

ACaPlan - Adaptive Care Planning

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Abstract In the elder care domain, a very strong requirement is the meticulous documentation of all treatment activities for every patient. This legally binding obligation turns out to be very tiring for the nurses, takes away time that they could spend with their patients, and is error-prone as the documentation is typically done at the end of the work-day. To solve this problem we proposed the introduction of adaptive process management into the care domain, which constitutes a paradigm shift, as currently the planning and operation of elder care is data-centric, not process centric. The advantages of care as a process are (1) automatic documentation while care activities are carried out, and (2) the process per patient directly represents the treatment and thus makes it very transparent.

In this demo we will show a fully integrated prototype that demonstrates flexible and adaptive processes management in order to plan and enact therapy plans in elder care homes. Leveraging process technology lets us access the wealth of tools and techniques available in this area, such as resource management through worklists, and process mining for assessing common treatment strategies.

1 Introduction

Effective elder care is a growing concern of nowadays society. Traditionally, patients are seen as a loose collection of diagnoses, treatment plans, and lab results in a folder. This data-centric view was directly translated into tools. Every patient is a record which has several documents attached; e.g. anamnesis, lab results, treatment plan, and documentation.

Conceptually, these documents are strongly connected, as, e.g., lab results are typically connected to steps in a treatment plan.

In reality, this connection exists implicitly in the heads of the care personal, and not explicitly in the user interface of the tools. There is typically a stronger focus on chronological dependencies than on logical connections.

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Documentation of the care activities is attached to the patient in the form of reports which are typically compiled in the evening, long after the actual care activities. This leads to the following problems (as the reports are often compiled from memory): care activities can be missing, documented incorrectly, or added without having been conducted.

We propose using business processes as a basis for planning and enacting therapy plans in elder care homes, in order to facilitate planning and automatic documentation. Since business processes are very well understood and researched we are able to transfer some of the advantages of this domain to the elder care domain:

- The documentation can be done semi-automatically: Whenever a therapy task (i.e., a process step) is carried out the correct documentation can at least be initialized by the system, if not completed.
- The system can remind the care personnel about upcoming therapy steps which they have to complete.
- Based on process log analysis, a variety of possibilities for analyzing the effectiveness of therapies is possible.

The ACaPlan (**A**daptive **C**are **P**lanning) project is built upon long running, highly adaptive processes which drive the patients therapy plan. For each patient there exists an individual therapy process instance containing the care tasks which are required for the patient. This process instance is started when the patient is admitted into the elder care home and keeps running until the patient leaves the elder care home, so it can potentially run for several years. During this time, whenever a new therapy is required for this patient, new process steps are added to his therapy process instance (runtime adaptation). Thus each process instance has a unique schema, which leads to interesting research questions for the BPM community.

In the ACaPlan prototype we want to cover all aspects of a nurse's daily working routine. Therefore, the following features were required:

- Decision support by providing structured high quality nursing knowledge for current and potentially to be added treatment steps.
- Automated documentation support by providing the care personnel with hardware that completes process steps with minimal interaction.
- Different views for the different roles that exist in a elder care home (doctors, nurses, administration). Especially for nurses an intuitive UI for guiding them through their daily routine for many concurrent patients is crucial.
- A system architecture for scaling up to thousands of concurrently long running process instances (one per patient).

In [1], flexibility requirements of care processes have been discussed and a preliminary realization in ACaPlan has been introduced. This demo paper presents the prototype in detail, together with new interfaces, functionalities, and extensions.

2 Maturity and Significance to the BPM Field

The ACaPlan project provides a novel approach for supporting elder care based on business process technology, thus demonstrating the power of business process technologies in a human-centric field. It has been developed in cooperation with several Austrian elder care facilities and is currently evolving as a showcase for adaptive process technology¹. ACaPlan supports the most important features a tool for nurses has to offer.

As the patients' process instances are constantly adapted at runtime, the ACaPlan demo is of high significance for the BPM field, as it demonstrates several concepts regarding process evolution and adaptation. Especially interesting is the user support during therapy planning, which is important to prevent the execution of process instances that are not consistent or even contradicting nursing standards. This includes mining for common treatments and treatment patterns.

