ProM
process mining workbench

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Isala's Question

Introduction

The Isala hospital is the largest top-clinical hospital in the Netherlands. The hospital has almost 800 beds and per year more than 550.000 patients visit the outpatient clinic. In total, the hospital has 5 different locations of which the biggest can be found in Zwolle.

Process Mining

The goal of process mining is to extract process knowledge (e.g. process models) from event logs produced by a wide variety of systems. Within a hospital, this can be an administrative system which take care of the documentation and billing of all services delivered to patients. There are three types of process mining:

• *Discovery*: inferring process models able to reproduce the observed behavior (e.g. a BPMN model or an EPC). For example, the discovered model may describe the typical steps taken before surgery.

• C*onformance* : checking if observed behavior in the event log conforms to a given model. For example, it may be checked whether a medical guideline which states that always a lab test and an X-ray needs to be done is always followed.

• *Enhancement* : projection of the information extracted from the log onto the model. For example, performance information may be projected on a discovered healthcare process in order to see for which examinations a long waiting time exists.

Questions

Within the hospital substantial efforts are taken to improve the care processes. Here, it was felt that much time was lost in interviewing people in order to get insights into a care process. Next to that, it was felt that large amounts of data are available within Isala's IT-systems concerning the processes that are executed.

Therefore, in order to investigate the potential of process mining, the top-5 most occurring diagnoses at the urology department have been investigated. For them, the following questions where posed:

• What is the regular behavior for each patient group?

• Are there any obligatory medical steps that are not performed for patients?

• Are there any obselete steps or steps that can be avoided?

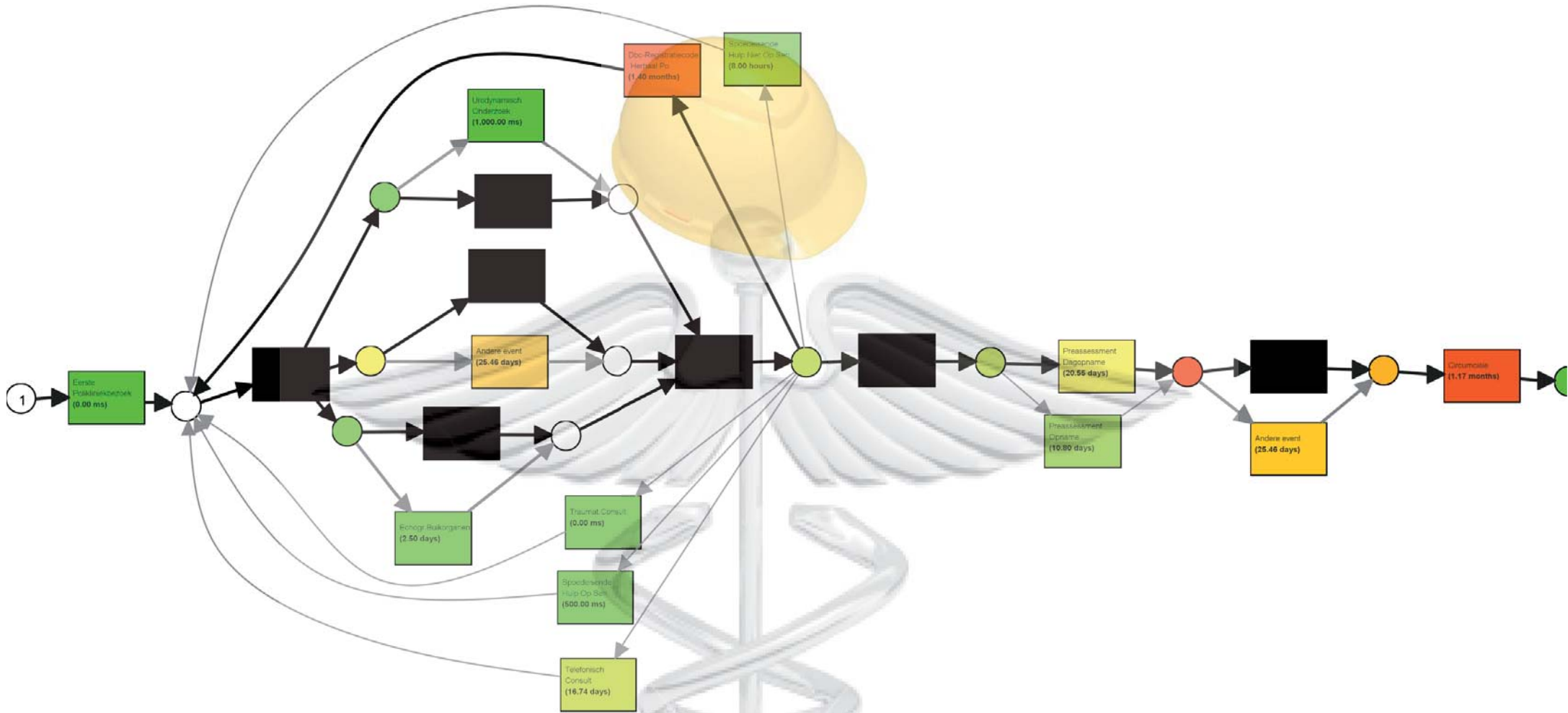• How can the process be optimized such that it can be performed within less time?

