Ernest Adams (2006). Fundamentals of Game Design. Prentice Hall.

Ruggiero L. (2000). Helping People With Diabetes Change Behavior: From Theory to Practice, Diabetes Spectrum, Volume 13 Number 3, 2000, Page 125, http://journal.diabetes.org/diabetesspectrum/00v13n3/pg125.htm.

Scheiner Ch, Witt M.:„The Backbone of Gamification – a Theoretical Consideration of Play and Game Mechanics", Schattauer 2012 Proceedings of the 42. Jahrestagung der Gesellschaft für Informatik e.V.

Shiffman S: A cluster analytic classification of smoking relapse episodes. *Addict Behav* 11:295-307, 1986.

Staines, J.nn. Study on e-maturity, BECTA Association, UK

Viherä, M-L. (1999). Ihminen Tietoyhteiskunnassa – Kansalaisten Viestintävalmiudet Kansalaisyhteiskunnan Mahdollistajana (English summary People an Information Society: The Citizens' Communication Skills and the Opening on New Propects for the Civil Society). Publication of the Turku School of Economics and BusinessAdministration, Series A-1:1999

Viherä, M-L-, & Nurmela, Juha. (2001). Communication capability as an intrinsic determinant for information age. Futures, 33, 245–265.

Wigdor, D., & Wixon, D. (2011). Brave NUI World: Designing Natural User Interfaces for Touch and Gesture. Morgan Kaufmann.

9 Annex

9.1 Survey Questionnaire (German Version)

EMPOWER Umfrage Diabetes

Willkommen zur EMPOWER Diabetespatienten/-innen - Umfrage

Sehr geehrte Damen, sehr geehrte Herren,

der Diabetes ist immer da. Ganz gleich was Sie tun, als Diabetespatient/-in stehen Sie vor der Aufgabe, die Krankheit zum Bestandteil Ihres täglichen Lebens zu machen.

Im Rahmen eines europaweiten Projektes möchte die Gesundheitsorganisation Region Ingolstadt e.V. gemeinsam mit der Salzburg Research Forschungsgesellschaft (Österreich) eine innovative Lösung, basierend auf frei zugänglichen Informationstechnologien, zu Ihrer Unterstützung entwickeln. Es soll Ihnen helfen, Diabetes langfristig selbst besser in den Griff zu bekommen.

Im Zuge des von der EU geförderten Projektes EMPOWER führen wir eine Umfrage durch, um herauszufinden, was Ihnen helfen würde, Diabetes selbst zu managen und eventuellen Spätfolgen vorzubeugen.

Mit ca. 20 Minuten Ihrer Zeit helfen Sie uns sehr! Alle Antworten werden anonym und vertraulich behandelt. Selbstverständlich können Sie die Ergebnisse auf der Projekthomepage www.empower-fp7.eu im Herbst 2012 einsehen.

Vielen herzlichen Dank,

Ihr EMPOWER Projektteam

Für Rückfragen wenden Sie sich bitte an:

GO IN Integrationsmanagement- und Beteiligungs-GmbH:

Fr. Dana Wunsch, Tel.: +49 (841) 88668-12, Mail: dana.wunsch@go-in-ingolstadt.de

oder

Salzburg Research Forschungsgesellschaft: Dr. Veronika Hornung-Prähauser, InnovationLab, Tel.:+43.662.2288-405,

Mail: veronika.hornung@salzburgresearch.at

Allgemeines

1. Geschlecht: *

- ○ Weiblich
- ○ Männlich

2. Alter *

3. Typ Diabetes (bitte anklicken oder X) *

- ☐ Typ1
- ☐ Typ 2
- ☐ Sonstiges

4. Seit wievielen Jahren diagnostiziert?

5. Welche Therapie verfolgen Sie zur Zeit? (Mehrfachnennungen möglich; bitte anklicken oder X)

- ☐ Nur Diät
- ☐ Tabletten (Orale Antidiabetika)
- ☐ Insulintherapie
- ☐ Sonstiges:

6. Welche Erfahrung mit **Diabetes-Programmen** (z.B. Aok Curaplan, Therapie Aktiv, Aktivtreff etc.) haben Sie? (zutreffendes ankreuzen) *

- ○ Ja, ich bin/ war Teilnehmer/-in bei einem Diabetes-Programm.
- ○ Nein, ich bin/ war noch nie Teilnehmer/-in bei einem Diabetes-Programm.

7. Ich habe schon mal an einer **Diabetes-Schulung** teilgenommen:
(Zutreffendes ankreuzen) *

- ○ Nein, ich war noch nie auf Diabetesschulung.
- ○ Ja, ich habe schon mal an einer Diabetes-Schulung mit folgenden Inhalten teilgenommen:

Wenn ja, welche? (bitte anklicken oder X)

- ☐ Ernährung
- ☐ Selbstkontrolle
- ☐ Hypo-/ Hyperglykämie
- ☐ Medikamente/Insulingabe
- ☐ Fußpflege/Fußkontrolle
- ☐ Bewegung
- ☐ Blutdruckmessung
- ☐ Sonstiges: _____

8. Wie haben Sie den Umgang mit Diabetes erlernt? (nur eine Antwort möglich) *

- ○ Ich lerne bzw. ändere meine Lebensweise nur nach Anweisungen (z.B. von Ärzten).
- ○ Ich lerne bzw. ändere meine Lebensweise anhand von unverbindlichen Vorschlägen (z.B. von Diätberaterinnen, Familie etc.).
- ○ Ich lerne bzw. ändere meine Lebensweise meistens selbstständig.