ACaPlan furthermore is used as the stable basis for the ANTS (ACaPlan NFC Treatment Support)² project. The goal of ANTS is to connect patient beds as well as a variety of NFC tagged care utilities to treatments through ontologies. By applying semantic reasoning techniques and fuzzy matching of care utilities to patients treatment plans, we hope to achieve a significant reduction in administrative load for the nursing staff.

3 Screencast, Documentation and Demo

In the ACaPlan project we have implemented the following features in order to provide process based support to nursing personnel:

1. A **nursing knowledge repository** [2] based on NANDA³, NIC⁴ and NOC⁵. This repository contains an in nursing science well researched classification for diagnoses containing the symptoms, causes, tasks which can be done in order to help the patient, and possible outcomes [3]. The tasks defined in each diagnosis are the basic building blocks for our therapy process. By implementing a **standardized nursing process** which can be found in nursing literature [4], ACaPlan supports nurses in finding good therapies for the current situation. This nursing process defines a standardized approach for finding a patient's needs by thoroughly analyzing his or her symptoms. Based on this information, possible diagnoses, required nursing tasks and possible outcomes of a therapy are defined.

¹ <http://cs.univie.ac.at/project/apes>

² <http://cs.univie.ac.at/project/ants>

³ North American Nursing Diagnosis Association, <http://www.nanda.org>

⁴ Nursing Interventions Classification, <http://www.nursing.uiowa.edu/cnce/nursing-interventions-classification-overview>

⁵ Nursing Outcomes Classification, <http://www.nursing.uiowa.edu/cnce/nursing-outcomes-classification-overview>

2. A **user interface** based on HTML, CSS and JavaScript, which is optimized for smartphones and tablets.
3. **Near Field Communication (NFC) devices**, which are added to the patient's bed. One of our goals is to keep the additional technical burden for the nurses as low as possible. Nurses should not be forced to use a tablet or a smartphone to document process steps. Instead, we want to incorporate NFC tags to commonly used artifacts, such as a set of medications which is administered to the patient every morning. Whenever the nurse administers the drugs to the patient, all he has to do is to register the NFC tag at the patient's bed, and the documentation is completed automatically.
4. Personalized views on care activities (worklists) based on roles.
5. A single therapy process per patient which serves as the patient's therapy plan. It contains all therapy tasks which have been completed or are scheduled for one single patient. It is responsible for **logging and documenting** executed therapy tasks and supporting the **planning of upcoming tasks**.

While the ACaPlan concepts are generic, the demonstrated implementation has the following properties:

- The implementation is composed of multiple **microservices** which communicate with each other over a RESTful API. Thus all advantages of microservices apply, including that the system is easy to scale whenever bottlenecks appear.
- The implementation uses the CPEE [5] as a **flexible process engine**, thus making it easy to initialize, adapt and execute the required processes.

The project website of ACaPlan with a working demo, a description of the technical details and the screencast can be found at:

<http://cs.univie.ac.at/project/acaplan>



Figure 1. Who cares? - ACaPlan Cockpit

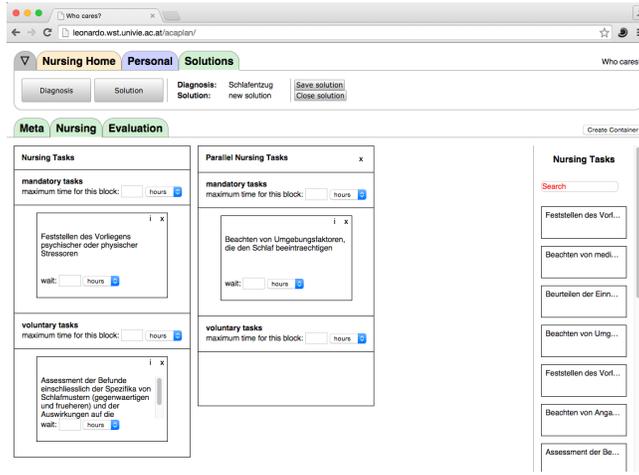


Figure 2. Who cares? - Solution Designer

The user interface of the ACaPlan project as depicted in Fig. 1 is based on JavaScript and HTML, and can therefore be tested on a multitude of different devices, including desktop computers, laptops, smartphones and tablets.

It hides the complexity of the underlying process instances from the nurses, who are not supposed to interact with them on a technical level. Instead, the nurses use to-do lists (as seen in Fig. 1) and a solution designer (Fig. 2) to plan, enact and execute therapy plans.

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