Results

Using process mining, the care process of five different patient groups has been analysed. In particular we focus on some results that have been obtained for patients suffering from phimosis.

• *Large average treatment time*: When visualizing the patient traces using the dotted chart plugin we immediately saw that the average treatment time is quite high (around 4 months) and that there was a huge variation for these treatment times. There were patients for which treatment was completed within 1 month whereas
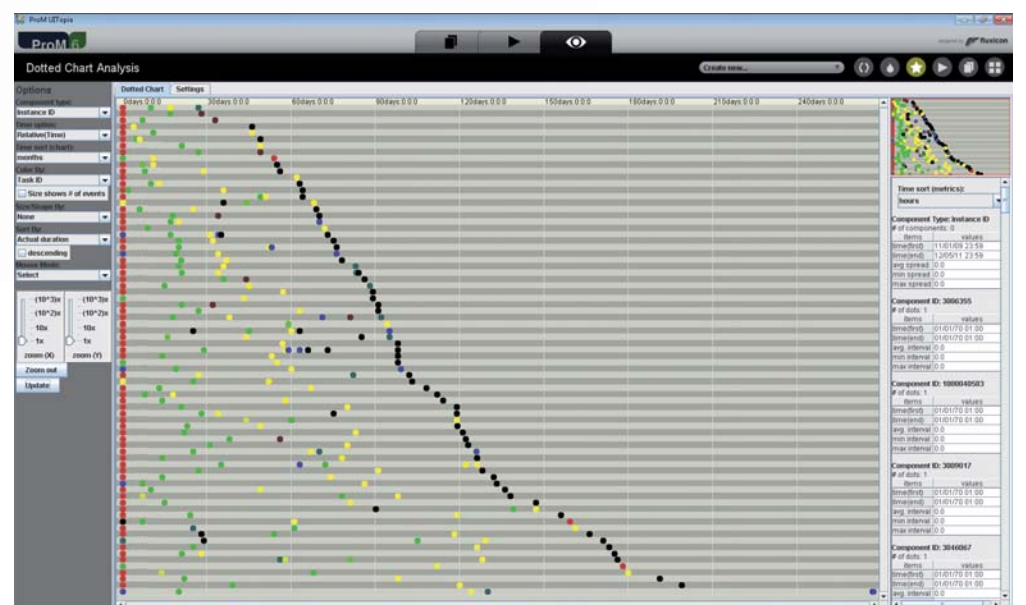
Screenshot of the dotted chart plugin of ProM 6 giving a visual overview of the actions that have taken place for each patient. On the vertical axis the different cases (i.e. patients) are shown and events are colored according to their action names. As can be seen, the process is shown using relative time, i.e. all cases start at time zero. The chart shows that there is a large variation in the total throughput time of cases.

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Screenshot of a discovered process model in which an action is represented by a rectangle. For a group of patients, the process till surgery is shown. A green colored rectangle indicates a short average watiting time for an action whereas a red colored rectange indicates a high average waiting time. For example, for the surgery shown at the outer right side there is a long average waiting time of more than 1 month.

there were also patients for which treatment was not completed within 1 year.

