TOPS - System for Planning and Providing the Health and Social Services at the Home Environment of Clients

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Abstract. In the health care field there is a growing demand for services provided in a clients' home environment. The high quality of services and responsibility for health and lives of patients require a professional approach and an appropriate set up of business processes within organizations providing these services. The aim of this paper is to describe the system for support of planning, recording, reporting and invoicing of the health and social services at home environment of clients.

Keywords: information system, mobile communication, planning, invoicing, health services, social services, home.

1 Introduction

Modern information and mobile technologies allow the creation of comprehensive solutions that can improve coordination and communication between employees and reduce paper work in many fields of human activity. Quite logically, these solutions are deployed first in engineering, where they are used by technically educated workers. Application of these solutions in other spheres then puts high demands on intuitive, good ergonomics and high stability of all elements of the solution.

Organizations offering home nursing and care services have qualified staff for providing specialized services. Based on contracts with health insurance companies or clients these organizations ensure the execution of these services by authorized personnel at clients' home environment.

The ambition of presented TOPS[1]project is to develop and offer a complex information and telecommunication solution to these organizations that cover all common and specific needs for providing services mentioned above, for example:

[1] TOPS - label for System for Planning and Providing the Health and Social Services at the Home Environment of Clients.

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- client evidence,
- care orders in the form of vouchers or contracts,
- staff evidence including their education and attendance,
- scheduling clients' visits,
- data acquisition about provided services directly at clients' home,
- care reporting,
- invoicing of provided services to health insurance companies or to clients.

2 Analysis

The existing solutions e.g. Pečovatelská služba[2], Alora[3] are mainly offered as installation package. Most of organizations providing health care are nonprofit. This is the reason they do not have resources for providing particular IT solution. Presented project is offered as supported service. It allows reducing cost for purchasing and maintenance.

Based on the analysis of needs and processes in these organizations the following basic requirements for the developed system were established:

- cover the entire set of activities in home care and nursing services from client intake, care planning, care reporting, recording all information, conducting long-term and short-term care plans, rating and invoicing,
- filed staff will report provided care directly in the client's home,
- synchronizations of data between stationary systems and mobile devices every few minutes,
- work on a mobile device has to be allowed even when the transmission network is not available (offline),
- use of a solution cannot be tied either to the existence of IT professionals in customer organizations or to buying the new equipment,
- data security,
- implementation of many different user roles,
- implementation of different rating rules and requirements for billing,
- creation of statistical reports,
- updates in line with legislative requirements,
- the ability to modify solution according to customers' requirements.

To successfully address the above-mentioned requirements the necessity of implementing these key intelligent features has been identified:

- proper allocation of care to the client visits based on contracts or vouchers,
- implementation of tools for working with multiple visits in scheduler,
- synchronization of data between the stationary system and mobile devices with minimal volumes of transferred data,

[2] Pečovatelská služba, Petr Zajíc software.
[3] Alora Home Health Software, Alora Healthcare Systems.

- automatic validation of reported data about provided care,
- implementation of a universal billing.

3 System Architecture

The TOPS architecture (Fig. 1) shows global concept of the whole solution. The architecture has three main parts: mobile devices for field-workers, PC for staff working in service centers and server infrastructure.

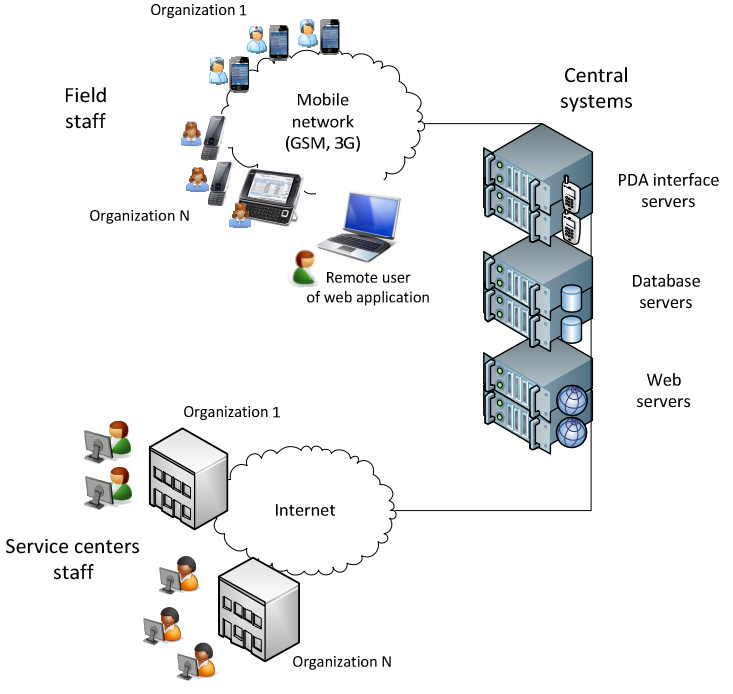

Fig. 1. TOPS Architecture

The base of the server infrastructure is a central database server. This server forms the lowest layer of the entire system.

