

MedGUIDE

ICT Integrated System for Coordinated Polypharmacy Management in Elders with Dementia

D1.3 Final version of MedGUIDE system architecture, user interface and services design

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Acronyms used in this deliverable

CCARE	ConnectedCare Services B.V
HU-UAS	Stichting Hogeschool Utrecht / Utrecht University of Applied Sciences
IVM	Stichting Instituut voor Verantwoord Medicijngebruik
MAT	AgeCare (Cyprus) LTD – Materia Group
KARDE	Karde AS
VIGS	Vigisense SA
TUC	Technical University of Cluj-Napoca
PwD	People with Dementia
API	Application Programming Interface

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1 Executive summary

This document presents the final version of the system architecture and the final design developed based on previous iterations. The document highlights the changes made to the design based on the wireframes presented in D1.2 and explain the design rationale of the final design of the MedGUIDE system. This deliverable describes the final user interface design, which guides the software development of the MedGUIDE prototypes. This document succeeds D1.2; most of the system architecture have not changed since D1.2. This document must be read together with D1.2 for a complete view of the system architecture.

The MedGUIDE systems and services development will follow an agile process, where architecture, API's and information models at a low level will change until a complete solution is ready. However, the system architecture will be guiding for the development and will not change much from what is described in D1.2 and this document.

2 Introduction

2.1 Scope of the project

The MedGUIDE project aims to support and improve the quality of life of older people suffering from mild dementia, or with severe memory problems. MedGUIDE will support the network of informal caregivers, and support in the medication management of both patient and caregivers. The main target groups are: Primary target group - people with dementia (PwD); Secondary target group - Formal and informal caregivers; the Tertiary target group - Healthcare and pharmaceutical professionals. The platform is aimed at the support of the medication adherence in order to support Patients with dementia and their care network.

2.2 Scope of this document

This document presents the final results of Task 1.2, “*Architecture and service design*” and Task 1.3 “*User experience design*”. It covers the technical architecture of the entire application: both its services, APIs and frontends. Next to this, it covers the user interface designs. The document is the basis for the development of the MedGUIDE prototypes - both the user interface, frontend architecture, and backend services.

This document combines the various components, structures and designs within the project.

2.3 Document structure

The deliverable consists of four chapters:

Chapter 3 describes the evaluation results of the wireframes that are presented in D1.2, *1st version of MedGUIDE system architecture and user interface*”.

Chapter 4 describes the user experience design of the final design that has been developed based on the evaluation of previous design phase.

Chapter 5 describes the architecture and services design. The section will describe the system architecture.

Chapter 6 concludes the document.

3 Updates resulted from the evaluation of 1st design iteration (D1.2)

The requirements set in D1.1 were used for the design and development of user scenarios, personas and wireframes which are detailed in D1.2 1st version of MedGUIDE system architecture, user interface and service design. MedGUIDE aimed to provide support medication adherence and provide insight in to the wellbeing of the patient including medication side effects and interactions. The platform design in the wireframes in D1.2 includes the following key functionalities:

- Medication reminders
- Personalized medication plan
- Situation awareness based on sensors and self-reports
- E-learning
- Communication and coordination

The design process as presented in D1.2 resulted in three applications:

1. The MedGUIDE basic application for PwD
2. The MedGUIDE advanced application for informal caregivers
3. The MedGUIDE pro application for formal caregivers (including pharmacists, general practitioners, and (community) nurses)

Wireframe designs were developed and evaluated with end-users. The main findings from the evaluation are:

1. Overall, users were positive about the functions and the idea of the prototype. If further detailed, professionals and caregivers did see the added value
2. Overall guidance through means of notifications, introduction tour, videos and avatars would be appreciated
3. The interface for the PwD and for the caregivers was perceived as too complex and included too many functionalities. The end-users recommended to keep only main functionalities.
4. The PwD were only interested in the e-learning aspect, their medication overview and the reminders. Other functionalities and access to the sensor data was perceived as too complex.
5. Mood report by the PwD would be appreciated by the caregivers but should be simplified, also physical discomfort would be relevant additional information.
6. The information provided about the medication intake and medication prescribed was perceived as useful by both informal caregiver as well as PwD. Though the way the information was presented needed some improvements.
7. The idea of the sensor information was appreciated but requires more detailing in order for the caregivers to understand how to use and interpret the information. They would like to see one overview of all sensors in the home page while at the same time be able to see each sensor data separately.
8. Close collaboration within the network of caregivers was appreciated, but only agenda and messages were needed, additional functionalities felt as too much and too complex.
9. The care network visualization was appreciated since it provides information on the members of the network.
10. Professional caregivers would like to have one overview of all patients in order to know which patients will need extra help or attention.

These results from the wireframe evaluation has resulted in a number of proposed modifications towards both the user interface of the final design presented in this document and the designed services and architecture. These changes are shortly described below.

3.1 Overall changes to the design

During the evaluation of the wireframes, the interface and the interaction was considered complex. Therefore, the following changes are proposed regarding the entire setup of the user interface:

1. The PwDs will only be provided with MedGUIDE basic, as the evaluation showed that the majority of PwDs considered MedGUIDE advanced as too complex.
2. The MedGUIDE advanced application (for formal and informal caregivers) shall be merged with MedGUIDE pro (for professional caregivers) so both applications can be developed simultaneously. The professional caregivers shall get additional rights to access additional functionalities (which were part of MedGUIDE pro in the wireframes).
3. The UI of both remaining applications should be simplified so there is as little content on the screen as possible. This helps both PwDs and caregivers to have a clean, easy to use application.

3.2 Changes to MedGUIDE basic application (for the PwD)

Below, all proposed changes related to MedGUIDE basic are listed. All these changes are based on findings within the evaluation of the wireframes:

1. The UI will be simplified even more to contain less data per screen and to contain more graphical content. The UI shall not be made customizable, but instead it shall be designed in such a way that it is easy to use for the entire target group
2. The menu will be replaced by a simple dashboard to simplify the navigation within the application
3. The evaluation showed that there is no direct requirement for the PwD to see its own sensor data, social tools and a timeline. These functionalities will therefore be removed from the basic application
4. The E-learning will be excluded from the MedGUIDE basic application because it was shown that it was only relevant for a small part of the PwDs. The E-learning shall be setup as a separate platform that is accessible for a PwD outside MedGUIDE basic, through a web browser on another device
5. The medication scheduling shall be removed. Instead, medication reminders should only be shown to the PwD when the medication needs to be taken, in order to prevent confusion about what time it is.
6. The mood reports should be simplified to contain less dimensions, so they are easier to use for a PwD
7. The “Ask for help” feature should be removed as the evaluations pointed out that PwDs would rather use traditional communication tools to ask for help (like a telephone)
8. Instead of one generic reminder system, 2 scenarios for medication reminders should be created: one with a smart pillbox and without a smart pillbox. This should be set during the setup by the professional. This makes it easier for the PwD to know what he/she has to do in his specific situation.

3.3 Changes to MedGUIDE advanced and MedGUIDE pro applications

Next to the general changes in the UI as described in section 3.2, there are also a number of modifications proposed specifically for MedGUIDE advanced and MedGUIDE pro. As MedGUIDE

advanced and MedGUIDE pro will be combined into one application, only the term MedGUIDE advanced will be used from now on. These proposed changes are:

For both (in)formal caregivers and professionals

1. The menu was considered as taking up too much space, so it should be changed to an off-screen menu on smaller screens
2. The to-do list should be removed as it was considered a peripheral feature in the scope of rest of the MedGUIDE application
3. As the “Ask for help” feature will be removed from MedGUIDE basic, the option to respond to such requests should subsequently be removed from MedGUIDE advanced
4. The option to manually send medication reminders shall be removed in order to only have medication reminders on set times during the days and to prevent taking wrong/double doses.
5. The journal functionality can be integrated into the social messaging component
6. To get a clear insight, all sensor-related data should be split in various specific pages
7. Due to feedback about the complexity of the medication overview, both a simple and a detailed medication overview should be added
8. Medication adherence should only be based on data from a smart pillbox or a self-report. Showing input from both sensors and self-reports can lead to confusion
9. The dashboard can be integrated with today’s overview and history to get the caregivers to the most relevant data directly
10. The calendar functionality can be narrowed down to a week- and day view only
11. The collaboration guidelines are considered unnecessary and can therefore be removed

For professional caregivers only

1. Patient list overview should be added in order to navigate to different patients
2. A patient setup wizard should be added to allow professionals to add and setup new patients. The setup should only be done by a professional, but it must be done together with the PwD and an informal caregiver to secure that data is setup correctly

4 User experience design

4.1 Overall design rationale

The final aim of MedGUIDE is to support PwDs in a better medication adherence and in their medication management, as well as providing insight into the wellbeing of the patient for caregivers and professionals, including the assessment of possible effects of medication.

The different end users will need to be supported in different ways. This is reflected in the different requirements and functionalities developed in the previous deliverables:

- **PwDs** need a simple platform that supports them in the medication adherence when needed.
- **Formal and Informal caregivers** are interested in the wellbeing of the senior, would like to see changes in the daily lives of the seniors, and would like to know how and when to provide support to the patient.
- **Professional caregivers** want to have an overview of the different patients they take care for, and know quickly which patient needs extra attention concerning the wellbeing as well as the support in medication adherence.

Based on the findings from the evaluation of the wireframes, and in view of the proposed changes presented in chapter 3, it has been decided to design two applications:

MedGUIDE basic: a very simple application for the PwD aimed at medication adherence through reminders and medication management through providing simple information of medication in the PwDs medication plan.

MedGUIDE advanced: an application for both professional and (in)formal caregivers aimed at supporting the care network by providing insight into the care of the PwD as well as supporting collaboration amongst caregivers.

As part of the final design, mock-up designs were created. These mock-ups show the final screen designs in detail, as opposed to the wireframe designs which show a sketch-level design. Using the mock-ups, the usability and preliminary user experience can be evaluated. Next to this, the mock-ups will be used as the functional documentation for the realization of the first prototype.

The **MedGUIDE E-learning platform** for caregivers will be developed as a separate external module, so it can be accessed without requiring user authentication. The E-learning platform for PwD will be integrated in the platform. The platforms design will be discussed in section 4.4.

4.2 MedGUIDE basic for PwDs

4.2.1 Design rationale

Patients with dementia have difficulties with keeping track of time and are focused on specific moments of the day. In some cases, they even have difficulties with keeping track of a day and night rhythm. Due to their memory problems it is difficult for them to keep track of their medication intake, but also on how they are feeling. Whenever they are asked by family members or caregivers how they were feeling the day before, they might have troubles recalling how they felt. MedGUIDE basic has therefore been very simple and will support PwDs with:

- their medication adherence
- understand which medication they are taking and why
- share how they are feeling with their loved ones.

Within the design of MedGUIDE basic, it is crucial for patients to have a low threshold when using the platform. The platform will therefore contain as little UI-elements as possible on each screen. Also, all navigation and interaction is provided through the use of an avatar.

Furthermore, it will be presented as an always-on ambient display on a 7-inch touch screen, that is solely used for MedGUIDE. The screen will be fixed to the living environment (e.g. hanging on the wall) and will therefore be a non-responsive, static application. The display will be located in the PwDs living room or kitchen, where it can be accessed and interacted with.

Each non-navigational screen contains a button to read the text out loud. During the setup of MedGUIDE basic it should be possible to set if this feature is on or off by default.

Following the results of the evaluation, it has been decided to remove the ask-for-help feature and to exclude the E-learning from the MedGUIDE basic application and set it up as a separate website (see section 4.4).

The following section highlights the main functionalities of the MedGUIDE basic application as presented in Figure 1. More details The final design can be accessed online via the following link: <http://bit.ly/medguide-senior-en>.

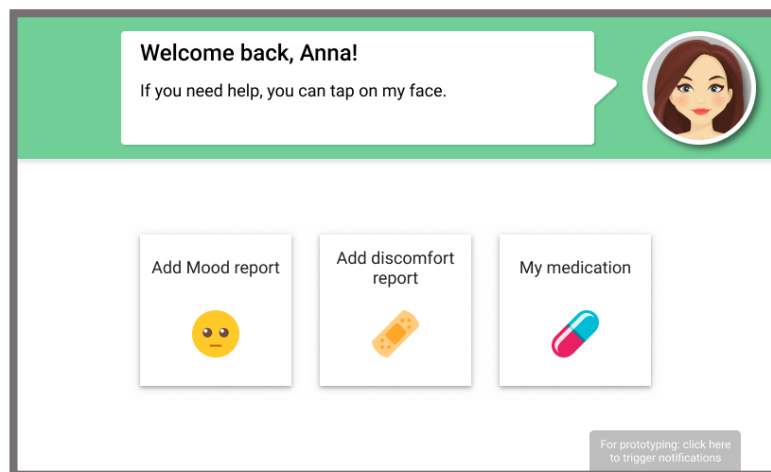


Figure 1 Final design of the dashboard of MedGUIDE basic

4.2.2 Introduction tour

For patients with dementia, one of the most crucial aspects when getting used with a new application is the introduction of the application. For the patients it is not only crucial to know how to use it, but also why they would use it. Therefore, MedGUIDE will support their first use via an introduction tour as presented in Figure 2 that consist of a basic explanation of the application and a video. In a later stage, they can always re-watch this video through the avatar-interface. The screen below also shows the text-to-speech feature.

