

# TRUSTED PATIENT COACH™

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## Abstract

*Trusted Patient Coach™ is an elaborate system used for the collection and analysis of patient data. Besides measured values, the system monitors and automatically analyzes the patient's care-plan defined by the physician (or patient), stores information about prescribed medication and facilitates patient-doctor communication. Its direct link to doctors and caregivers is what makes the system unique. The system provides current data, a complex overview of patients and escalates potential events via alarms or text messages. From a technical point of view, the system is implemented as a distributed mobile system comprised of a patient mobile phone application and a master portal.*

## Keywords

*Health care, mobile system, medication adherence, care-plan compliance, data analytics*

## Mobility and Motivation

Today, mobile technologies extend across most areas of one's life. For many years now, the mobile phone is no longer used solely for making calls and sending text messages. And the health care and patient treatment industry is no exception. A patient always has his/her mobile phone handy. We can use this knowledge to our benefit.

The use of mobile systems in the health care industry is the natural consequence of the ever so expanding use of smartphones. Complimenting this technology with know-how and interactions with physicians gives us an utterly unique system that can actively support in treating patient health problems.

Attending physicians can go to one place in the system to see an overview of all their patients along with the current values, history and health care for each of these patients. All without having the patient pay a visit to his/her attending physician. Replacing scheduled and non-scheduled visits for patients with long-term illnesses makes the provided health care considerably more efficient.

We must also not forget about another key benefit of using mobile systems in the health care industry - the automatic evaluation of measured and collected data. This way the system can also detect critical states

which otherwise may not be brought to the attention of medical professionals. The system continuously evaluates data, providing real time information about the patients' progress in meeting their care-plan goals.

## High-level structure

System Trusted Patient Coach™ consists of several fundamental parts – the mobile application for patients, central web portal running on the main server, data storage and integrated external systems.

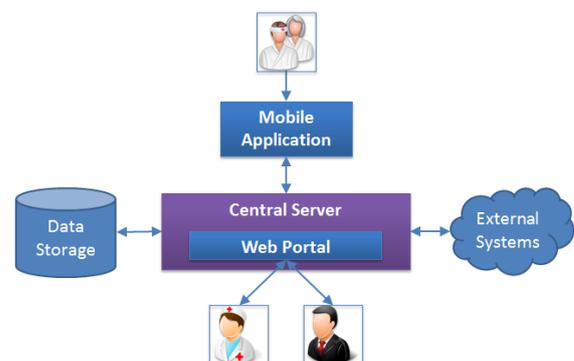


Fig. 1: High-level structure of the system.

Patients use their mobile application to access the system on a daily basis. They may also use the web portal directly if absolutely necessary (for example while on vacation). By using the web portal, however, the patient only has access to limited system functionality (for example reminders or alarm escalations are not available here).

The main server operates the central part of the system. The main server is integrated with the data storage and also external systems for interacting with available resources on the Internet or, for example, with medical records and hospital systems.

Attending physicians access the system via the web portal, providing a neat overview of patient information. The web portal is also used, to a limited extent, by caregivers to "check" the data for patients they are caring for (for example, that they are taking their medication on time).

## Main features

The functionality of the entire system is divided into several modules, each of which focuses on one feature as a whole – for example medication or measured data. The module structure also corresponds to the modular architecture of the main server, as well as the mobile application for patients. Some modules depend on others and therefore make up a dependency map for these modules.

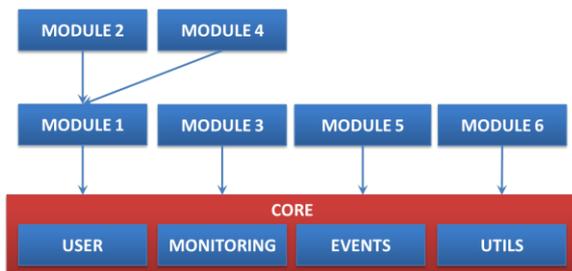


Fig. 2: Dependencies of system modules and structure of system core.

The system contains a system core, i.e. a basic set of modules, essential for the system to function. The core facilitates basic system functionality – user administration and user rights, allocation of rights, or logging each access to the system and data.

## Patient data

One of the basic features of the Trusted Patient Coach™ system is collecting and processing patient data. Patient data is collected on a regular basis (as defined by the physician) and automatically processed and evaluated in real time. The patient simply enters all

data into his/her mobile application and is prompted to submit new data by a reminder stored directly in the phone. Once entered into the device, the data is immediately available to the attending physician.

For security reasons, data is stored on the main server to prevent the loss or misuse of data within the mobile phone. Thus, the mobile application only holds the bare minimum of data; all other information is downloaded from the main server in real time. This approach also ensures the data is always up to date when using the system.