Database servers use Oracle platform which is appropriately equipped to ensure safe and reliable operation of the system and necessary computing power. During the TOPS development the emphasis on solving data security was accentuated because sensitive personal details about clients, their diagnosis, etc. are stored in central database and transmitted to smart mobile devices (PDA).

The main user interface for service centers staffis a web application, which includes:agenda, care planning, preparation and printing of contractual documents,

reportsand invoicing. This application is equipped with many dynamic components using AJAX technology and communicates directly with the central database via Web servers.

Field staff use mobile devices such as PDA. PDAs are operated with the Android operating system and the TOPS mobile client. These mobile devices communicate with central systems via a public mobile network (e.g. 3G, HSDPA, EDGE,GPRS) in a separate APN[4]. It allows separating a communication inside TOPS project from the other data communication in mobile network [1]. Communications with client application on mobile devices cater PDA interface servers.

4 PDA Mobile Devices

A mobile device is given to a field staff that provides health and social care at a client's home. An integral part of the client application development was an analysis of the field staff needs, not only in terms of accurate records of provided care, but also in communication with coordinating person during operating changes in the daily plan. For the coordinating person application provides actual information about the staff location and actions in progress. PDA also use camera as barcode reader. Barcode reader is useful to identify client [2] or to verify that worker really made the activity.

Thanks to the touch screen and easy control it allows the quick and intuitive auditing for the health status of clients, actions in progress or drugs that were administered. These records could be later showed, edited and billed to clients or insurance company using TOPS web application. Field worker can also use information about his planned and realized visits, addresses and access details to the client and contact information of his family members.

4.1 Synchronization

Unlike web application, client application for mobile device does not communicate directly with the central database but it uses local database. Local database content is synchronized with a central database server via PDA interface servers. The main purpose of this solution is to secure EHR[5] in situations when online connection is not available to central systems via mobile network (e.g. in sparsely populated areas).

Synchronization mechanism was developed as a part of a project. Synchronization uses XML standard for communication and minimizes the volume of data synchronized between mobile device and central database. The synchronization procedure is activated on mobile device every 5 minutes, therefore the central systems and mobile devices work with almost online information and can react very quickly to possible changes of daily schedule.

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[4] APN - Access Point Name identifies an IP Packet Data Network, that a mobile data user wants to communicate with.

[5] EHR – Electronic Health Record.

4.2 PDA Task Processing

Task transferred to the PDA (Fig. 2) contains also EHR needed for its execution. After a manual acceptance of the received task, device starts to record a field worker motion trajectory during transport stage. Time period of different stages (transportation, particular actions, waiting for client, study of medical records, etc.) is automatically measured.

Fig. 2. PDA application screens. From the left side: daily task list, one task view - list of operations, daily record of the visiting client.

By using simple dialogs the worker may confirm the actual number of executed actions, medicine consumption and eventually values of temperature, blood pressure, glucose, etc. The client application on PDA is also able to browse daily records, comments and measured values retrospectively. Qualified staff can therefore assess an acute deterioration or improvement of client´s health. At the end of a visit the employee can also write daily record.

4.3 Data Security

Every employee log on to the application with his unique user account name and password. During synchronizations only data filtrated on the basis of user permissions necessary to carry out planned activities are transferred to mobile devices. [3]

Data cannot be misused by unauthorized people even in the case when mobile device is stolen or lost. Downloaded data are encrypted. The number of invalid attempts to log on is limited. Data is erased from mobile device in the situation when this limit is exceeded.

5 Web Application

The web application is designed primarily for coordinating staff and managers. Advantage of the web solution is the ability to use the application practically from anywhere and from any platform. There is no need to install application on computer. Internet connection and installed web browser are the only needed requirements.

Application is composed from modules: Scheduler, Cards, Codebooks, Maps, Reports, Invoicing and Administration. User access to concrete modules, organizations and its parts (institutions and workplaces) and service types is limited by user roles and licenses. Application design is modular and there is possibility to add the necessary modules for future functions or standards dynamically, e.g. [4]. In the following chapters there are brief characteristics of main modules.

5.1 Module Scheduler

Module Scheduler (Fig. 3) is the planning calendar for managing employee schedules.