9. Wie schätzen Sie sich beim Einhalten der Therapie und von unterstützenden Aktivitäten ein (z.B. Selbstkontrolle, Bewegung, Diät)? (nur eine Antwort möglich) *

- ○ Ich beobachte meinen Diabetes immer selber. Ich setze meine Therapie- und Aktivitätenpläne weitgehend selbständig um.
- ○ Ich beobachte meinen Diabetes nur mit Unterstützung von Familie, Ärzten und Diätberaterinnen. Ich setze meine Therapie- und Aktivitätenpläne meistens mit deren Hilfe um.
- ○ Ich beobachte meinen Diabetes nur gelegentlich selber. Ich setze meine Therapie- und Aktivitätenpläne unregelmäßig um.

10. Wie schätzen Sie Ihre Internet- bzw. EDV-Kenntnisse ein?
(Mehrfachnennungen möglich; bitte anklicken oder X)

- ☐ Ich kann E-mails öffnen, lesen, schreiben, senden und ausdrucken.
- ☐ Ich kann kurze Texte (SMS) auf dem Mobiltelefon öffnen, lesen, schreiben und senden.
- ☐ Ich recherchiere manchmal über Diabetes im Internet.
- ☐ Ich schreibe hin und wieder meine Meinung oder Kommentare in einem Online-Chat, einem Online-Diskussionsforum oder einem Web-Blog.
- ☐ Ich bestelle manchmal Waren übers Internet (z.B. Katalog, Diabetesbedarfsmittel etc.).
- ☐ Ich verwende manchmal Tabellenkalkulation und/oder Grafikprogramme.

11. Welche Medien nutzen Sie oder Ihr(e) Partner/in, die/der Ihnen bei der Vorbeugung von Diabetes-Spätfolgen hilft?
(Mehrfachnennungen sind möglich; anklicken oder X)

	Durch mich genutzt.	Von Partner/-in genutzt.
Standcomputer ohne Internet-Zugang (PC).	☐	☐
Standcomputer mit Internet-Zugang (PC).	☐	☐
Notebook/Laptop ohne Internet-Zugang.	☐	☐
Notebook/Laptop mit Internet-Zugang.	☐	☐
Tablet-Computer (z.B. iPad) ohne Internet-Zugang.	☐	☐
Tablet-Computer (z.B. iPad) mit Internet-Zugang.	☐	☐
Mobiltelefon ohne Internet-Zugang.	☐	☐
Mobiltelefon mit Internet-Zugang (z.B. Smart-Phone).	☐	☐
I-Pod Touch/Classic	☐	☐
Fernseher	☐	☐
Sonstiges	☐	☐

Wenn Sonstiges, bitte näher beschreiben:

12. Wie oft nutzen Sie oder Ihr(e) Partner/in, die/der Ihnen bei Diabetes-Vorbeugung hilft, diese Medien?
(Mehrfachnennungen möglich; anklicken oder X)

	Mindestens 1x pro Tag	Mindestens 1x pro Woche	Mindestens alle 3 Monate	Seltener	Nie	Sonstiges
Standcomputer ohne Internet-Zugang (PC).	☐	☐	☐	☐	☐	☐
Standcomputer mit Internet-Zugang (PC).	☐	☐	☐	☐	☐	☐
Notebook/Laptop mit Internet-Zugang.	☐	☐	☐	☐	☐	☐
Tablet-Computer (z.B. i-Pad).	☐	☐	☐	☐	☐	☐
Mobiltelefon ohne Internet-Zugang.	☐	☐	☐	☐	☐	☐
Mobiltelefon mit Internet-Zugang (z.B. Smart-Phone).	☐	☐	☐	☐	☐	☐
Sonstiges	☐	☐	☐	☐	☐	☐

Wenn Sonstiges, bitte näher beschreiben:

Persönliche Dokumentation über Verlauf von Diabetes

13. Kennen Sie den Diabetespass der deutschen oder österreichischen Diabetes Gesellschaft?
(nur eine Antwort möglich)

- ○ Ich habe noch nie davon gehört.
- ○ Ich kenne den Diabetespass in Papierform, habe ihn aber noch nie genutzt.
- ○ Ich habe den Diabetespass schon mal benutzt, aber mit dem Einschreiben wieder aufgehört.
- ○ Ich benutze den Diabetespass regelmäßig.

14. Kennen und verwenden Sie ein Diabetestagebuch ?
(Zutreffendes ankreuzen; anklicken oder X)

- ☐ Ich habe noch nie davon gehört.
- ☐ Ich kenne ein Diabetestagesbuch in Papierform, habe es aber noch nie genutzt.
- ☐ Ich verwende hin und wieder ein Diabetestagesbuch in Papierform.
- ☐ Ich habe schon einmal ein Software-Programm zur Dokumentation meiner Diabetes-Werte erprobt.

15. Welche Informationen zum Verlauf Ihres Diabetes notieren Sie sich hin und wieder?
(Mehrfachnennungen sind möglich; zutreffendes ankreuzen;anklicken oder X)

	Auf Papier	Elektronisch	Nie
Blutzuckerwerte	☐	☐	☐
Blutdruckwerte	☐	☐	☐
Gewicht	☐	☐	☐
Dauer von sportlicher Aktivität	☐	☐	☐
Insulingaben (Korrekturinsulin)	☐	☐	☐
Broteinheiten	☐	☐	☐
Notizen zur allgemeinen Ernährung	☐	☐	☐
Notizen zur speziellen Diät	☐	☐	☐
Notizen zur Fußpflege	☐	☐	☐
Notizen zur Sehfähigkeit	☐	☐	☐
Notizen zu Rauchen (z.B. Anzahl Zigaretten)	☐	☐	☐
Notizen zu Schlaflosigkeit	☐	☐	☐
Notizen zu Gemütsverfassung (z.B. schlechte Laune)	☐	☐	☐
Notizen zu Alkohol	☐	☐	☐
Arzttermine	☐	☐	☐
Kontakte zu anderen Diabetespatienten	☐	☐	☐
Sonstiges:	☐	☐	☐