## Care-plan and compliance

Additional modules, which analyze and process collected data, are linked to the basic patient data module described above. Based on the measured data, the system evaluates the care-plan progress or escalates critical values in the form of alerts.

The attending physician defines care-plans for users; the system then oversees the progress of meeting the respective care-plan goal. The patient also has the option of creating his/her own rules, which the system evaluates, however, he/she may not change a care-plan defined by the physician. The patient and physician have access to the current care-plan progress.

Alerts are escalated both passively and actively. The passive form of escalation is presented to the respective user upon his/her access to the system. The active form of escalation is carried out immediately (for example an email). Critical situations, which are to be escalated, including the form in which the respective alarm shall be distributed to individual users, can be defined within the system.

## Medication

Another important feature of the Trusted Patient Coach™ feature is the medication module. This module holds information about the patient's medication and oversees the patient's behavior when it comes to taking medication. The attending physician can see if and when the patient took his/her medication. Patients are also reminded to take their prescribed medication via phone reminders.

This module can also utilize information available on the Internet, particularly by integrating with public drug databases to obtain detailed information about individual types of medication.

## Technological overview

From a technological point of view, the central part of the Trusted Patient Coach™ system is built on standard Microsoft technologies. Using such

technologies can significantly simplify product certification for use in the medical environment.

Tools and technologies, native for the specified mobile phone platforms – Google Android or Apple iOS – are used for the implementation of mobile applications.

### Mobile applications

Mobile applications are implemented as native applications – Google Android and Apple iOS. These two platforms cover the majority of smartphone users.

Unlike platform agnostic technologies (for example HTML 5, JS and CSS), native applications utilize the full potential of the selected platform and all special features of the respective device – for example the support of integrating medical sensors connected to a tablet.



Fig. 3: Screenshot of the Trusted Patient Coach™ mobile application.

The mobile application has a very simple structure. Once authenticated, the user is directed to the home screen, which displays all notifications and important information. The user can then navigate through the individual modules using an easy navigation bar.

For example, the figure above shows a screen of the module for measuring patient data. The user can see a neat list of measured values, summarizing the basic information available. A detailed graph, showing the values over a sortable period of time, can be displayed for each value. A new value/measurement can also be entered.

The PANIC button plays a key role and is available on all screens of the application. This button allows the patient to contact the physician or urgent medical care in emergencies. Standard smartphone features can be used to connect the patient with the physician.

### Web portal

The web portal is implemented as a standard website based on MS technologies (ASP.NET MVC). Using standard MS technologies can make the certification process for the medical environment significantly easier. The web portal uses the same service layer as the mobile application in the form of WS/SOAP services.

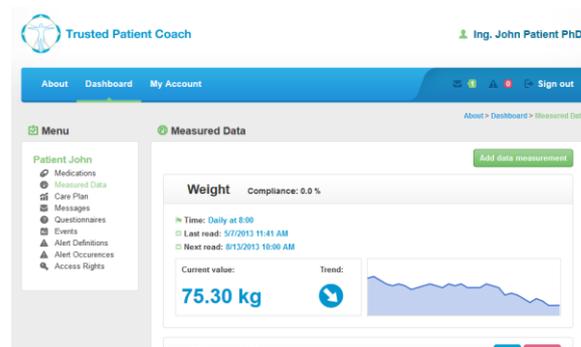


Fig. 4: Screenshot of the central Trusted Patient Coach™ web portal.

The web portal structure was particularly designed for the needs of attending physicians and health care professionals, who were consulted on a regular basis and played a key role in the design phase. The portal, however, can also be used by family members and by patients themselves. The structure of the website will adapt to the authenticated user, particularly based on the role of the user (patient, physician, nurse, family member etc.).

Attending physicians will see an overview of their patients and summarized information (for example care-plan compliance), with data interchange to electronic medical records. Medical professionals, in general, can see information about the selected patient and can of course define rules for patient treatment. Thus, the physician directly influences the content and behavior of the system for each individual patient.

The patient will see the same information on the web portal as he/she would in the mobile application, and therefore offers an alternative to the mobile application, for example, should the patient leave his/her mobile phone behind or not have an internet connection (for example while on vacation).

Family members can see detailed information about their relatives. Access rights control the extent and detail of information shown. Patients can choose which data he/she wants to make visible to their family members.

The “closed loop” system enables tracking of and support for the patient to achieve higher adherence over sustained periods to medication and care plan, as prescribed by his or her physician. The system facilitates communications between the patient and caregiver, with earlier and more rapid interventions when the patient gets “off track” and with support to get back “on track.”

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