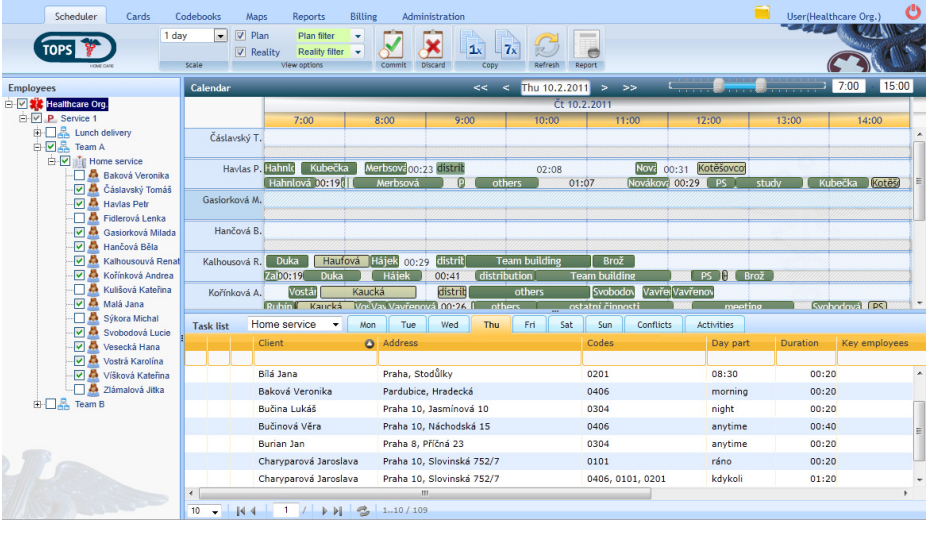

Fig. 3. Web application – module Scheduler. Hierarchical structure of organization and employees on the left side allows to select employees and to display their planning calendars in the central part of the window. Task list placed in the bottom displays tasks prepared for scheduling.

Color of task informs about task state. The coordinating employee responsible for planning activities can therefore simply recognize if the task has already been transferred to the PDA, whether activity starts or whether it was successfully or unsuccessfully completed. In the necessary cases this employee can make operational rescheduling by moving task with mouse to the different person calendar or to different time.

The module Scheduler can display employees' calendars in three regimes: plan only, reality only and both together. Simultaneous display offers a visual comparison of the plan and reality. This module includes intelligent functions like plan transfer to different employee, quick creating of the new plan based on history and care orders, etc.

The system automatically generates the tasks based on data from client's contracts or vouchers for each day to the task list. The task list is essentially a table where one row corresponds to one task or activity. This arrangement allows viewing relevant information for planning, such as the address of the client, required time for the visit or the expected duration of task. The tasks are automatically removed from the task list after their transfer with mouse to the planning calendar.

5.2 Module Reports

The module Reports is the extension of application which is designed primarily for managers. This module allows creating different kinds of reports and statistics. All reports are displayed in the tables (also called grids) within the web application. The reports can be exported into files in formats CSV, XLS, XLSX.

The key features of reports are dynamics and flexibility. Reports are represented by database queries. Any report definition can be uploaded into the application dynamically at any time without changes of database structures.

In the module Reports there is the strict verification of user rights which limits not only access to concrete report, but also restrict a set of processed data (rows and columns of reports). Similar security verifications are implemented in all modules of TOPS application.

The module includes the ability to create press kits. The application allows defining a very wide range of output formats - from simple formats such as CSV or TXT through XLS to complex outputs which include text, tables, images and graphs - e.g. formats PDF, DOC, RTF, XLSX, XLSM.

The most typical reports are monthly statement of work, an overview of monthly billing, an overview of care provided to clients, different annual statistical reports, etc.

5.3 Module Invoicing

The system can perform the rating of all services provided to clients. The unique mechanism for care and nursing services rating was developed. User can define several different types of rating rules which have an impact on the overall outcome of an invoicing process.

Calculations can be based on the number of performed operations, kilometers, time spent, amount of consumed material, weight of washed and pressed clothes, flat fee or various combinations of these parameters. The module was built with respect to user friendliness and simplicity.

An optional addition to the invoicing process is the ability to create reports for health insurance companies. These report scan be uploaded to the systems of health insurance companies.

5.4 Module Maps

The TOPS application allows working with maps, in which following flags (listed below) can be shown for selected employees and time period:

- actual location based on GPS data from employee PDA,
- locations of planned/performed visits,
- trace of employees' movement,
- user-defined points of interest (health facilities, pharmacies, supermarkets, cook shops etc.).

Module Maps uses Google Maps API. GPS data about employees' locations are sent to the central database during the synchronization process. Module Maps is a useful tool for utilization of employees' working time because it helps to respond effectively to any request for changes in plans.

6 Conclusion

The article describes the system TOPS. TOPS is a complex telematics solution within the field of e-health specifically designed for providing the nursing and social services at the clients' home environment. Powerful and robust solution was created by usage of advanced mobile and information technology which helps with evidence, planning, reporting and invoicing of provided services. These features allow employees to save time on administrative work and spend more time on professional and productive activities. This solution brings significant economic effect to the organizations, because the productivity of field workers after deployment TOPS increased by 10% to 15%.

The complex solution described above is offered as a service. It also allows the quick implementation of requirements following from relatively frequent legislative changes in this area. TOPS running as a service has become operationally and financially affordable for large, medium and small organizations that provide health and social care.

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