Wenn Sonstiges, bitte näher beschreiben:

16. Wie oft messen Sie Ihren Blutzucker (BG-Blutglukosewert) selbstständig? (bitte Anzahl eingeben; wenn Nie=0)

	Wie oft?
Pro Tag	
Pro Woche	
Nach Anlass	
Nie selber, nur bei Arzt/Ärztin	

17. Wie oft messen Sie Ihren Blutdruck selbstständig? (bitte Anzahl eingeben; wenn Nie=0)

	Wie oft?
Pro Tag	
Pro Woche	
Nach Anlass	
Nie selber, nur bei Arzt/Ärztin	

18. Wie oft wiegen Sie Ihr Körpergewicht selber? (bitte Anzahl eingeben; wenn Nie=0)

	Wie oft?
Pro Tag	
Pro Woche	
Nach Anlass	
Nie selber, nur bei Arzt/Ärztin	

19. Welche Hilfsmitteln verwenden Sie zur Messung Ihrer Werte? (Mehrfachnennungen sind möglich; anklicken oder X)

- ☐ Blutzuckermessgerät
- ☐ Blutdruckmessgerät

- [ ] Waage
- [ ] Schritt- bzw. Kilometerzähler
- [ ] Broteinheiten/Kalorienzähler
- [ ] Sonstiges

20. Was sind Ihrer Meinung nach die größten Hindernisse beim Messen und Dokumentieren von diabetes-relevanten Informationen? (Mehrfachnennungen möglich; anklicken oder X)

- [ ] Zu wenig Wissen, was, wann gemessen werden soll.
- [ ] Zu komplizierte und teure Messgeräte.
- [ ] Der Nutzen ist nicht sofort erkennbar.
- [ ] Zu wenig Wissen, was man aufgrund von gemessenen Werte ändern soll.
- [ ] Zu wenig Kontakt zu kundigen Personen um Werte genau zu besprechen.
- [ ] Sonstiges

Zielsetzung und Aktivitäten zur Vorbeugung von Diabetes-Spätfolgen

21. Welche Therapieziele vereinbaren Sie regelmäßig mit Ihrem Arzt/Ihrer Ärztin? (Mehrfachnennungen möglich;anklicken oder X)

- [ ] Blutzuckerwerte selbst kontrollieren
- [ ] Blutdruckwerte selbst kontrollieren
- [ ] Verringerung von Gewicht selbst kontrollieren (Körpergewicht; Taillenumfang)
- [ ] Einnahme von Medikamenten
- [ ] Bewegungsprogramm
- [ ] Dokumentation von Wohlbefinden (z.B. Schlaflosigkeit, schlechte Laune)
- [ ] Jährliche Labor- und Begleituntersuchungen (Cholesterin etc., Fußinspektion, Augenbefund)
- [ ] Vereinbare keine Ziele
- [ ] Sonstiges:

22. Welche persönlichen Ziele zur Vorbeugung von Diabetes-Spätfolgen setzen Sie sich?
(Mehrfachnennungen möglich; anklicken oder X)

- ☐ Die vierteljährlichen Ziele, die mit Arzt/Ärztin vereinbart wurden, so gut erreichen wie möglich.
- ☐ Die jährlichen Ziele, die mit Arzt/Ärztin vereinbart wurden, so gut erreichen wie möglich.
- ☐ Mich mehr über Krankheit informieren.
- ☐ Lernen, wie ich die Probleme und Umstellungen, die der Verlauf von Diabetes mit sich bringt, besser lösen kann.
- ☐ Keine speziellen, so weitermachen wie bisher.
- ☐ Sonstiges _____

23. Was tun Sie konkret, um die vereinbarten Ziele zu erreichen? Welche Aktivität fällt Ihnen dabei am leichtesten/schwersten?
(Mehrfachnennungen möglich; anklicken oder X)

	Fällt mir leicht.	Fällt mir sehr schwer.
Mehr Selbstkontrolle auszuüben.	☐	☐
Blutzzuckerwerte erreichen	☐	☐
Körperliches Training	☐	☐
Mentales Training	☐	☐
Ernährungsumstellung	☐	☐
Regelmäßige Dokumentation in einem Diabetes-Tagebuch	☐	☐
Einhaltung ärztlicher Kontrollen und Facharztbesuche	☐	☐
Sonstige	☐	☐

Wenn Sonstiges, bitte näher beschreiben:

_____

24. Was hilft Ihnen, Ihre Ziele zu erreichen? Bitte kurz beschreiben:

_____

25. Wie möchten Sie an Ihre Ziele und Aktivitäten erinnert werden? (Mehrfachnennung möglich; anklicken oder X)

- ☐ per Telefon
- ☐ via Mobiltelefon per SMS
- ☐ Via Computer, per eMail
- ☐ Gar nicht
- ☐ Sonstiges

Wissen und Lernen über Diabetes Selbstmanagement

26. Woher beziehen Sie Ihre Informationen & Wissen zu Diabetes?
(Mehrfachnennungen sind möglich; anklicken oder X)

	Häufig	Selten	Nie
Fachpersonal: z.B. Arzt/Ärztin; Diätassistent/innen; aus Diabetes-Schulungen	☐	☐	☐
Teilnahme an persönlichen Treffen von Selbsthilfegruppen	☐	☐	☐
Teilnahme an Online-Selbsthilfegruppen	☐	☐	☐
Sprechstunden bei Krankenkassen oder Versicherungen	☐	☐	☐
Familie	☐	☐	☐
Freunde	☐	☐	☐
Persönlich bekannte Diabetespatient/innen	☐	☐	☐
Fachlich-orientierte Internetquellen (z.B. Diabetes-Portale, Vereinigungen)	☐	☐	☐
Informelle Internetquellen (z.B. Diabetes-Foren; soziale Netzwerke wie Facebook)	☐	☐	☐
Fernsehsendungen	☐	☐	☐
Fachbücher	☐	☐	☐
Diabetes-Broschüren aus Apotheke	☐	☐	☐
Sonstiges	☐	☐	☐

Wenn Sonstiges, bitte näher beschreiben:

Bewertung Ihrer Bedürfnisse beim selbstständigen Beobachten von Diabetes

Im Folgenden finden Sie konkrete Aussagen, welche Schritte beim selbstständigen Messen, Dokumentieren, Bewerten und Kommunizieren von diabetes-relevanten Aktivitäten oft schwer fallen.