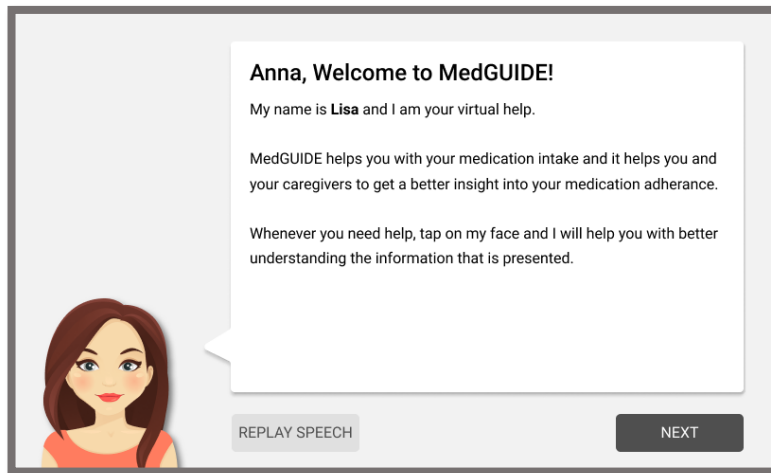


Figure 2 The final design of the first screen of the introduction tour

4.2.3 Medication overview

For a patient with dementia who is using multiple types of medication it is always a challenge to know which medication they are taking. MedGUIDE basic will therefore support them by providing the basic information about their medicines as presented in Figure 3 and Figure 4.

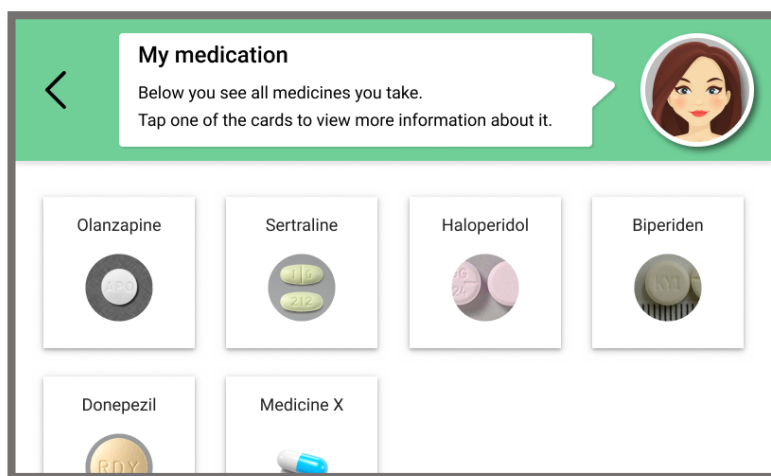


Figure 3 The medication overview of MedGUIDE basic

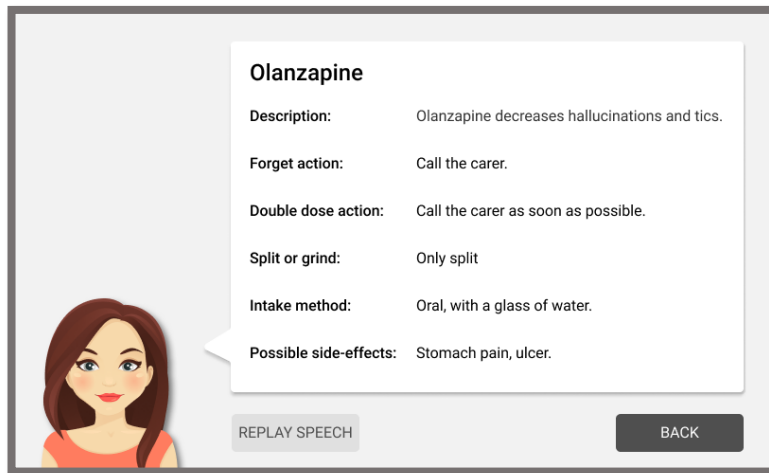


Figure 4 final design of medication details

4.2.4 Medication reminders

To keep track whether they have taken the medication, and when they have to take it, MedGUIDE basic will also provide the PwDs with reminders on the specific moments medication should be taken. The medication reminders will be linked to the smart pillbox when available and will appear automatically on the set time as presented in Figure 5 and Figure 6. They will disappear when the medication has been taken (either confirmed by a signal from the smart pillbox or by pushing a button in the application).

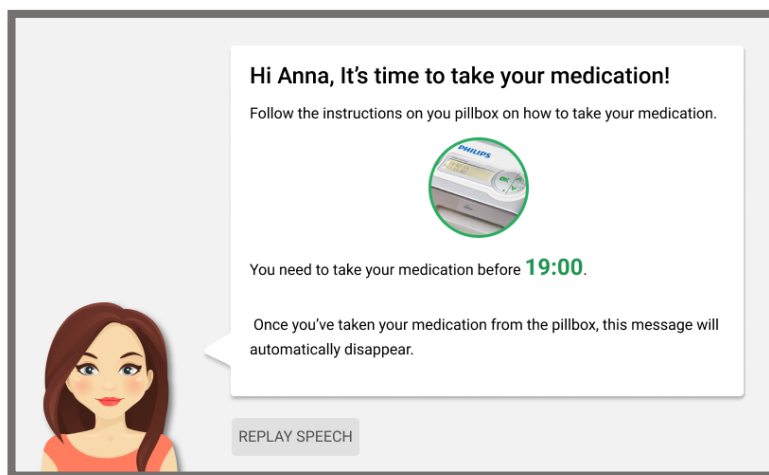


Figure 5 Final design of a reminder when there is a smart pillbox available

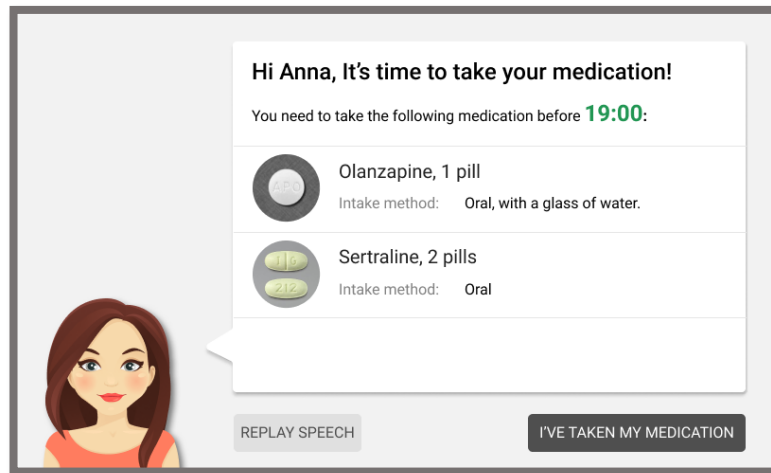


Figure 6 Final design of a reminder when there is no smart pillbox available

4.2.5 Self-reports

Patients with dementia often have difficulties to recall how they were feeling the day before or whether they are feeling better or different from the day or week before. MedGUIDE basic will support the patient by sharing how he/she is feeling. This can be either by sharing a mood report on their overall feeling (Figure 7), or by sharing specific physical discomfort (Figure 8). The amount of options within the self-reports has been kept low, so it is easier to make a choice for the PwD.

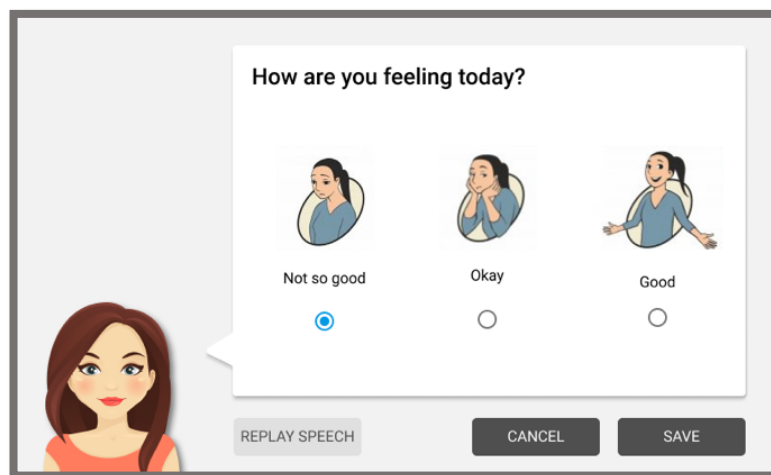


Figure 7 The final design of a self-report on the mood of the PwD

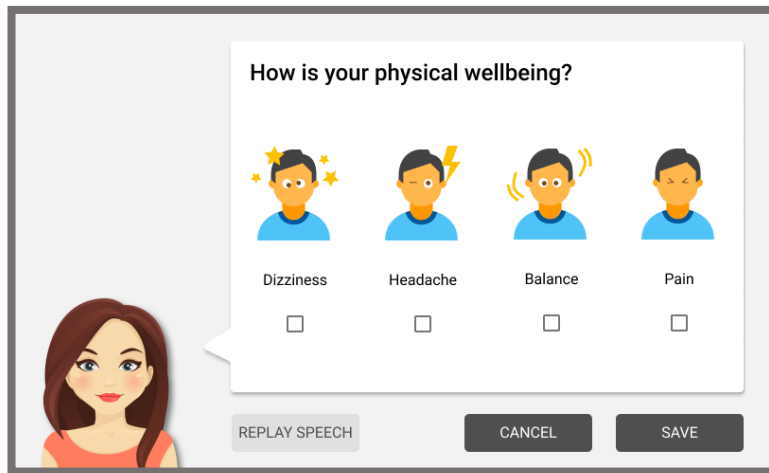


Figure 8 The final design of a physical discomfort self-report

The patient might not always remember or feel triggered to share his mood. Therefore, the system can ask the patient to share his self-report. This can be triggered by an interval set in the system (Figure 9), but an even more engaging and personal way is whenever the patient is triggered by a family member to share how they are doing (Figure 10). The caregivers as will be shown in the next section, can request the senior to share how they are feeling. Both scenarios will result in a notification which the PwD can still dismiss.

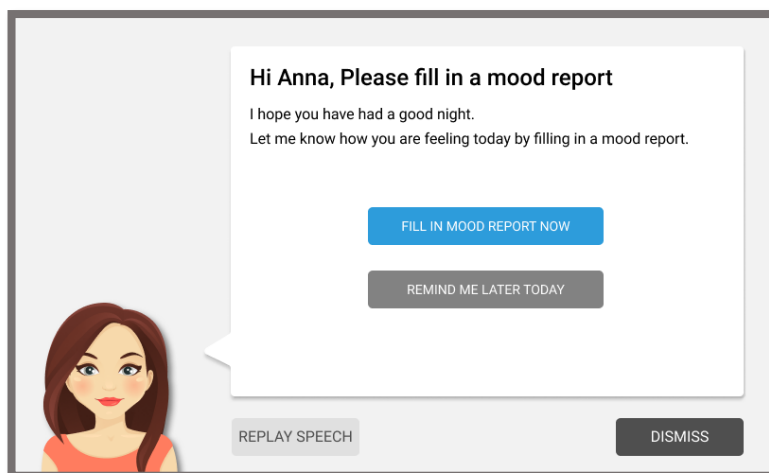


Figure 9 Notification requesting the PwD to fill in a mood self-report

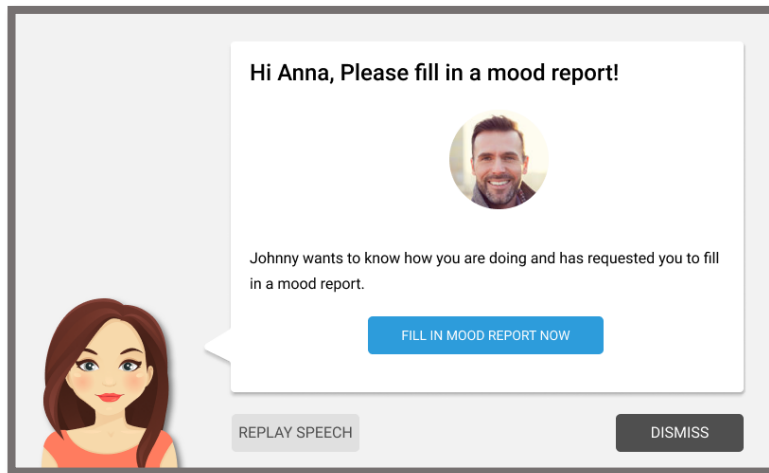


Figure 10 Notification triggered by an informal caregiver to fill in a mood self-report

4.2.6 Avatar

To support and engage the patient in the use of the application, all non-navigational pages and all notification and support communication will take place via a personal coach/avatar. This avatar will provide the senior with the regular workflow as presented previously, but it can also help the patient whenever he needs help (Figure 11). Depending on the current context, the avatar will show the PwD various helping options, which varies from watching a video (Figure 12), navigating to another page within MedGUIDE basic or navigating to another avatar-based screen.

