

Workflow-Modellierung und Analyse in der computergestützten Prostatabrachytherapie

Enhancing Computer Guided Prostate Brachytherapy by Workflow Modeling and Analysis

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Reducing risks in computer assisted surgery by closely analysing all steps of the treatment is an important requirement for adequate safety of both patient and medical staff. Unfortunately, classical Business Process Reengineering (BPR) methods do not meet the needs of computer assisted surgery; especially human-machine-interfaces are not considered, although they have been successfully applied in healthcare.

Therefore, we used the following classical BPR methods to analyse a workflow in computer guided prostate brachytherapy: define the objective of each task and eliminate those that add no value, identify one responsible for each task, when possible perform tasks in parallel, strive for high resource flexibility, allow a resource to practice its specialty, eliminate costs associated with paper documentation, reduce time to transfer work between tasks, automate wherever possible. In order to meet the requirements of CAS, the following safety enhancing methods were added: simplify wherever possible, try to reduce interfaces, strive for machine-to-machine interfaces instead of human-to-machine or machine-to-human interfaces, include automated validation wherever possible.

Using these methods we examined the workflow of the complex, strongly data driven, clinical procedure of MR Image guided prostate brachytherapy starting with the patient's registration in hospital till his dismissal. The patient population are men with low risk prostate cancer. Radioactive seeds are placed in the peripheral zone of the prostate gland while the patient lies under general anesthesia in an interventional MR scanner. Near real time images display the current seed positions allowing a continuous update and improvement of the calculated dose plan. All in all we monitored 22 brachytherapy procedures and reviewed the internal documentations of 330 identical procedures.

In order to model the workflow itself we identified all single tasks, their input data, their output data and the process control flow with conditional branching. Different resources like tools and actors were contemplated and connected with the tasks. Interfaces between data storage devices (i.e. scanner hard disc, planning tool hard disc or patient chart) and different tasks were described. Here, the nature of the interfaces, whether they be human to human, human to machine or machine to machine was contemplated as well.

In the end, seven critical points were spotted and enhancing procedures proposed. These included inserting the opturator, registering the template automatically, using automated validation algorithms to check the plausibility of data, moving non patient related tasks out of the OR and visualizing the calculated seed positions directly on the template.

We have shown, that by modeling and analyzing the workflow of computer guided prostate brachytherapy according to the above mentioned principles safety risks could be identified and reduced. Additionally, costs could be cut down by shorter operating time and greater flexibility of the specialists.