1) Wie wichtig sind Ihnen die einzelnen Schritte heute?

2) Wie zufrieden sind Sie mit den einzelnen Schritten in der Vergangenheit gewesen?

Bitte bewerten Sie die folgenden Bedürfnissaussagen in Hinblick auf Wichtigkeit und Zufriedenheit mit "Noten" zwischen 1 und 5.

In diesem Kapitel ist es uns sehr wichtig, dass Sie möglichst alle Aussagen bewerten. Danke!

27. Wie **WICHTIG** sind Ihnen die einzelnen Schritte **beim Messen** Ihrer diabetes-relevanten Aktivitäten?

	1= sehr wichtig	2= wichtig	3= mittelwichtig	4= weniger wichtig	5= gar nicht wichtig
Beobachten und Messen meiner Vitalwerte (z.B.Blutzucker, Blutdruck, Gewicht etc..)	○	○	○	○	○
Hilfe bei der Bewertung gemessener Werte.	○	○	○	○	○
Automatische Übernahme meiner Vitaldaten in meinen Diabetespass, Diabetestagebuch o.ä..	○	○	○	○	○
Vermeidung von Fehlern beim Messen und Bewerten von Werten.	○	○	○	○	○
Finden von Örtlichkeiten, wo ich ungestört meine Blutzuckerwerte messen kann.	○	○	○	○	○
Eigene Kontrolle einer Diabetes-gerechten Ernährung.	○	○	○	○	○
Eigene Kontrolle von ausreichend Bewegung.	○	○	○	○	○
Zeit sparen durch schnelles Finden von relevanten Informationen zu Diabetes.	○	○	○	○	○

28. Wie **WICHTIG** sind Ihnen die einzelnen Schritte **beim Dokumentieren, Bewerten und Kommunikation** Ihrer diabetes-relevanten Aktivitäten?

	1= sehr wichtig	2= wichtig	3= mittelwichtig	4= weniger wichtig	5= gar nicht wichtig
Einfaches Umrechnen von Kalorien in Broteinheiten.	○	○	○	○	○
Informationen, wie wirkungsvoll mein Aktivitätsprogramm ist.	○	○	○	○	○
Einen einfachen Überblick zur Dokumentation von Diabetes.	○	○	○	○	○
Mehr Information zum Festlegen von Aktivitätszielen (ev.Beispiele).	○	○	○	○	○
Zusätzliche Unterstützung bei der Umsetzung von Diabetes-Zielen.	○	○	○	○	○
Automatische Erinnerung an die vereinbarten Therapieziele.	○	○	○	○	○
Automatische Erinnerung an meine „Diabetes-Aufgaben" .	○	○	○	○	○
Unterstützung bei der Planung von Mahlzeiten.	○	○	○	○	○
Finden von Restaurants, wo Diabetes-gerecht gekocht wird.	○	○	○	○	○
Unterstützung bei der Planung des Bewegungsprogrammes.	○	○	○	○	○
Unterstützung bei der Einhaltung des Bewegungsprogrammes.	○	○	○	○	○
Zusätzliche Beratung bzw. Informationen von Experten z.B.Diätberater, Bewegungscoach oder Sportbetreuer.	○	○	○	○	○
Informationsaustausch mit anderen Diabetes-Betroffenen.	○	○	○	○	○
Aktive Unterstützung seitens der Familie.	○	○	○	○	○
Kontakt zu Diabetes-Selbsthilfegruppe.	○	○	○	○	○
Information zu geeigneten Urlaubsorten.	○	○	○	○	○

29. Wie **ZUFRIEDEN** sind Sie mit den einzelnen Schritten **beim Messen** Ihrer diabetes-relevanten Werte und Aktivitäten?

	1= sehr zufrieden	2= zufrieden	3= mittel zufrieden	4= weniger zufrieden	5= gar nicht zufrieden
Beobachten und Messen meiner Vitalwerte (z.B. Blutzucker, Blutdruck, Gewicht etc..)	○	○	○	○	○
Hilfe bei der Bewertung gemessener Werte.	○	○	○	○	○
Automatische Übernahme meiner Vitaldaten in meinen Diabetespass, Diabetestagebuch o.ä..	○	○	○	○	○
Vermeidung von Fehlern beim Messen und Bewerten von Werten.	○	○	○	○	○
Finden von Örtlichkeiten, wo ich ungestört meine Blutzuckerwerte messen kann.	○	○	○	○	○
Eigene Kontrolle einer Diabetes-gerechten Ernährung.	○	○	○	○	○
Eigene Kontrolle von ausreichend Bewegung.	○	○	○	○	○
Zeit sparen durch schnelles Finden von relevanten Informationen zu Diabetes.	○	○	○	○	○
Einfaches Umrechnen von Kalorien in Broteinheiten.	○	○	○	○	○
Informationen, wie wirkungsvoll mein Aktivitätsprogramm ist.	○	○	○	○	○
Einen einfachen Überblick zur Dokumentation von Diabetes.	○	○	○	○	○
Mehr Information zum Festlegen von Aktivitätszielen (ev. Beispiele).	○	○	○	○	○
Zusätzliche Beratung bzw. Informationen von Experten z.B.Diätberater oder Trainer.	○	○	○	○	○

30. Wie **ZUFRIEDEN** sind Sie mit den einzelnen Schritten **beim Dokumentieren, Bewerten und Kommunikation** Ihrer diabetes-relevanten Werte und Aktivitäten?