- *Large average waiting time for the surgery and the pre-operative assessment* : As a next step we investigated the reason for the huge average waiting time. To this end, we discovered the process model for the phimosis patients and projected timing information on it. As a result, we identified that for the surgery the average waiting time was 1.25 months and that for the pre-operative assessment the average waiting time was around 22 days.

- *For 6% of the patients no pre-operative assessment examination has been registered*: Before surgery, a pre-operative screening is obliged for each non-urgent patient. When checking this rule using ProM's LTL-checker it was discovered for which patients this rule did not hold.


Screenshot of the LTL-checker of ProM 6 in which the green-colored instances are the patients for which no pre-assessment has been performed.

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- *58% of the patients follow the same path*: When animating the care process using the Fuzzy Model Animation plugin it was discovered that several patients follow the same path. When investigating this into more detail it was found that these patients first have a first visit to the outpatient clinic, a pre-operative assessment, and finally the surgery.

Next Steps

The presented results and the results for the other four urology groups were presented to medical specialists and a selected group of people of the board of directors, marketing, finance, and capacity management. They all were impressed by the obtained results. As a result, it was decided to allocate people for performing process mining analyses within the hospital. That is, for each medical department, the most important care processes will be analysed and optimised using process mining.
This illustrates the practical value of process mining in care organizations.
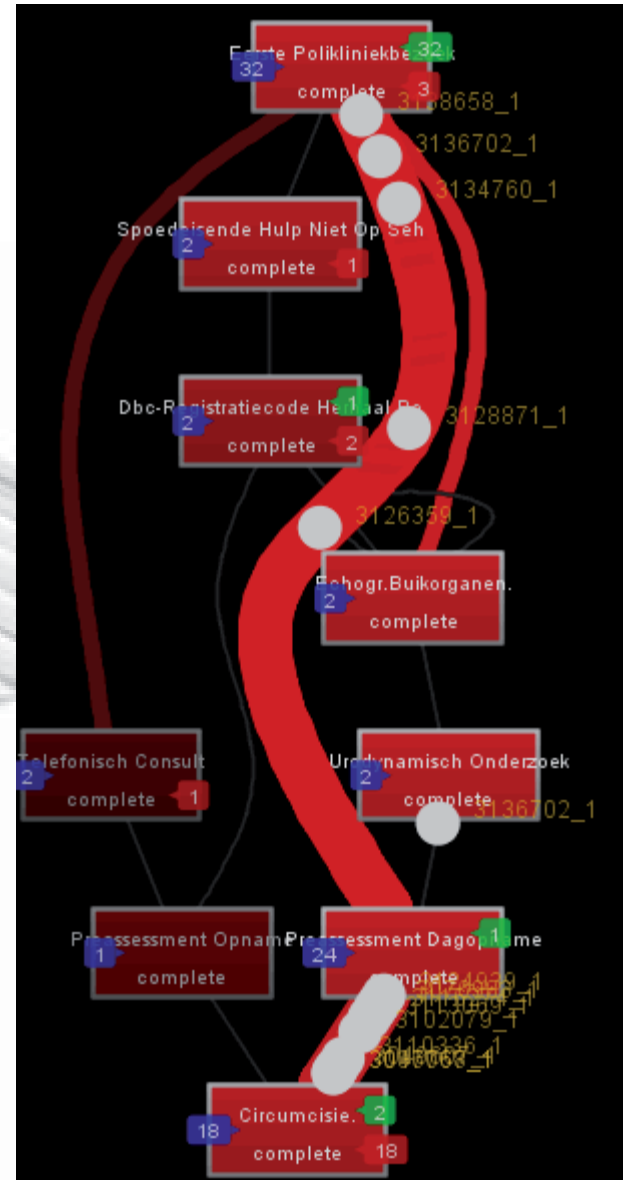
Screenshot of the Fuzzy Model Animation plugin of ProM 6. the Fuzzy Miner offers a dynamic view of the process by replaying the log in the model. The animation shows cases flowing through the model (depicted as white dots in the figure). In the animation, frequently taken paths are highlighted, which prevents them from being overlooked.

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