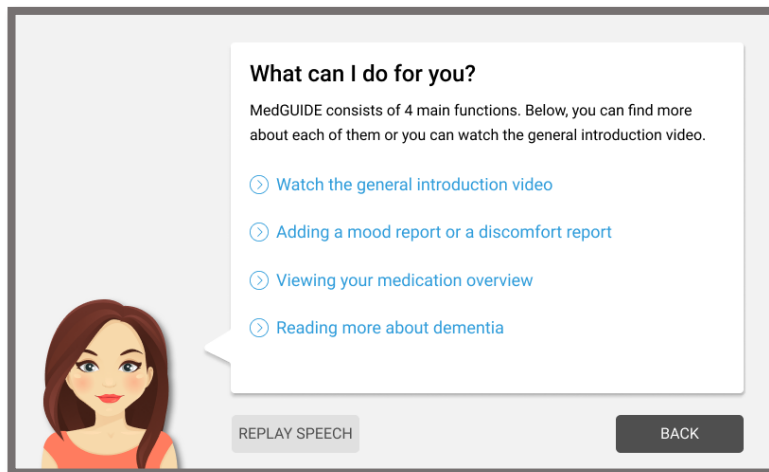


Figure 11 Example of the help functionality of the avatar on the dashboard

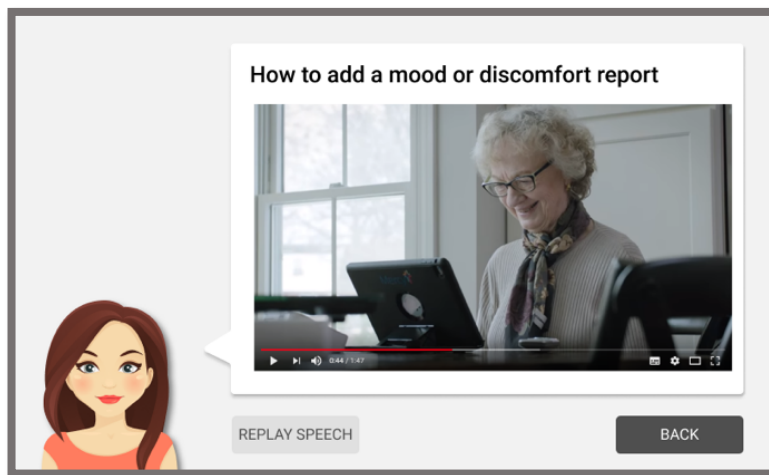


Figure 12 Example of the avatar presenting a movie on how to use MedGUIDE

4.3 MedGUIDE advanced for caregivers

4.3.1 Design rationale

MedGUIDE advanced is aimed at both the professional caregivers and the (in)formal caregivers. Within the care of a patient with dementia, both of them play an important role. The GP's role is cure based and whenever the patient visits the GP, the goal will be to analyze the status and based on that adapt or provide the needed treatment plan. On the other hand, the home care professional visiting the patient on a regular basis needs to keep track of the patient wellbeing, and provides the needed day to day care. The third professional actor that plays a smaller but still important is the pharmacist. He/she provides the needed medication, and evaluates whether the given medication doesn't have interrelated effects on each other, or negative side effects. All three types of professionals experience the same challenge: they do not have the time or the means to continuously know how the patient is doing, whether the medication is taken correctly, whether the medication is not affecting someone's daily live negatively, or whether the patient's wellbeing is decreasing because of the dementia. The (in)formal caregivers, which are mostly family members or friends and neighbors that support the patient on a daily or weekly basis, do often have this more detailed picture. However next to that, from the moment of the diagnosis of dementia, a lot of questions arise for them. The caregivers are anxious to know how the patient is doing, what the effects of the dementia are, and how medication influences the PwD. For this group it is important to have peace of mind though using MedGUIDE advanced, and know that their loved ones are doing well. MedGUIDE advanced will therefore support all caregivers by:

- Providing insight into the patient's medication plan and adherence
- Understanding which medication are taken
- Providing situational awareness based on sensors and self-reports
- Communication and collaboration between all caregivers

Furthermore, it will support professional caregivers by:

- Providing insight into which patient will need extra attention
- Evaluating interactions between the taken medication

MedGUIDE advanced will be presented to the user as a responsive web application that can be used on mobile phones, tablets and computers. The final design is created for the tablet form factor, but in the prototyping phase, a responsive version of this design has to be implemented.

The previously mentioned changes are implemented in the final design and will be discussed in the sections below. The following functionalities are removed from the application during the mockup design iteration:

- The to-do functionality
- The collaboration guidelines

Some functionalities are still to be designed in the next phase based on the findings of the mock-up evaluation:

- The authentication/login
- The entire set of patient setup screens/wizard, including the setup of sensors and medication plan
- The interface for annotating drug-drug interaction

The following section highlights the main functionalities of MedGUIDE advanced as presented in Figure 13. The mock-up can be accessed online: <http://bit.ly/medguide-caregiver-en>.

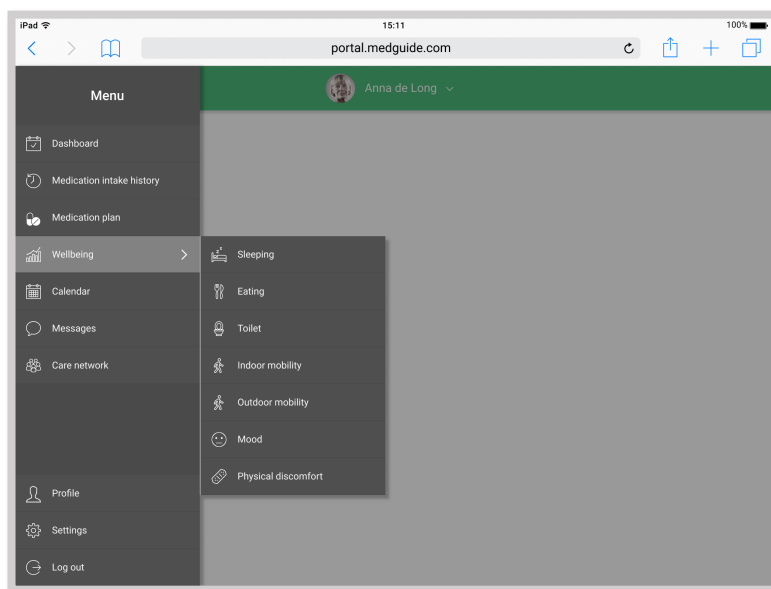


Figure 13 Final design of the MedGUIDE advanced menu

4.3.2 Dashboard, Caseload overview and patient switcher

After logging into MedGUIDE advanced, the (in)formal caregiver is presented directly with the dashboard of the PwD as shown in Figure 14. The professional caregiver goes to the caseload overview after logging in, as he is likely to be the professional caregiver for more patients that use MedGUIDE. On the caseload overview, the professional caregiver can view in a glance what the status is of the patients is. He can quickly scan which patients he should open and which of them are doing fine based on a summary of the patient status and the amount of unread messages.

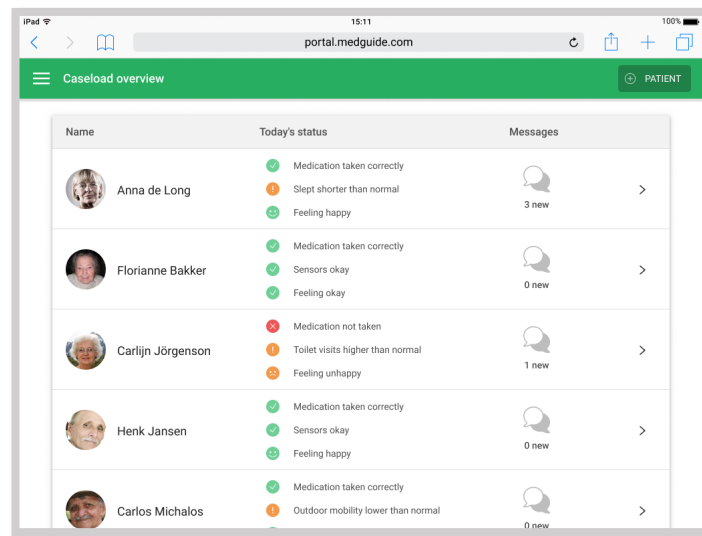


Figure 14 The final design of the caseload overview for the professional caregiver

After selecting a patient, the caregiver navigates to the dashboard of that PwD (Figure 15). After navigating to the context of patient, both professional caregivers and (in)formal caregivers with multiple care-relationships to PwDs can switch between patients using the patient-switcher in the header.

The dashboard shows in a single overview the status of the PwD. The timeline shows the current day with 5 different perspectives:

- The sleeping pattern, measured by a sensor in the bed
- The toileting and eating pattern, measured by sensors on the toilet door, the kitchen drawers and the fridge
- The indoor and outdoor mobility (measured by sensors in the house and on the PwD)
- Logged self-reports (both mood and discomfort, added by a caregiver or by the PwD himself)
- The medication adherence (measured by the smart pillbox or by manual input of the PwD)

Below this graphical timeline, a textual summary gives the caregiver a quick overview on the medication, the measured sensor data and the latest self-reports. With the date picker in the header are, the user can navigate to another day in the past, to view the overview of that specific day.

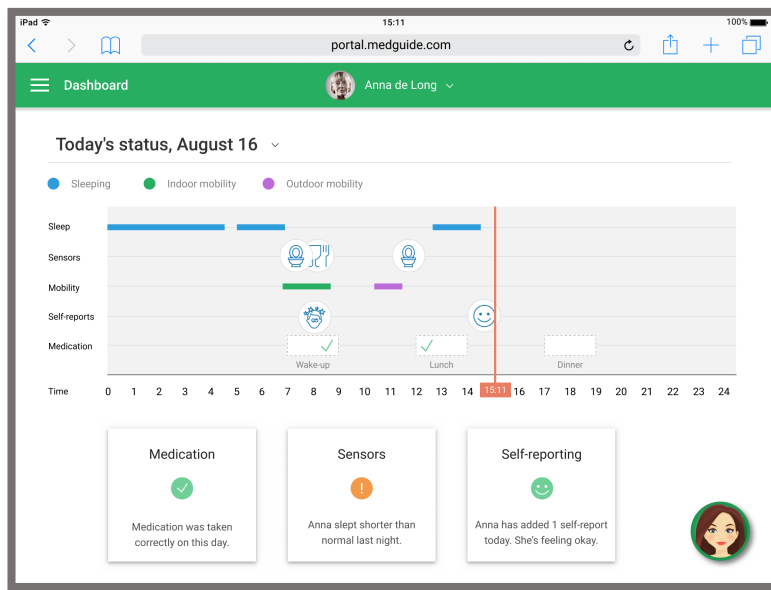


Figure 15 The final design of a dashboard of a PwD

4.3.3 Medication intake

As the main objective of MedGUIDE advanced is to allow monitoring of the medication intake by the PwD, the caregiver can view the details of the measured medication adherence on a dedicated page (Figure 16). It shows in a week-view or a month-view the intake history based on either the smart pillbox-registered data or the self-reported data by the patient (Figure 17). The views provide both a detailed insight as well as an overview over a longer period of the intake during the set intake moments over a day. Using the date-picker in the month view, also a longer history can be viewed, giving even more context.