	1= sehr zufrieden	2= zufrieden	3= mittel zufrieden	4= weniger zufrieden	5= gar nicht zufrieden
Automatische Erinnerung an die vereinbarten Therapieziele.	○	○	○	○	○
Automatische Erinnerung an meine „Diabetes-Aufgaben".	○	○	○	○	○
Unterstützung bei der Planung von Mahlzeiten.	○	○	○	○	○
Finden von Restaurants, wo Diabetes-gerecht gekocht wird.	○	○	○	○	○
Unterstützung bei der Planung des Bewegungs-programmes.	○	○	○	○	○
Unterstützung bei der Einhaltung des Bewegungsprogrammes.	○	○	○	○	○
Informationsaustausch mit anderen Diabetes-Betroffenen.	○	○	○	○	○
Aktive Unterstützung seitens der Familie.	○	○	○	○	○
Kontakt zu Diabetes-Selbsthilfegruppe.	○	○	○	○	○
Information zu geeigneten Urlaubsorten.	○	○	○	○	○

Besten Dank für Ihre Zeit und Hilfe!

Die Ergebnisse der Umfrage können Sie im Herbst auf der Projekthomepage EMPOWER www.empower-fp7.eu einsehen.

Ihr EMPOWER Projektteam

9.2 Data for GAP-Analysis

9.2.1 Needs of study participants in total

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,39	1,85	-0,47
2	Support for assessing relevance of values	2,30	2,26	0,04
3	Automatic transfer of vital values	2,48	2,92	-0,44
4	Avoid mistakes when measuring vital values	2,07	2,08	-0,01
5	Find location for measuring vital data	3,73	2,50	1,23
6	Self-control of diet	2,48	2,43	0,04
7	Self-control of personal physics/sport	2,38	2,33	0,04
8	Find diabetes information quickly and save time	2,50	2,61	-0,11
9	Automatic transfer of bread units	2,56	2,70	-0,14
10	Support activity program	2,44	2,95	-0,51
11	Simple overview of documentation	2,07	2,53	-0,45
12	Support of activity goals	2,53	2,67	-0,14
13	Reminder for goals	2,75	2,78	-0,03
14	Reminder for tasks	2,73	2,89	-0,16
15	Planning of diet	2,98	2,64	0,34
16	Find diabetic friendly restaurant	3,28	3,03	0,25
17	Planning of sport	2,83	2,86	-0,04
18	Compliance to sport	2,59	2,91	-0,32
19	Consultancy of experts	2,63	2,62	0,01
20	Exchange information	2,86	2,59	0,26
21	Support by family	2,48	2,39	0,09
22	Support b selfhelp-group	3,20	2,75	0,45
23	Find diabetes friendly vacation spots	3,83	3,27	0,56
		2,65	2,63	

Figure 59 - Overview user all needs

9.2.2 User needs all – Type 1 and Type 2

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,28	1,89	-0,61
2	Support for assessing relevance of values	2,41	2,24	0,18
3	Automatic transfer of vital values	2,00	3,35	-1,35
4	Avoid mistakes when measuring vital values	2,11	1,94	0,17
5	Find location for measuring vital data	4,12	2,13	1,99
6	Self-control of diet	2,61	2,25	0,36
7	Self-control of personal physicals port	2,28	2,31	-0,03
8	Find diabetes information quickly and save time	2,44	2,56	-0,13
9	Automatic transfer of bread units	1,78	2,25	-0,47
10	Support activity program	2,29	2,94	-0,64
11	Simple overview of documentation	1,56	2,53	-0,97
12	Support of activity goals	2,41	2,67	-0,25
13	Reminder for goals	2,59	2,81	-0,22
14	Reminder for tasks	2,47	2,88	-0,40
15	Planning of diet	3,06	2,67	0,39
16	Find diabetic friendly restaurant	3,66	2,71	0,93
17	Planning of sport	3,24	2,87	0,37
18	Compliance to sport	2,69	2,93	-0,24
19	Consultancy of experts	2,65	2,76	-0,12
20	Exchange information	2,65	2,53	0,11
21	Support by family	2,12	1,93	0,18
22	Support by selfhelp-group	3,18	2,53	0,64
23	Find diabetes friendly vacation spots	3,82	2,93	0,89
		2,58	2,55	

Figure 60 - User needs - Type 1 diabetes patients

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,48	1,86	-0,38
2	Support for assessing relevance of values	2,23	2,30	-0,07
3	Automatic transfer of vital values	2,87	2,60	0,27
4	Avoid mistakes when measuring vital values	2,04	2,15	-0,11
5	Find location for measuring vital data	3,43	2,74	0,70
6	Self-control of diet	2,43	2,60	-0,17
7	Self control of personal physicals port	2,52	2,37	0,16
8	Find diabetes information quickly and save time	2,48	2,63	-0,15
9	Automatic transfer of bread units	3,13	3,00	0,13
10	Support activity program	2,57	2,96	-0,38
11	Simple overview of documentation	2,52	2,50	0,02
12	Support of activity goals	2,59	2,65	-0,06
13	Reminder for goals	2,82	2,74	0,08
14	Reminder for tasks	2,86	2,89	-0,03
15	Planning of diet	2,91	2,65	0,26
16	Find diabeticfriendly restaurant	3,05	3,32	-0,27
17	Planning of sport	2,60	2,95	-0,35
18	Compliance to sport	2,50	2,90	-0,40
19	Consultancy of experts	2,61	2,42	0,19
20	Exchange information	2,96	2,57	0,39
21	Support by family	2,67	2,65	0,02
22	Support by selfhelp-group	3,18	2,86	0,33
23	Find diabetes friendly vacation spots	3,83	3,50	0,33
		2,70	2,68	

Figure 61 - User needs - Type 2 diabetes patients

9.2.3 Access: Needs of users having different forms of access to ICTs

Access to an online Computer (PC or Laptop)				
Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,46	1,85	-0,39
2	Support for assessing relevance of values	2,38	2,23	0,15
3	Automatic transfer of vital values	2,53	3,03	-0,50
4	Avoid mistakes when measuring vital values	2,15	2,16	-0,01
5	Find location for measuring vital data	3,85	2,48	1,36
6	Self-control of diet	2,59	2,39	0,20
7	Self-control of personal physics/sport	2,45	2,33	0,12
8	Find diabetes information quickly and save time	2,53	2,58	-0,05
9	Automatic transfer of bread units	2,53	2,71	-0,18
10	Support activity program	2,45	3,00	-0,55
11	Simple overview of documentation	1,94	2,45	-0,51
12	Support of activity goals	2,55	2,71	-0,16
13	Reminder for goals	2,76	2,84	-0,08
14	Reminder for tasks	2,73	2,97	-0,24
15	Planning of meal	2,88	2,67	0,21
16	Find diabetic friendly restaurant	3,24	3,03	0,21
17	Planning of sport	2,85	2,93	-0,08
18	Compliance to sport	2,56	3,00	-0,44
19	Consultancy of experts	2,61	2,63	-0,03
20	Exchange information	2,97	2,63	0,34
21	Support by family	2,55	2,48	0,06
22	Contact to selfhelp-group	3,22	2,73	0,49
23	Find diabetes friendly vacation spots	3,79	3,32	0,47
		2,68	2,66	

Figure 62- User needs – Access to PC

Access to a smartphone				
Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,24	1,88	-0,65
2	Support for assessing relevance of values	2,31	2,06	0,25
3	Automatic transfer of vital values	1,71	3,50	-1,79
4	Avoid mistakes when measuring vital values	2,24	2,06	0,17
5	Find location for measuring vital data	3,81	2,31	1,50
6	Self-control of diet	2,47	2,56	-0,09
7	Self control of personal physics/sport	2,12	2,47	-0,35
8	Find diabetes information quickly and save time	2,33	2,63	-0,29
9	Automatic transfer of bread units	1,02	2,75	-0,93
10	Support activity program	2,13	3,44	-1,31
11	Simple overview of documentation	1,59	2,69	-1,10
12	Support of activity goals	2,19	3,13	-0,94
13	Reminder for goals	2,19	3,19	-1,00
14	Reminder for tasks	2,13	3,44	-1,31
15	Planning of meal	2,63	3,00	0,38
16	Find diabetic friendly restaurant	3,19	3,36	-0,17
17	Planning of sport	2,81	3,27	-0,45
18	Compliance to sport	2,19	3,40	-1,21
19	Consultancy of experts	2,44	2,75	-0,31
20	Exchange information	2,81	2,93	0,12
21	Support by family	2,25	2,07	0,18
22	Contact to selfhelp-group	3,44	2,93	0,50
23	Find diabetes friendly vacation spots	3,88	3,23	0,64
		2,43	2,83	

Figure 63 - User needs - Access to smartphone

Access to an online Tablet PC

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,11	1,67	-0,56
2	Support for assessing relevance of values	2,11	1,89	0,22
3	Automatic transfer of vital values	1,44	3,00	-1,56
4	Avoid mistakes when measuring vital values	1,89	2,00	-0,11
5	Find location for measuring vital data	3,67	3,11	0,56
6	Self-control of diet	2,00	2,56	-0,56
7	Self-control of personal physics/sport	1,75	2,22	-0,47
8	Find diabetes information quickly and save time	2,38	2,67	-0,29
9	Automatic transfer of bread units	2,67	3,00	-0,33
10	Support activity program	1,89	2,78	-0,89
11	Simple overview of documentation	1,56	2,22	0,67
12	Support of activity goals	2,00	2,44	-0,44
13	Reminder for goals	2,22	3,11	-0,89
14	Reminder for tasks	1,89	3,11	-1,22
15	Planning of meal	2,33	2,67	-0,33
16	Find diabetic friendly restaurant	2,44	2,78	-0,33
17	Planning of sport	2,44	3,00	-0,56
18	Compliance to sport	1,89	2,78	-0,89
19	Consultancy of experts	2,11	2,33	-0,22
20	Exchange information	2,67	3,00	-0,33
21	Support by family	2,33	3,11	-0,78
22	Contact to selfhelp-group	3,00	3,11	-0,11
23	Find diabetes friendly vacation spots	3,44	3,88	-0,43
		2,23	2,71	