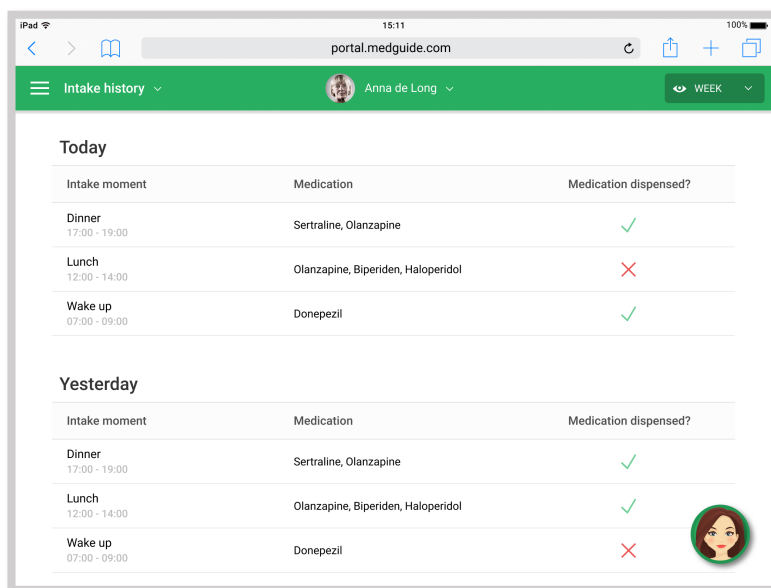


Figure 16 Final design of week view of medication intake history, showing data from smart pillbox

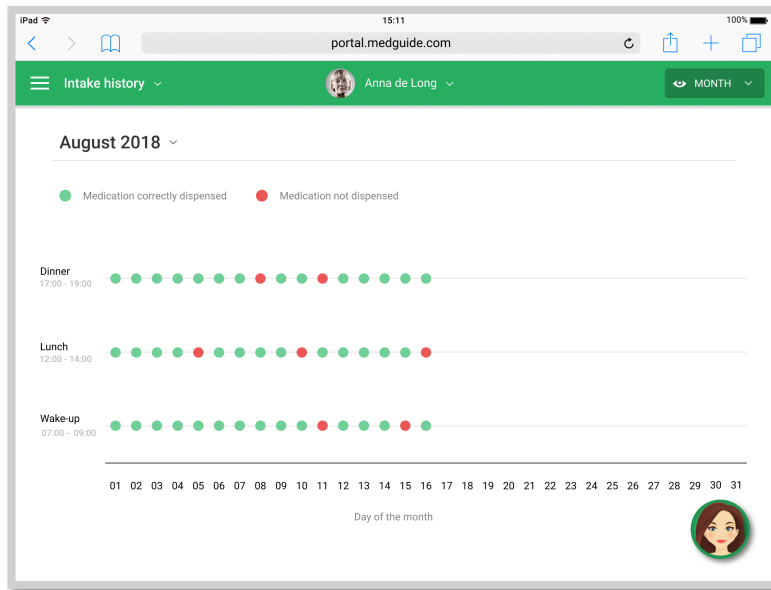


Figure 17 The final design of the month view of the medication intake

4.3.4 Medication plan

Within the medication plan, the caregivers and professionals have the choice of various presentation views: the simple overview (which is similar to the PwDs medication plan overview) which simply shows all the medicines a PwD takes, and a planning overview that gives more detailed insight into all intake moments of all prescribed medication throughout a week as presented in Figure 18. From both views, the user can navigate to a detail view, where both prescription details and general information is showed. The medication data should mainly be derived from a 3rd party pharmacy system, but from the evaluation, it was considered essential to also allow (in)formal caregivers to add (non-prescription) medication to the system themselves. This can be done through a simple dialog and these drugs will be added alongside the other medication in the medication plan. The intake moments are set during the setup phase of MedGUIDE, and the medication reminders for a PwD are triggered by these timeframes.

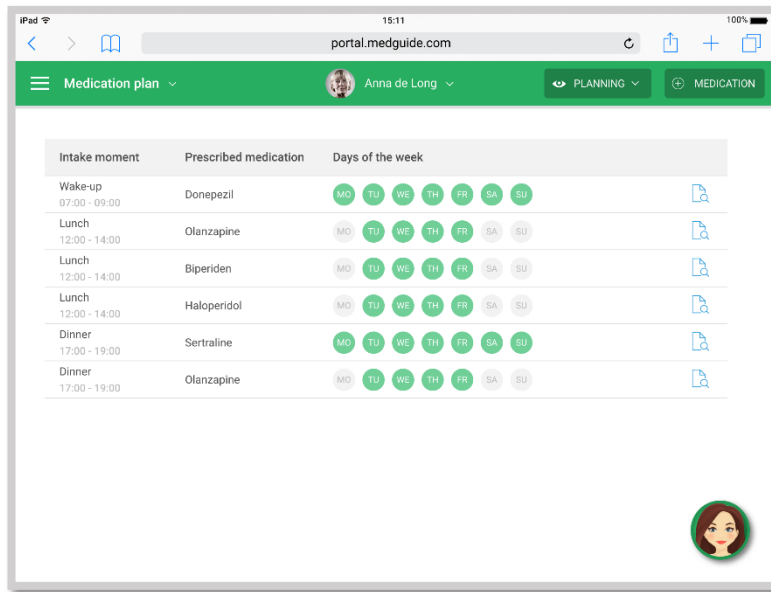


Figure 18 The final design of the medication plan in planning view

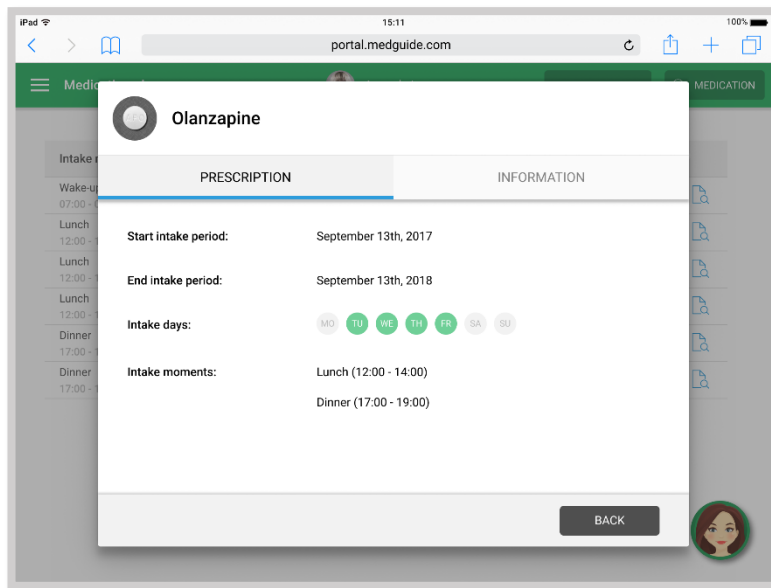


Figure 19 The final design of a details-dialog of a selected medication

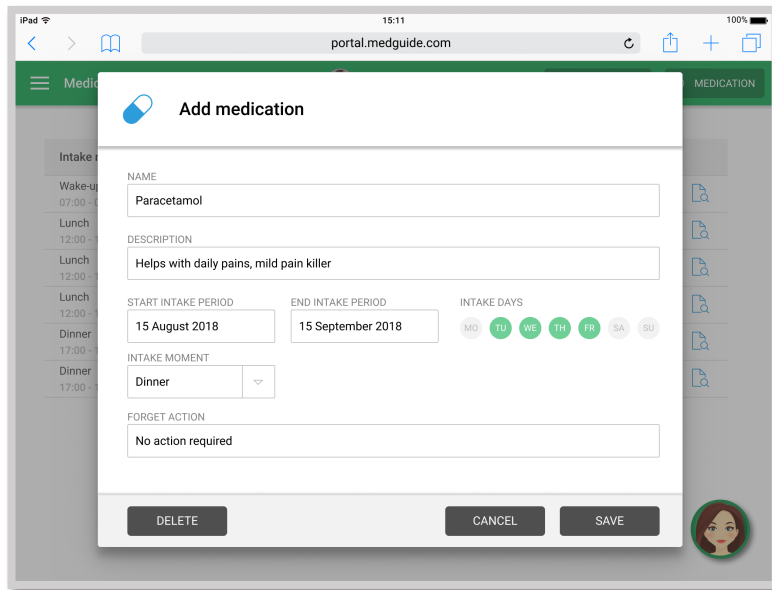


Figure 20 Dialog to allow adding additional non-prescription medication to the medication plan

4.3.5 Wellbeing

For the professional caregivers as well as the informal caregiver it is important to know how the patients is doing, and whether his daily patterns are changing. Unobtrusive monitoring sensors in the patients home will provide insight into the wellbeing of the patient. As previously mentioned all different wellbeing aspects are spilt into different views, in order to provide the needed information. For each of the data sets, a logical and easy to understand graphical presentation has been designed, accompanied by a detailed list view that gives the user insight into the patients wellbeing. A few examples are presented in Figure 21, Figure 22, and Figure 23.

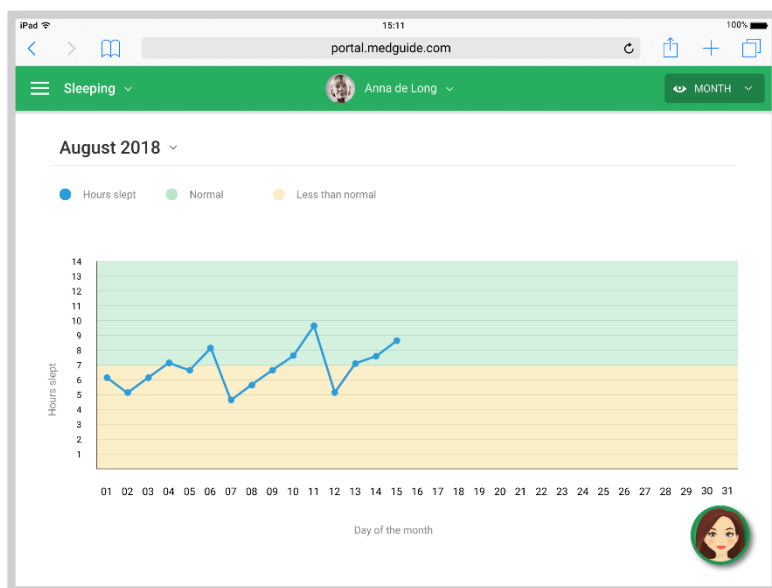


Figure 21 The final design of the month-view of the sleeping data

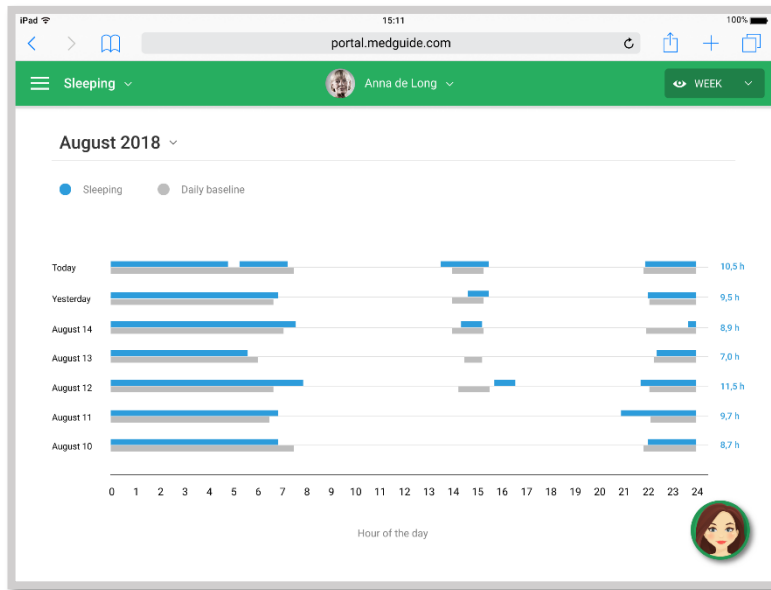


Figure 22 The final design of the week and day view of the sleeping data

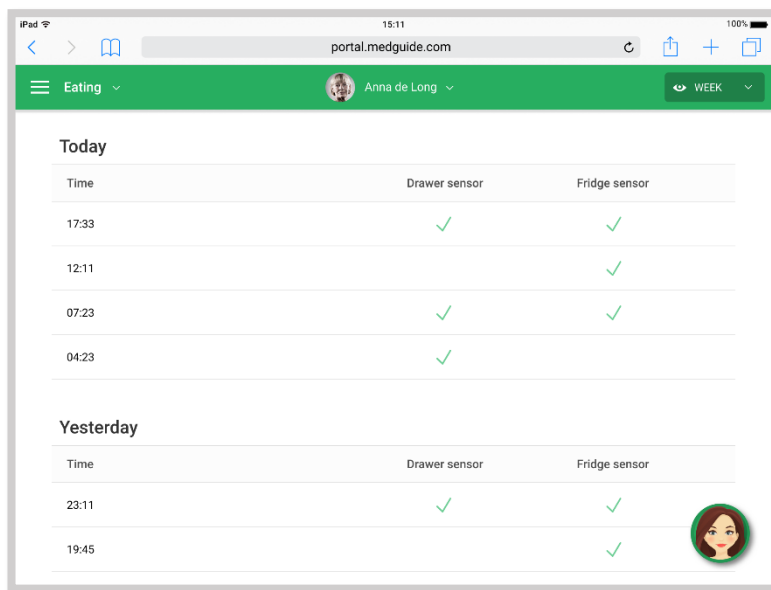


Figure 23 The final design of the week and day view of the eating pattern

4.3.6 Self-reporting

As both the self-reports and the sensor-based data are related to overall wellbeing, they are presented in a similar fashion. Figure 24 and Figure 25 show the mood reports. Figure 26 and Figure 27 present the physical discomfort reports. Next to viewing the history of when a self-report has been added and what its contents were, the caregiver can also use the button in the top-right to either add a self-report by himself or request a new self-reporting from the senior. This last action will trigger a notification in MedGUIDE basic.