Figure 64 - User needs - Access to tablet PC

9.2.4 Competence: Needs of users with low, medium, high eSkills

LOW

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,75	3,00	-1,25
2	Support for assessing relevance of values	2,00	3,00	-1,00
3	Automatic transfer of vital values	2,50	3,00	-0,50
4	Avoid mistakes when measuring vital values	1,50	2,00	-0,50
5	Find location for measuring vital data	5,00	2,00	3,00
6	Self-control of diet	1,50	3,00	-1,50
7	Self-control of personal physics/sport	1,00	2,00	-1,00
8	Find diabetes information quickly and save time	2,00	3,00	-1,00
9	Automatic transfer of bread units	3,00	4,00	-1,00
10	Support activity program	2,00	3,00	-1,00
11	Simple overview of documentation	1,50	3,00	-1,50
12	Support of activity goals	2,00	3,00	-1,00
13	Reminder for goals	3,00	3,00	0,00
14	Reminder for tasks	3,00	3,00	0,00
15	Planning of meals	2,00	3,00	-1,00
16	Find diabetic friendly restaurant	3,00	3,00	0,00
17	Planning of sport	2,00	2,00	0,00
18	Compliance to sport	2,00	2,00	0,00
19	Consultancy of experts	3,00	3,00	0,00
20	Exchange information	2,00	2,00	0,00
21	Support by family	1,50	2,50	-1,00
22	Contact to selfhelp-group	4,00	3,50	0,50
23	Find diabetes friendly vacation spots	4,00	5,00	-1,00
N=2		2,40	2,87	

Figure 65 - Needs of patients with low eSkills

MEDIUM

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,25	1,67	0,42
2	Support for assessing relevance of values	1,64	2,18	-0,55
3	Automatic transfer of vital values	2,58	2,55	0,04
4	Avoid mistakes when measuring vital values	1,92	2,27	-0,36
5	Find location for measuring vital data	3,25	2,73	0,52
6	Self-control of diet	3,00	2,55	0,45
7	Self-control of personal physics/sport	3,08	2,64	0,45
8	Find diabetes information quickly and save time	2,33	2,55	-0,21
9	Automatic transfer of bread units	2,42	2,64	-0,22
10	Support activity program	2,75	2,91	-0,16
11	Simple overview of documentation	2,00	2,55	-0,55
12	Support of activity goals	2,50	2,55	-0,05
13	Reminder for goals	2,50	2,73	-0,23
14	Reminder for tasks	2,67	2,91	-0,24
15	Planning of meals	2,58	2,82	-0,23
16	Find diabetic friendly restaurant	3,17	3,45	-0,29
17	Planning of sport	2,50	2,91	-0,41
18	Compliance to sport	2,55	3,09	-0,55
19	Consultancy of experts	2,58	2,40	0,18
20	Exchange information	2,67	2,55	0,12
21	Support by family	2,17	2,30	-0,13
22	Contact to selfhelp-group	2,92	2,64	0,28
23	Find diabetes friendly vacation spots	3,58	3,50	0,08
N=12		2,55	2,65	

Figure 66 - Needs of patients with medium eSkills

HIGH

Nr	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1.33	1.82	-0,45
2	Support for assessing relevance of values	2.59	2.32	0,27
3	Automatic transfer of vital values	2.32	3,27	-0,95
4	Avoid mistakes when measuring vital values	2.09	2.05	0,05
5	Find location for measuring vital data	4.09	2,48	1,61
6	Self-control of diet	2.45	2,35	0,07
7	Self-control of personal physics/sport	2.14	2.30	-0,16
8	Find diabetes information quickly and save time	2.52	2,67	-0,14
9	Automatic transfer of bread units	2.45	2,71	-0,26
10	Support activity program	2.23	3.14	-0,92
11	Simple overview of documentation	1.82	2,55	-0,73
12	Support of activity goals	2.45	2,85	-0,40
13	Reminder for goals	2.82	2.90	-0,09
14	Reminder for tasks	2.68	3,00	-0,32
15	Planning of meals	3.14	2,60	0,54
16	Find diabetic friendly restaurant	3.32	2,84	0,48
17	Planning of sport	3.09	3,05	0,04
18	Compliance to sport	2.64	3,05	-0,42
19	Consultancy of experts	2.55	2,82	-0,27
20	Exchange information	3.05	2,75	0,30
21	Support by family	2.73	2,40	0,33
22	Contact to selfhelp-group	3.32	2,75	0,57
23	Find diabetes friendly vacation spots	3.95	3,15	0,80
N=20		2,69	2,69	

Figure 67 - Needs of patients with high eSkills

9.2.5 Competence: Needs of supported, guided, independent learner

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,44	1,88	-0,43
2	Support for assessing relevance of values	2,50	2,29	0,21
3	Automatic transfer of vital values	2,50	2,57	-0,07
4	Avoid mistakes when measuring vital values	1,88	2,14	-0,27
5	Find location for measuring vital data	3,88	3,00	0,88
6	Self-control of diet	2,63	2,43	0,20
7	Self-control of personal physics/sport	2,57	2,14	0,43
8	Find diabetes information quickly and save time	2,75	2,43	0,32
9	Automatic transfer of bread units	2,88	3,29	-0,41
10	Support activity program	2,50	3,00	-0,50
11	Simple overview of documentation	2,00	2,29	-0,29
12	Support of activity goals	2,63	2,57	0,05
13	Reminder for goals	3,38	2,57	0,80
14	Reminder for tasks	3,13	2,57	0,55
15	Planning of diet	2,63	2,14	0,48
16	Find diabetic friendly restaurant	2,63	2,29	0,34
17	Planning of sport	2,88	2,71	0,16
18	Compliance to sport	2,88	2,43	0,45
19	Consultancy of experts	2,88	2,57	0,30
20	Exchange information	3,13	2,71	0,41
21	Support by family	2,63	2,71	-0,09
22	Support b selfhelp-group	2,88	2,71	0,16
23	Find diabetes friendly vacation spots	3,75	3,71	0,04
	N=7	2,73	2,57	