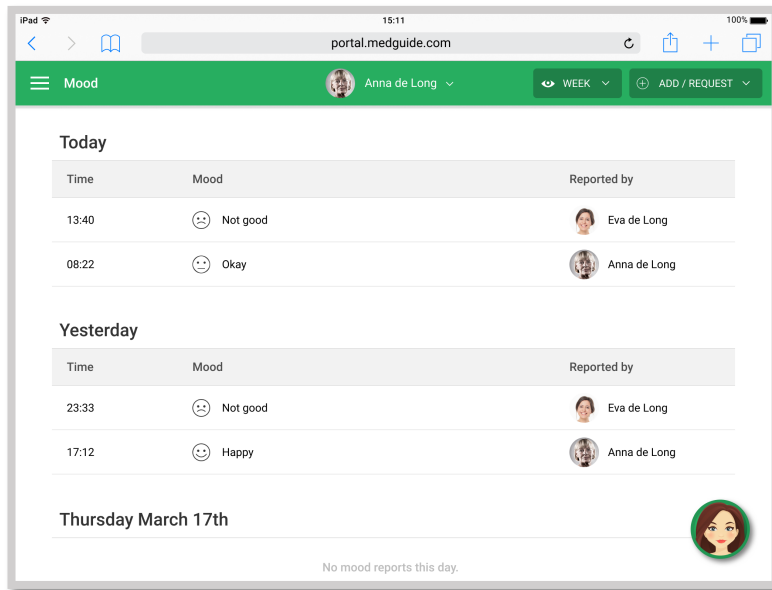


Figure 24 Day-view and week-view of mood reports

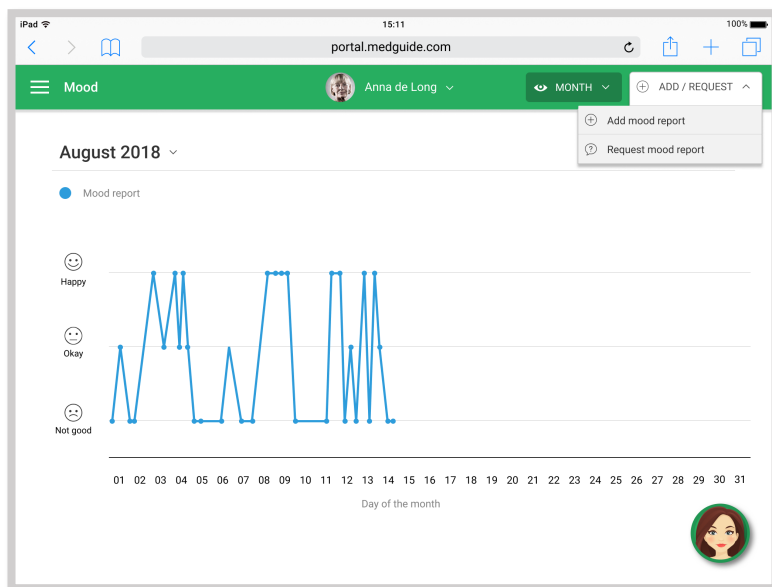


Figure 25 The month overview of mood reports

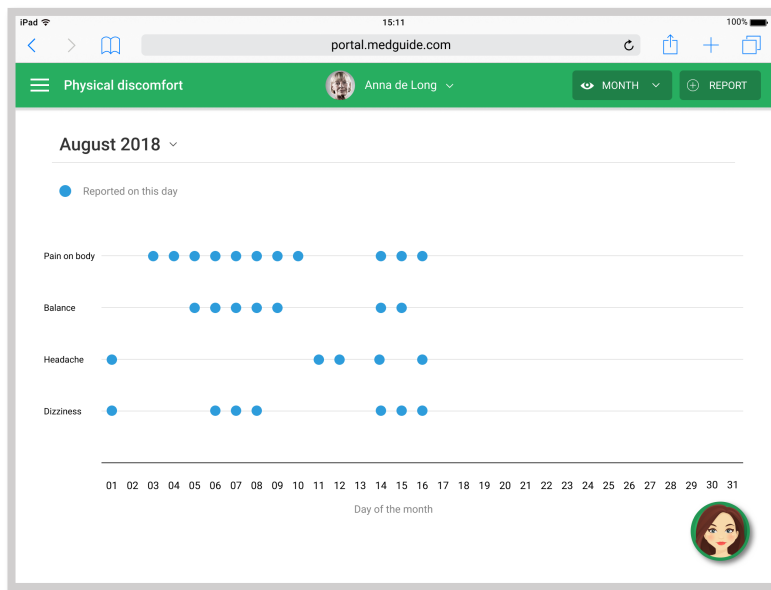


Figure 26 The month overview of reported discomfort reports

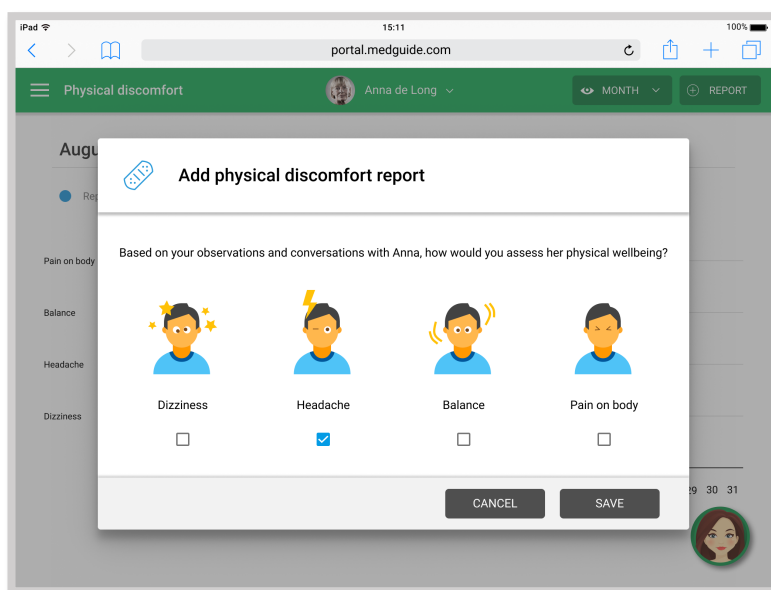


Figure 27 The final design of the dialog for the caregiver to add a discomfort report about the PwD

4.3.7 Collaboration functionalities

To allow collaboration between all caregivers around one PwD, the calendar and the messages functionalities provide the necessary yet basic means of working together. The calendar (Figure 28) shows appointments related to the patient, but it also shows the medication intake moments, so this can be considered when planning visits or activities with the PwD. The messages (Figure 29) allow for a simple and straight forward communication platform which allows all caregivers to communicate directly. Following the results of the evaluation, the journal functionality can be partially done in sharing updates within the messages system. The other reporting actions (e.g. by a GP) should be done in the other systems they currently use. It has been chosen not to have different message threads, as this is not the core of MedGUIDE. Also, advanced calendars views and the to-do functionality have

been left out to keep the collaboration simple. The calendar allows for creating appointments (Figure 30) together with other caregivers in the care network only.

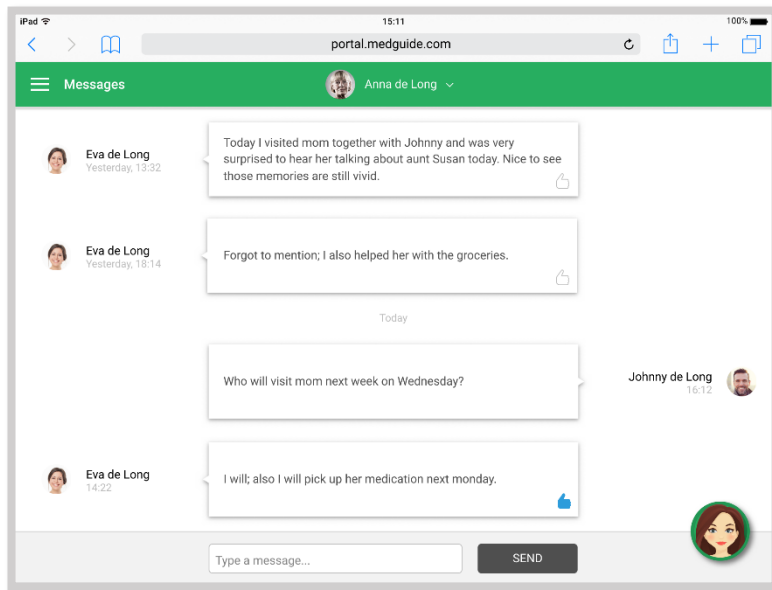


Figure 28 The final design of the message functionality

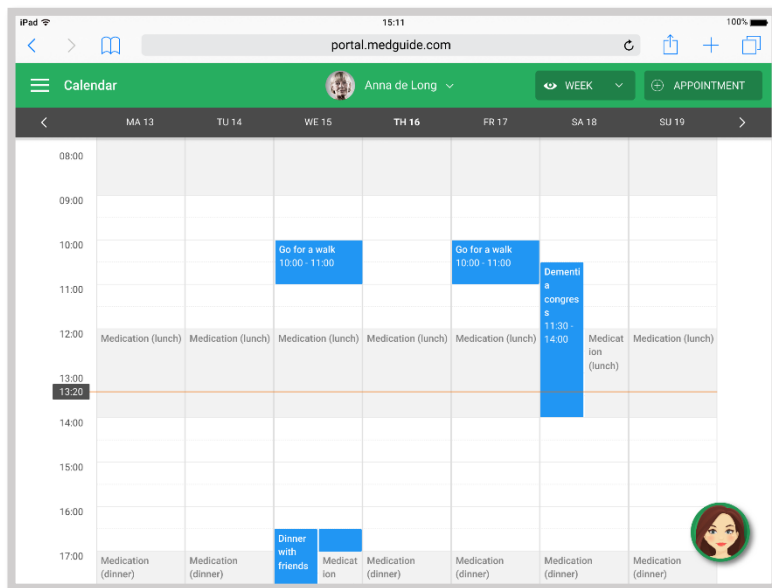


Figure 29 The final design of the week view of the Calendar

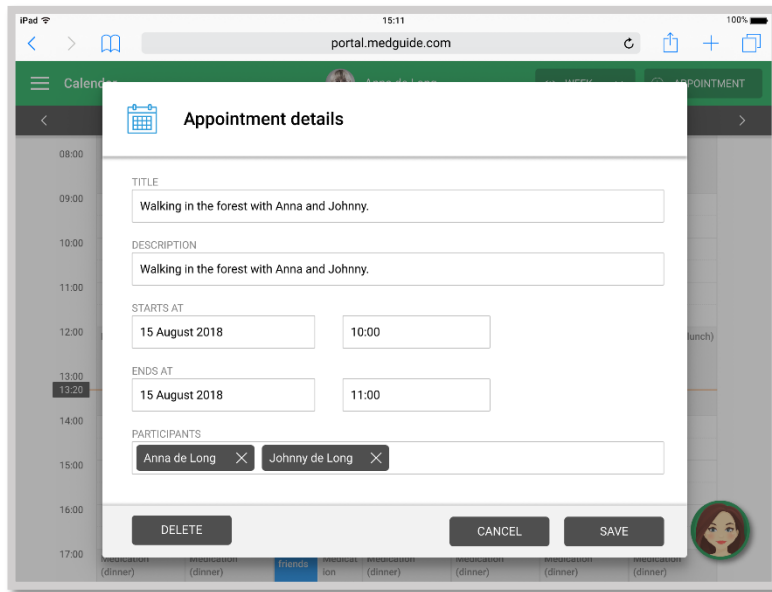


Figure 30 When adding or editing an appointment, other caregivers can be added as participants

4.3.8 Care network

The care network provides the caregivers an overview of all people involved in the care of the PwD. The care network shows which of the caregivers are professionals and which are (in)formal caregivers. The care network has been simplified compared to the wireframes, as it no longer shows the levels of authorization. It does show for each caregiver what their perceived workload is. This subjective value was considered as an effective and simple way of self-reporting by the caregivers and allows them to translate their actual work load into a subjective value.