Figure 68 – Needs of supported learners

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,25	1,79	-0,54
2	Support for assessing relevance of values	2,14	2,08	0,06
3	Automatic transfer of vital values	2,67	2,33	0,33
4	Avoid mistakes when measuring vital values	2,07	2,33	-0,27
5	Find location for measuring vital data	3,29	2,92	0,37
6	Self-control of diet	2,33	2,67	-0,33
7	Self-control of personal physics/sport	2,21	2,58	-0,37
8	Find diabetes information quickly and save time	2,36	2,42	-0,06
9	Automatic transfer of bread units	2,50	2,25	0,25
10	Support activity program	2,57	2,75	-0,18
11	Simple overview of documentation	2,40	2,58	-0,18
12	Support of activity goals	2,62	2,36	0,25
13	Reminder for goals	2,69	2,50	0,19
14	Reminder for tasks	2,92	2,75	0,17
15	Planning of diet	3,21	2,58	0,63
16	Find diabetic friendly restaurant	3,46	3,08	0,38
17	Planning of sport	2,69	2,75	-0,06
18	Compliance to sport	2,69	2,91	-0,22
19	Consultancy of experts	2,79	2,17	0,62
20	Exchange information	2,73	2,46	0,27
21	Support by family	2,27	2,00	0,27
22	Support b selfhelp-group	3,08	2,69	0,38
23	Find diabetes friendly vacation spots	3,71	3,09	0,62
	N=14	2,64	2,52	

Figure 69 – Needs of guided learners

Nr.	Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,47	1,89	-0,42
2	Support for assessing relevance of values	2,33	2,37	-0,04
3	Automatic transfer of vital values	2,32	3,42	-1,11
4	Avoid mistakes when measuring vital values	2,16	1,89	0,26
5	Find location for measuring vital data	4,00	2,00	2,00
6	Self-control of diet	2,53	2,28	0,25
7	Self-control of personal physics/sport	2,42	2,24	0,19
8	Find diabetes information quickly and save time	2,50	2,82	-0,32
9	Automatic transfer of bread units	2,47	2,78	-0,30
10	Support activity program	2,32	3,06	-0,74
11	Simple overview of documentation	1,84	2,58	-0,74
12	Support of activity goals	2,42	2,89	-0,47
13	Reminder for goals	2,53	3,06	-0,53
14	Reminder for tasks	2,42	3,12	-0,70
15	Planning of diet	2,95	2,88	0,07
16	Find diabetic friendly restaurant	3,42	3,33	0,09
17	Planning of sport	2,89	3,00	-0,11
18	Compliance to sport	2,39	3,12	-0,73
19	Consultancy of experts	2,42	2,94	-0,52
20	Exchange information	2,84	2,65	0,20
21	Support by family	2,58	2,53	0,05
22	Support b selfhelp-group	3,42	2,81	0,61
23	Find diabetes friendly vacation spots	3,95	3,20	0,75
	N=17	2,63	2,73	

Figure 70 – Needs of independent learners

9.2.6 Motivation: Needs of users with self-care coping strategies

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,21	1,63	-0,42
2	Support for assessing relevance of values	2,35	2,08	0,27
3	Automatic transfer of vital values	2,61	2,81	-0,20
4	Avoid mistakes when measuring vital values	2,18	2,08	0,10
5	Find location for measuring vital data	3,74	2,40	1,34
6	Self-control of diet	2,18	2,27	-0,09
7	Self-control of personal physics/sport	2,11	2,20	-0,09
8	Find diabetes information quickly and save time	2,50	2,40	0,10
9	Automatic transfer of bread units	2,46	2,58	-0,11
10	Support activity program	2,41	2,81	-0,40
11	Simple overview of documentation	2,00	2,35	-0,35
12	Support of activity goals	2,31	2,56	-0,25
13	Reminder for goals	2,69	2,72	-0,03
14	Reminder for tasks	2,77	2,88	0,11
15	Planning of diet	2,96	2,64	0,32
16	Find diabetic friendly restaurant	3,31	3,13	0,18
17	Planning of sport	2,81	2,76	0,05
18	Compliance to sport	2,60	2,88	-0,27
19	Consultancy of experts	2,59	2,60	-0,01
20	Exchange information	2,89	2,60	0,29
21	Support by family	2,33	2,38	-0,04
22	Support b selfhelp-group	3,19	2,75	0,44
23	Find diabetes friendly vacation spots	3,85	3,23	0,62
24		2,61	2,55	
N=26				

Figure 71 – Needs of active followers

Nr.	EMPOWER Needs	Importance	Satisfaction	Gap-Analysis
1	Measuring of vital values	1,50	2,00	-0,50
2	Support for assessing relevance of values	2,00	2,33	-0,33
3	Automatic transfer of vital values	2,38	2,67	-0,29
4	Avoid mistakes when measuring vital values	1,88	2,33	-0,46
5	Find location for measuring vital data	3,00	2,83	0,17
6	Self-control of diet	2,88	3,17	-0,29
7	Self-control of personal physics/sport	3,00	2,83	0,17
8	Find diabetes information quickly and save time	2,38	2,83	-0,46
9	Automatic transfer of bread units	2,89	2,83	0,06
10	Support activity program	2,50	3,33	-0,83
11	Simple overview of documentation	2,38	3,00	-0,63
12	Support of activity goals	3,13	3,17	-0,04
13	Reminder for goals	2,75	2,67	0,08
14	Reminder for tasks	2,75	2,83	-0,08
15	Planning of diet	2,88	2,83	0,04
16	Find diabetic friendly restaurant	2,88	3,50	-0,63
17	Planning of sport	2,75	3,33	-0,58
18	Compliance to sport	2,75	3,17	-0,42
19	Consultancy of experts	2,75	2,33	0,42
20	Exchange information	2,78	2,71	0,06
21	Support by family	2,56	2,29	0,27
22	Support b selfhelp-group	3,38	2,86	0,52
23	Find diabetes friendly vacation spots	3,38	3,67	-0,29
N~7		2,67	2,85	

Figure 72 – Needs of passive followers