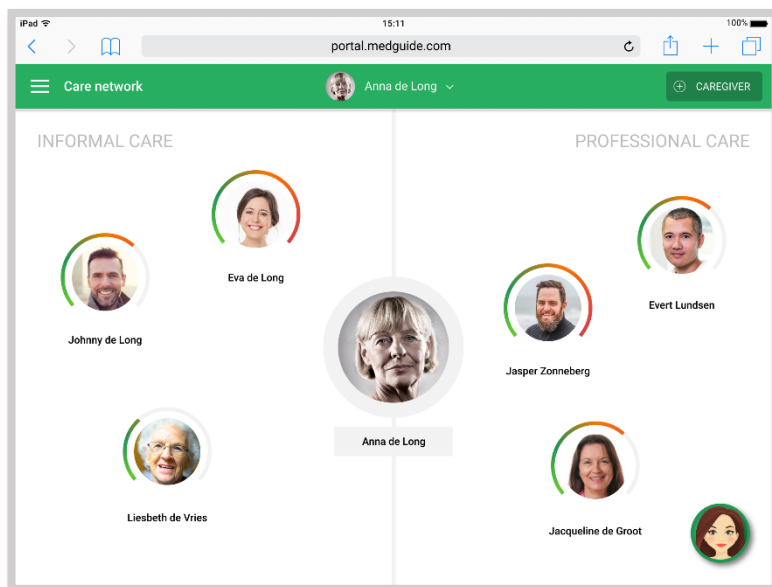


Figure 31 The final design of the care network overview

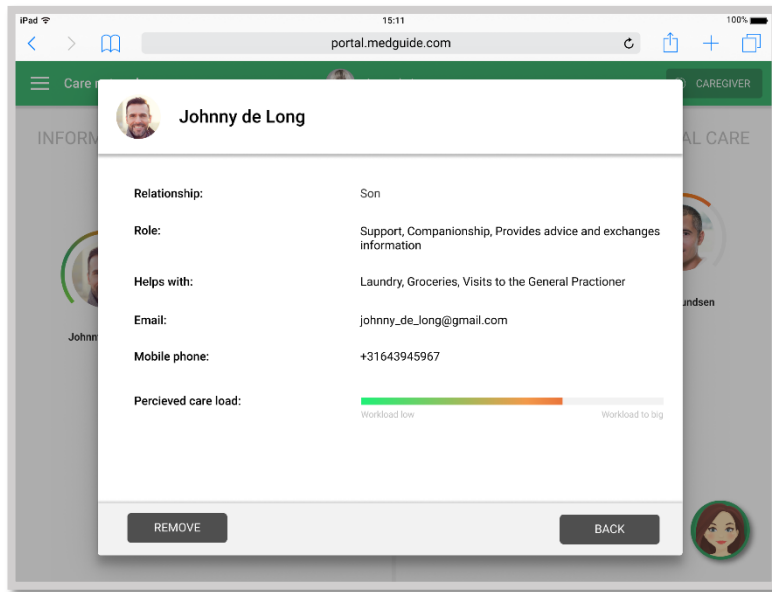


Figure 32 Detailed information on an individual caregiver.

4.3.9 Profile and settings

In the profile functionality, the caregiver can setup his own profile (Figure 33), Including his perceived workload and his role within the network. This information helps the other caregivers with coordinating the care. The user can also manage his/her account on his/her profile page, allowing him/her to move out of the care network of a PwD in MedGUIDE. Next to the personal settings of the profile, each user can set various settings in the settings area (Figure 34) mainly related to how he/she would like to receive notifications from events that happen within MedGUIDE. This way, the user can set his own scheme of how he would like to be actively notified (Figure 35) of the status of the PwD.

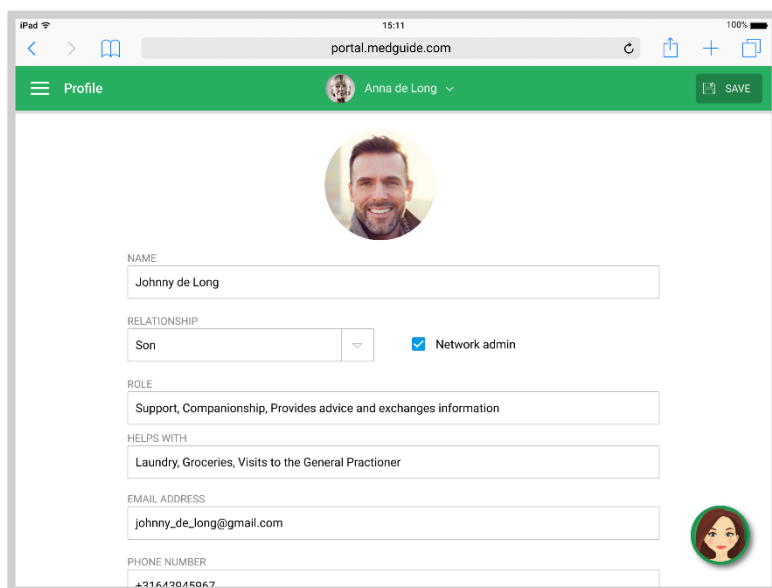


Figure 33 The final design of the profile page of an informal caregiver

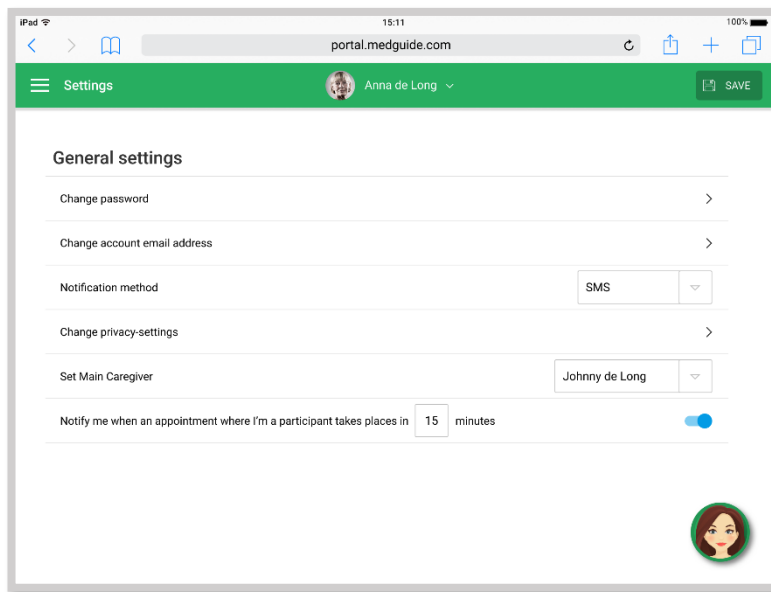


Figure 34 General settings for a caregiver, allowing him to manage the general application settings

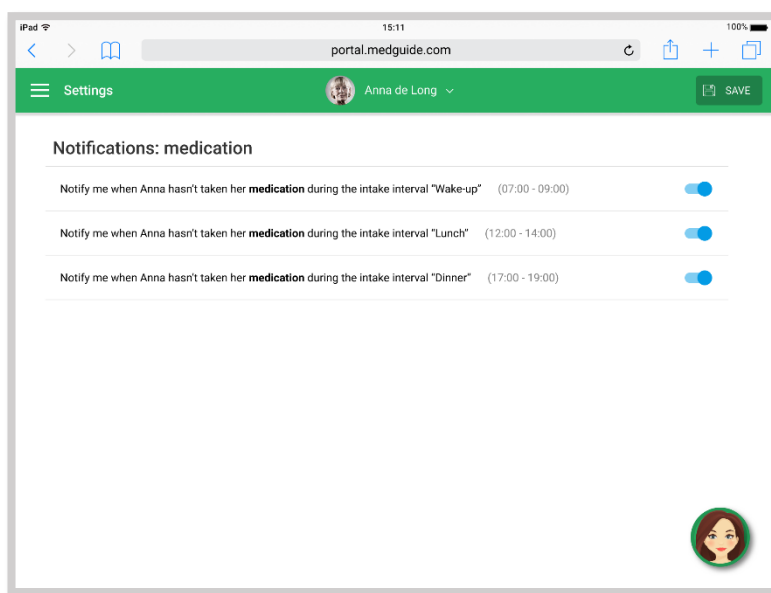


Figure 35 Settings of medication notifications

4.3.10 Avatar

Just like in MedGUIDE basic, also MedGUIDE advanced incorporates an avatar (Figure 36). However, in MedGUIDE advanced, the avatar has a secondary role; the user can use the application without the avatar if wanted. The avatar is only used as a pseudo-help functionality, and can give the caregiver contextual help about the screen he is on. Just like in MedGUIDE basic, during the first usage, the avatar gives a short introduction and shows a video to explain how to use MedGUIDE.

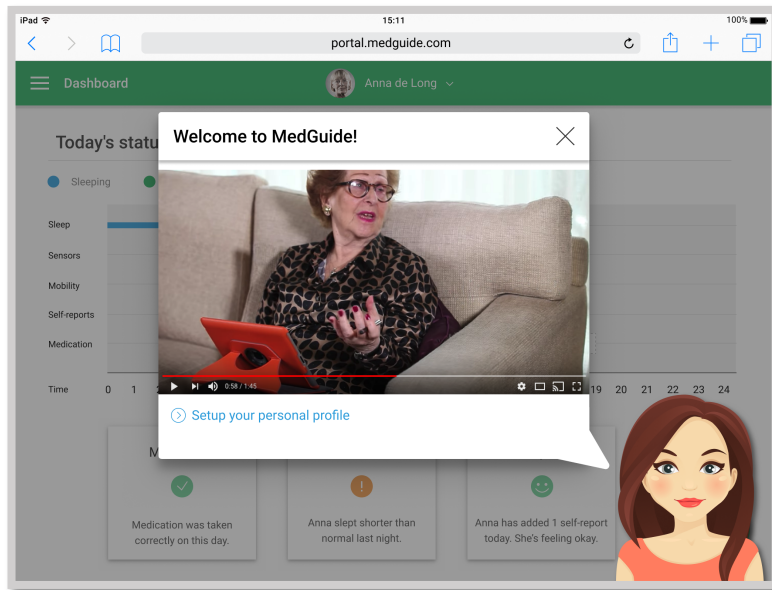


Figure 36 The final design of the avatar showing the user a video during the first usage tour

Besides of being a passive help, the avatar is also used to actively explain the user how to interpret the data on a certain page and to give hints about certain patterns in the wellbeing of the PwD (Figure 37 and Figure 38).

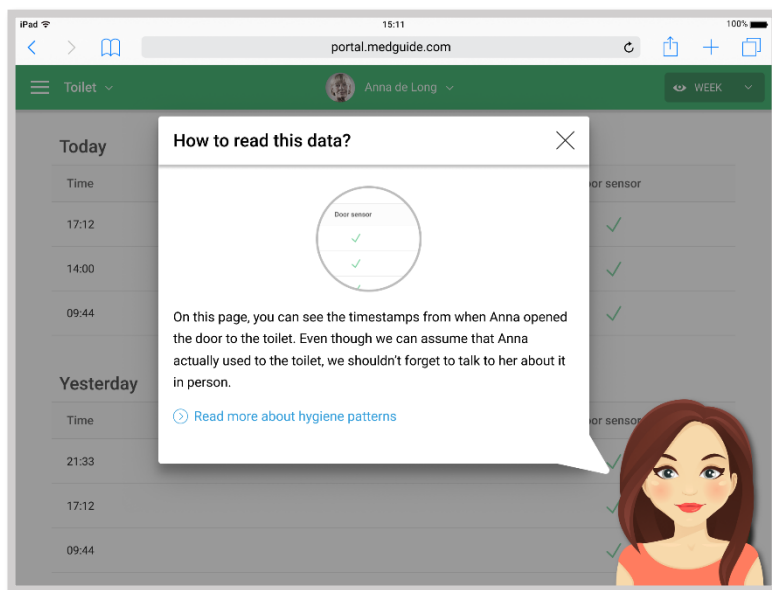


Figure 37 The final design of the avatar explaining how to read the data on the toileting page

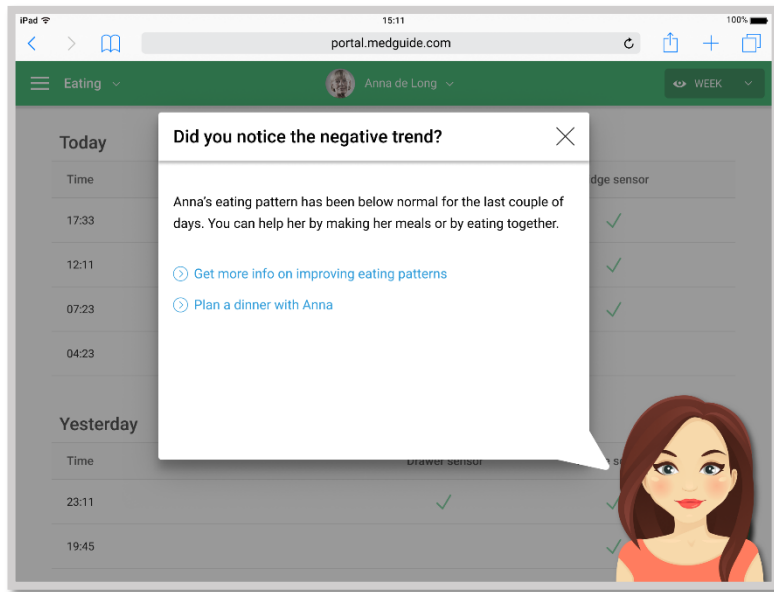


Figure 38 Example of avatar giving the user hints on wellbeing data about the PwD

4.4 MedGUIDE e-learning platform

The MedGUIDE e-learning application is two-fold:

1. The knowledge module(s) in the PwD's MedGUIDE application (see examples in Figure 39, Figure 40 and Figure 41). This part contains simple presentations of the three main stages of dementia, nutrition, physical activity advice as well as information about assistive technology.

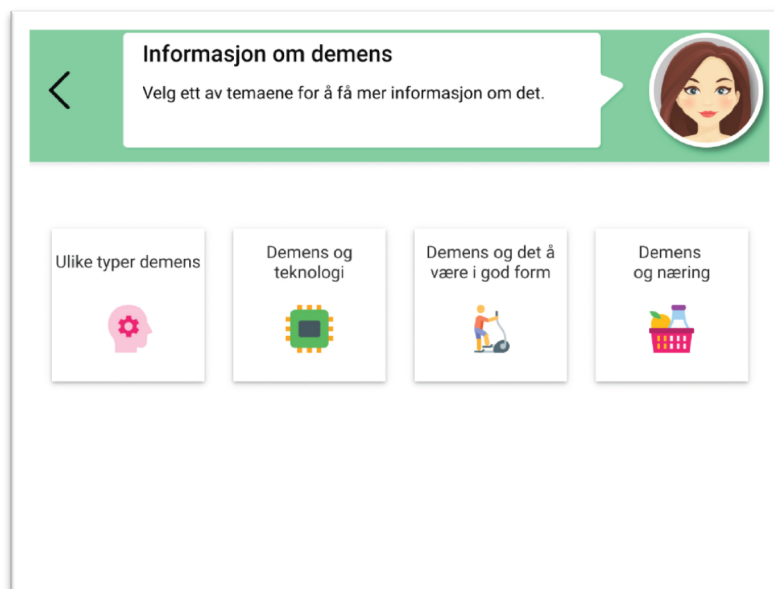


Figure 39 Menu choice of the PwD's app providing access to knowledge pages (In Norwegian)

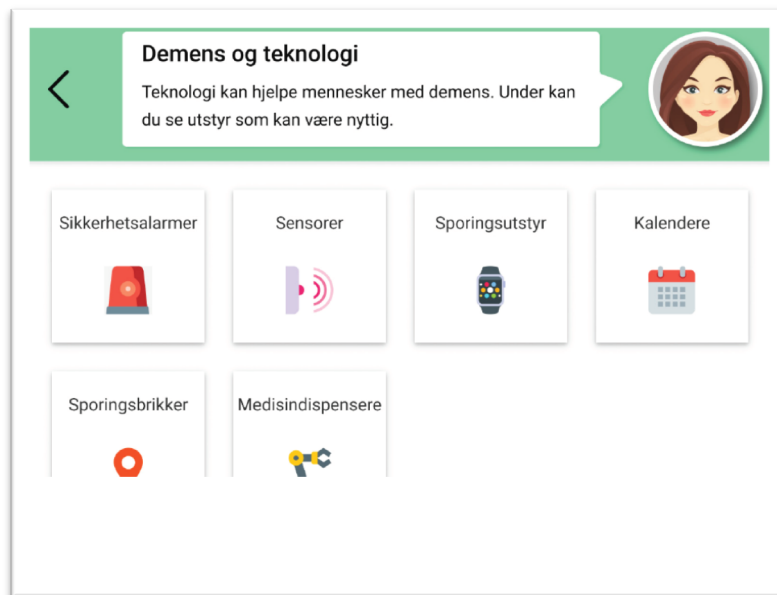


Figure 40 Knowledge page for PwD describing assistive technologies (in Norwegian)

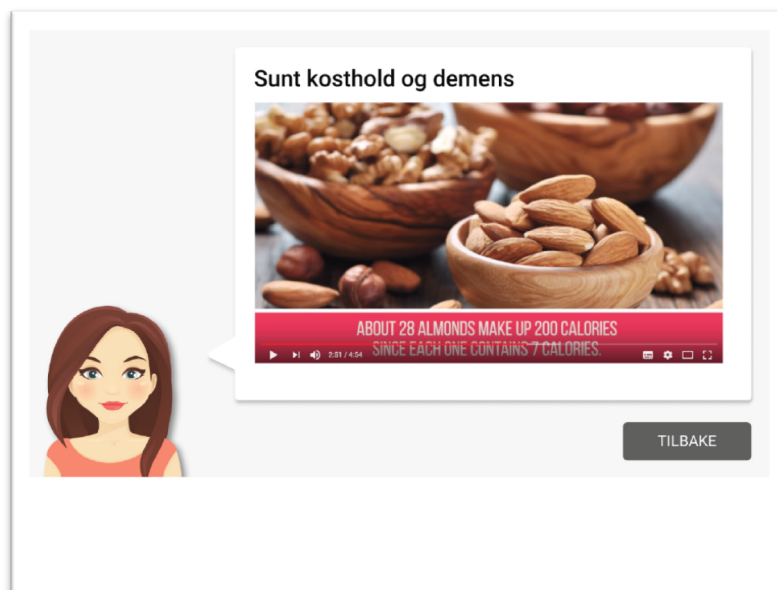


Figure 41 Knowledge page about healthy diet, presented as a video (in Norwegian)

- The e-learning resource for formal and informal caregivers. This part has been developed on the WordPress platform and is currently separated from the MedGUIDE application for caregivers.

A prototype of the e-learning applications can be accessed online: <http://medguidelearn.wpengine.com/>. The design of the prototype of the e-learning resource is shown in Figure 42.

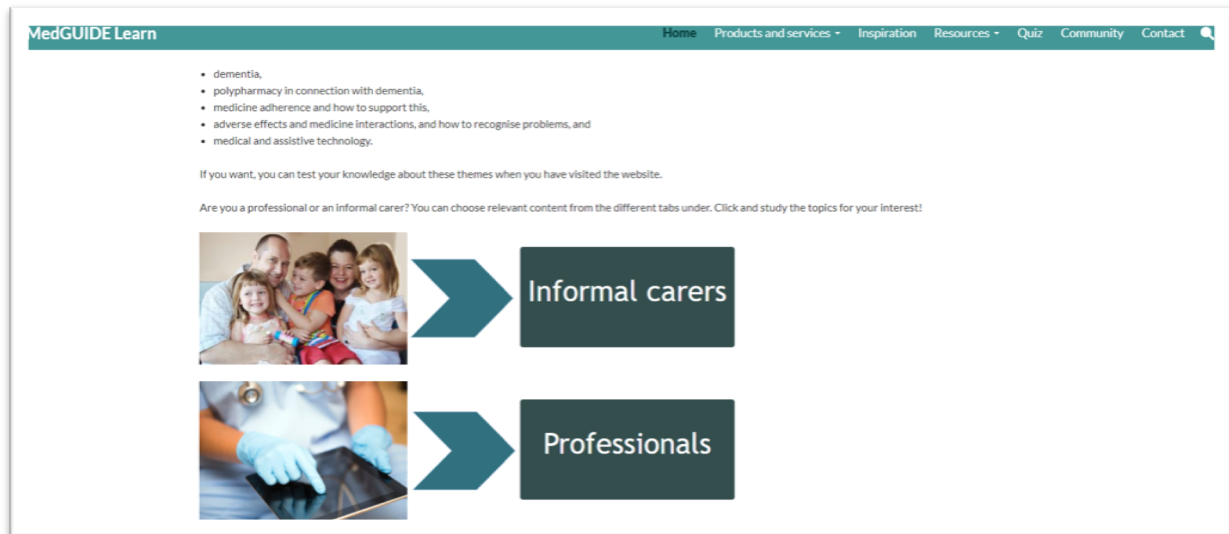


Figure 42 Home page for the MedGUIDE Learn website

This resource offers knowledge modules about:

- dementia,
- polypharmacy in connection with dementia,
- medicine adherence and how to support this,
- adverse effects and medicine interactions, and how to recognize problems, and
- medical and assistive technology.

The users may choose relevant content from the different tabs depending if they are professional (formal) or informal carers. They can test their knowledge about these themes by visiting the quiz's.

For informal carers ("family and friends"), the topics will be populated with content as popular scientific, easy-to-read-and-understand presentations of following:

- A. How and why dementia develops.
- B. Medicine adherence for people with dementia.
- C. Polypharmacy and dementia: Adverse effects and interactions.
- D. Changes in behavior and health of people with dementia and how to report it.
- E. Sensor systems: How to use sensor technology to support people with dementia.

For professionals ("home and health carers"), a selection of technical and professionally oriented (but still understandable) information was made:

- A. Medical, assistive and health technologies.
- B. Self-reporting: observations and longitudinal analysis.
- C. Medicine adherence for people with dementia: risks and methods.
- D. Supportive actions for the well-being of people with dementia.
- E. Interpretation of self-reported and sensor-based data with focus on adverse effects and interactions.
- F. How to use sensor technology for diverse dementia patients: requirements and configuration alternatives.

The top menu items for both professional and informal carers are identical:

Home
Products and services
Medication support
Memory assistance
Fall prevention and detection
Outdoors mobility and safety
Reminiscence and cognitive training
Smart home technology
Finders
Inspiration (useful videos about dementia and assistive technology)
Resources (country-wise)
Organisations
Publications
Quiz
Community
Contact

The MedGUIDE learn solution is responsively designed and can be integrated with the MedGUIDE app as an external resource that renders nicely also on a tablet (see Figure 43).

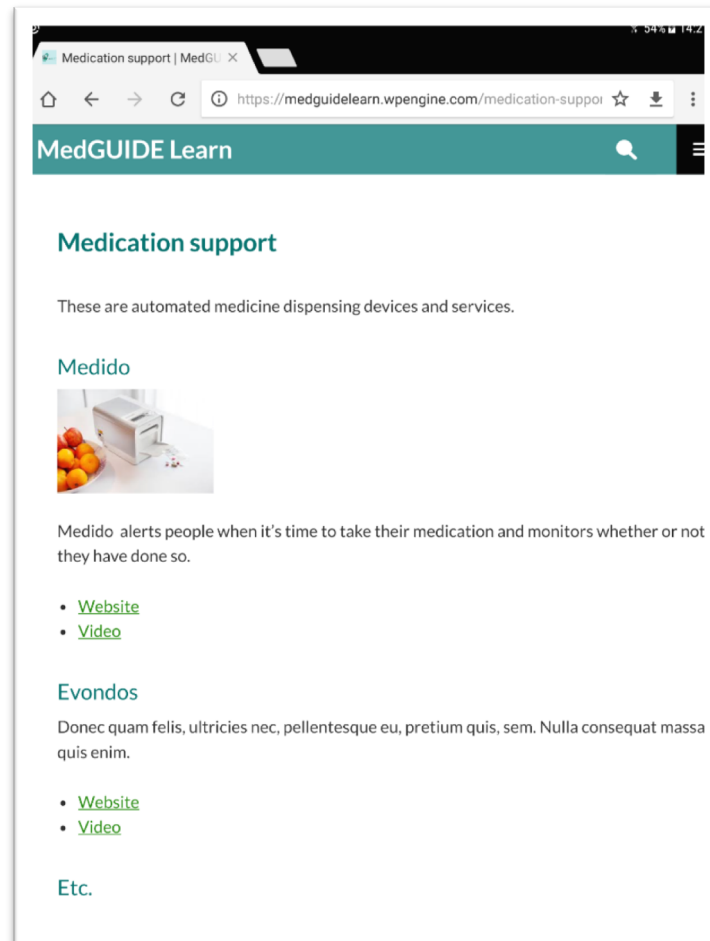
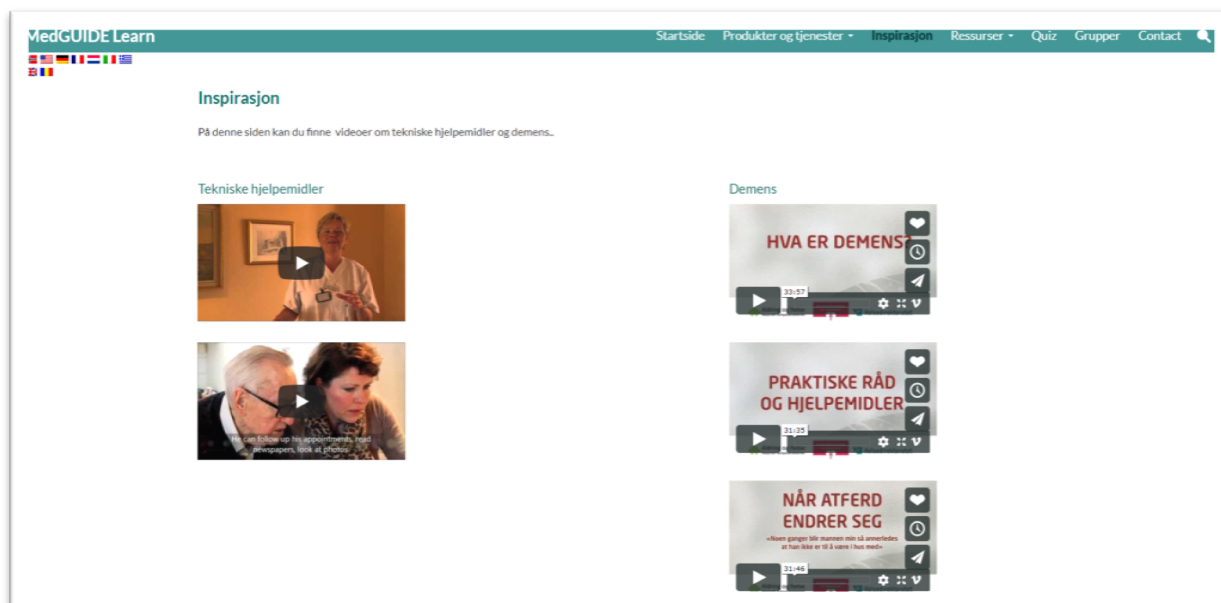


Figure 43 Tablet view of 'Medication support' under menu choice 'Products and services'

MedGUIDE learn is multi-lingual and is currently under development in order to provide the following languages:

- Dutch
- English (baseline)
- French
- German
- Greek
- Italian
- Norwegian
- Romanian

The contents can thus be culturally and language-wide adapted to all project countries' preferences. The contents should also be inspirational and easy to understand. It was therefore decided to add multimedia material, such as videos as presented in Figure 44.



The screenshot shows the 'Inspirasjon' (Inspiration) page on the MedGUIDE Learn website. The page features a navigation bar with links for 'Startside', 'Produkter og tjenester', 'Inspirasjon', 'Ressurser', 'Quiz', 'Grupper', and 'Contact'. Below the navigation bar, there are two main sections: 'Tekniske hjelpemidler' (Technical aids) and 'Demens' (Dementia). The 'Tekniske hjelpemidler' section contains two video thumbnails: one showing a woman speaking and another showing an elderly man and a woman. The 'Demens' section contains three video thumbnails with titles: 'HVA ER DEMENS', 'PRAKTISKE RÅD OG HJELPEMIDLER', and 'NÅR ATFERD ENDRE SEG'. Each video thumbnail includes a play button, a heart icon, and a play button icon.

Figure 44 A Norwegian page for video material about dementia and assistive technologies

5 Architecture and service design

5.1 Introduction

Within Task 1.2, the feedback and requirements resulted from Task 1.1 are translated into the baseline for the MedGUIDE architecture.

In MedGuide, a 4+1 architectural view model for the design of each individual service was used. The view model describes the services and components that constitute the MedGUIDE project.

A detailed view of all the different components and their explanation, can be found in D1.2. Based on the first trials minor updates have been done in the overall architecture described in D1.2.

The following principles are guiding the development of all services and tools being developed:

- Modular design, to ensure that systems and components could easily be reused by other components and other systems. Modules should be as self-contained as possible.
- Interfaces and communication, to ensure easy of scale and transparency on how the system works, and the format of the data being shared among the different components of the system. With a well-known API and information model it is easy for others to adapt and provide other tools based on the same information.
- Followed standards, when there exists a standard that helps or guides the development of the MedGUIDE services, those standards and best practices were adhered to. By applying standards and best-practices the usability and modular ability of our solutions will be higher.

5.2 MedGUIDE architecture

In Figure 45 the overall conceptual architecture of the MedGuide system is presented.

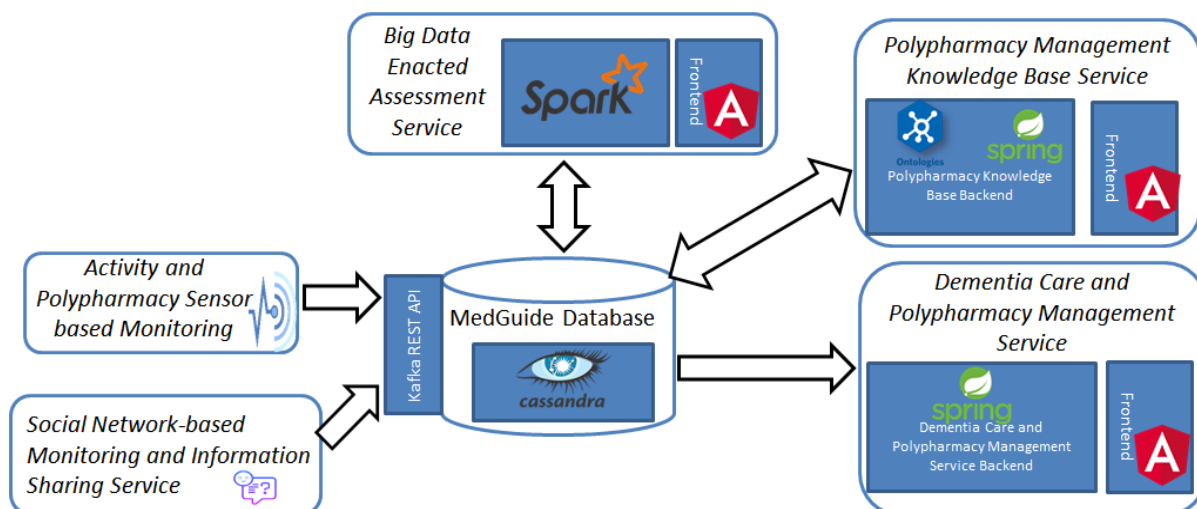


Figure 45 MedGuide system overall architecture

The system will feature five services each targeting the implementation of specific functionalities of MedGuide:

1. Activity and Polypharmacy Sensor based Monitoring deals with monitoring and integration of various variables and distributed data sources describing the elder's: (i) Activity of Daily Life and Lifestyle such as physical activity, sleeping patterns, movement habits, nutrition and social interaction aspects and (ii) medication intake and adherence to the prescribed therapy.

2. Social Network-based Monitoring and Information Sharing brings the ‘human perspective’ provided by family, informal caregivers or the patient itself by using (self)-reports.
3. Big Data Enacted Assessment Service leverages on big data techniques to analyse the heterogeneous and distributed streams of monitored data to establish the baseline Daily Life Activities for each elderly patient, and to detect deviations that represent changes, either sudden or gradual, in patients’ activity routines which may signal progression of his symptoms, wellbeing decline or side effects of medication.
4. Polypharmacy Management Knowledge Base, uses a polypharmacy management ontology allowing the doctors to annotate the deviations detected by the assessment service with potential side effects of polypharmacy in dementia treatment.
5. Dementia Care and Polypharmacy Management Service provides personalized and coordinated guidance, motivation and support for all types of system end-users using specific dashboard interfaces.

5.3 Sensor data capture architecture

The data capture framework as seen in Figure 46 was used in MedGUIDE. This model is agnostic towards the sensors used. A smart sensor gateway was installed using a Raspberry PI that controls and sends only appropriate data to the backend for further analysis. And the data from the backend are then used to drive the other services offered.

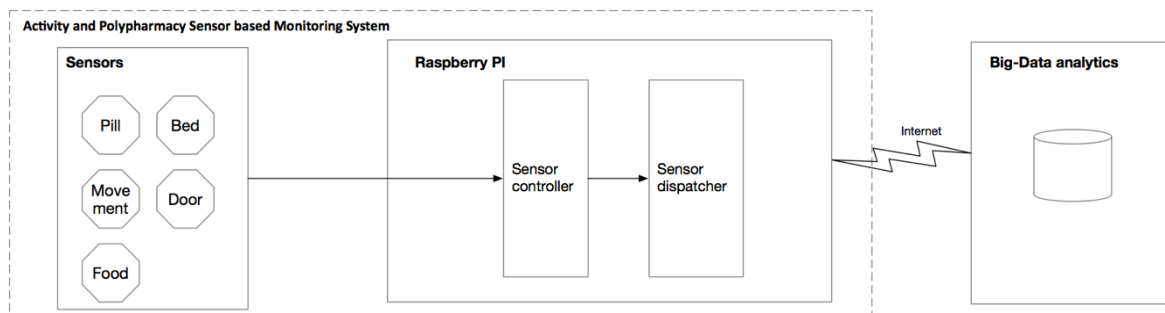


Figure 46 Logical view of sensor capture architecture

5.4 Self-reporting process

Some data about the PwD’s activities are captured automatically using sensors that sends data back to the system for analysis. Other data such as data about how well they feel, and the PwD’s subjective perspective on some of the daily routines performed, is harder to catch. In the MedGUIDE project, a self-reporting process was established. The reporting process is triggered by different events such as events from the sensor-controller, or it could be triggered by a timer e.g. in the morning: “Did you

sleep well?”, after eating: “Was the food tasty?”, after medication: “Did you take all your medication?” etc. Figure 47 presents a typical such process.

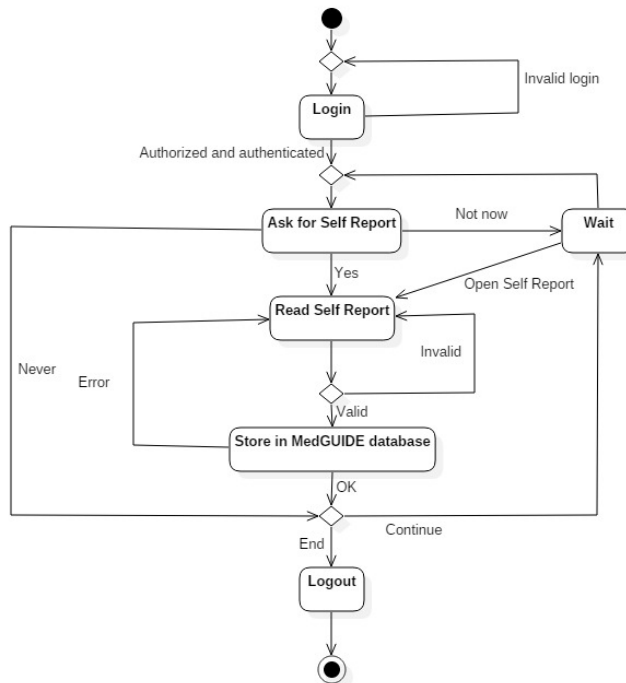


Figure 47 Activity diagram illustrating the flow of the Self Reports process

5.5 MedGUIDE basic Frontend

By following some basic guidelines and methodologies described below, the frontend adheres to modern design and development guidelines, and can easily be adapted to other front-end solutions such as an App, or a more full-fledged web design. This also ensures a high level of flexibility, and will be easily adapted to more advanced frontend solutions for other user groups.

5.5.1 Technical scope

The primary frontend is designed as a web-application that should be able to run in Chrome and Firefox on a Raspberry Pi. The frontend will be built upon Angular 5¹, using the NG-zorro² library for the UI. The application should have a fixed resolution of 800 x 480 and should be touch-friendly.

The application should be multilingual, based on a backend parameter. It should at least support English, Dutch, Greek, Norwegian and Romanian.

5.5.2 Generic User interface principles

The user interface of the senior frontend is specifically designed to work together with a 7" touchscreen combined with a Raspberry Pi. Although it roughly follows the Material Design³ guidelines

¹ <https://angular.io/>

² <https://github.com/NG-ZORRO>

³ <https://material.io/>

and principles, the UI also has some specific design features specific for the target group (seniors) and the hardware.

5.5.3 Color, icons and typography

Throughout the senior interface, bright, contrasting and primary colors are used to enhance usability. Next to this, a consistent and screen-readable font is used, next to a colorful icon library that fits the functional scope of the application.

5.5.4 Layout structure and responsiveness

The generic UI should have a fixed resolution and consists of a header containing the navigation and avatar, followed by a vertically scrollable area which contains the content of a page.

5.6 MedGUIDE Advanced Frontend

5.6.1 Technical scope

The caregiver frontend is designed as a web-application that should be able to run in any modern browser⁴ with JavaScript enabled. The application should be responsive and touch-friendly, as it should work on mobile phones, tablets and computers.

5.6.2 Generic User Interface principles

The user interface of the caregiver frontend is based on common user interface guidelines for touch-enabled browser applications. It roughly follows the Material Design⁵ guidelines and principles. It further means that the frontend uses as much standardized UI components as possible and the layout adheres to a common, easy to use and recognizable structure.

5.6.3 Layout structure and responsiveness

The generic UI is column-based and should adhere to the common UI structure of Material Design. This means that the layout is consistent over all resolutions, where the header contains the menu, title and action button, followed by a vertically scrollable area which contains the content of a page. The UI contains various breakpoints, based on common device resolutions⁶. On small resolutions (<840px), the menu is off-canvas on the left; on larger resolutions, the menu is always present in a minimized form on the left of the screen.

When the minimal height and width of the application is exceeded, the entire application becomes scrollable in 2 axis.

⁴ 2018 versions of Chrome, Firefox, Edge, Samsung Browser, Safari

⁵ <https://material.io/>

⁶ <https://material.io/guidelines/layout/responsive-ui.html#responsive-ui-breakpoints>

6 Conclusions

This deliverable has presented the final design of the MedGUIDE system. The design is aimed at both PwD and formal and informal caregivers. For both target groups a personalized and simplified interface design has been developed. The main goal is to support the Patients with dementia in the adherence of the medication, as well as support them in sharing and tracking how they are feeling. The caregivers will be supported with the MedGUIDE system by knowing in detail how the patient is doing through user state assessment provided by sensors as well as through means of self-reports. The platform will keep track of the medication intake and changes in the medication adherence. The platform will support close collaboration amongst caregivers.

The results of the lab evaluation of the final design can be found in “D3.1 MedGUIDE Wizard of Oz 1st evaluation in controlled environment”. Based on these findings the MedGUIDE final design will be adapted and developed into the first prototype, which will be presented in “D3.2 MedGUIDE system prototype – 1st release”.