Friedrich-Alexander-Universität
Medizinische Fakultät

Uniklinikum Erlangen

Data-Driven Characterization and Modeling of the Radiotherapy Workflow

At the Department of Radiation Oncology of the Universitätsklinikum Erlangen, approximately 1,500 patients are treated each year across five linear accelerators. Before a patient receives their first treatment session, several sequential preparatory procedures must be completed — including imaging (CT and MRI), contouring, treatment planning, and quality assurance. Since each procedure depends on the timely completion of the previous one, delays at any stage can prolong the overall treatment duration and potentially affect clinical outcomes.

With the increasing digitalization of clinical workflows, digital footprints of nearly all procedures are now recorded across multiple hospital systems, such as the Oncology Information System (OIS) and the Patient Management System. This thesis aims to leverage these data sources to characterize the radiotherapy workflow in terms of inter-procedure time intervals for different patient categories. The analysis will also explore the development of predictive models to estimate treatment duration and identify potential delays. Furthermore, patient arrival patterns and waiting times (Figure 1) can be analyzed.

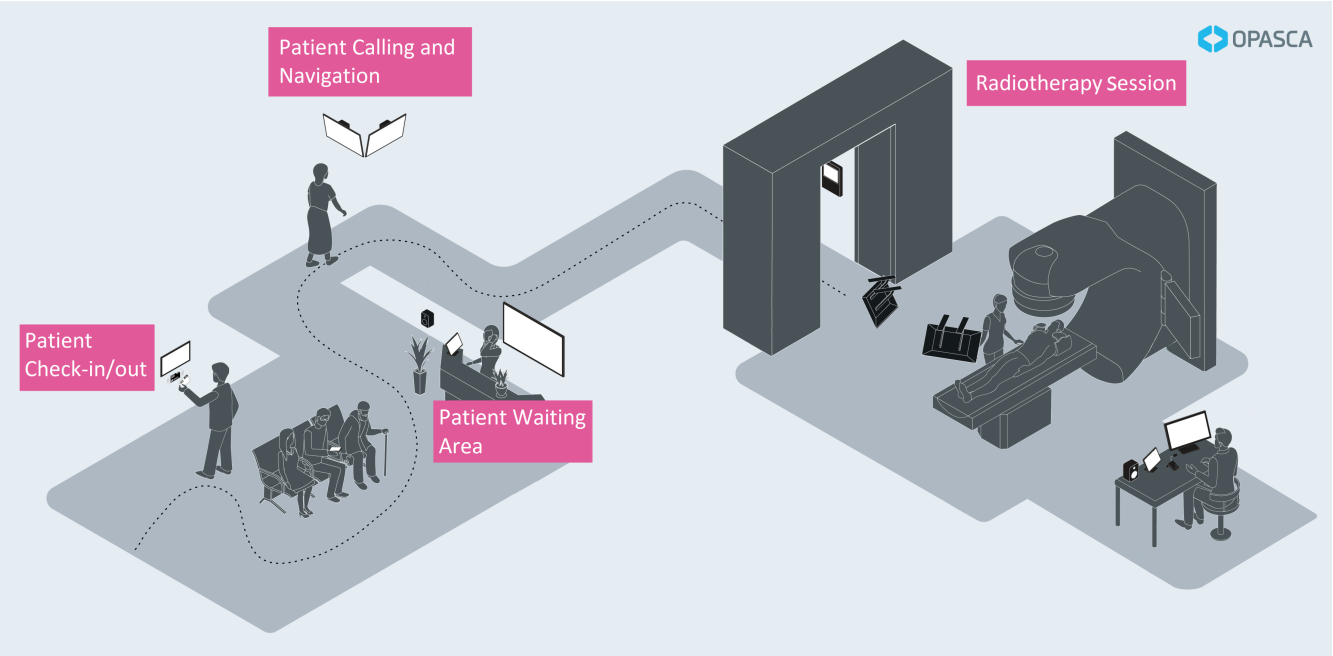

Figure 1: Radiotherapy workflow segment from patient check-in to radiotherapy session. Adapted from the OPASCA website (opasca.com/strahlentherapie).

The thesis will include objectives such as:

- Conduct literature review on radiotherapy, clinical radiotherapy workflows, patient scheduling, and other relevant topics
- Query the oncology information system (OIS) database to extract timestamps and metadata related to each procedure
- Characterize patient workflows in terms of inter-procedure time intervals and analyze how these vary across different pathologies
- Develop predictive models to:
  - estimate total treatment duration based on the pathology
  - predict periods of high departmental workload
  - predict potential time delays in the workflow
- Collect and analyze statistics related to patient arrival patterns, waiting times, and service times
- Implement a simulation model (e.g., using `simpy`) to explore questions such as the impact of different appointment scheduling rules (Individual block, Bailey-Welch, Dome, etc.) on waiting time

The scope of the thesis can be expanded or adapted according to the student's background and interests.

If you are interested in the project, please send your *curriculum vitæ* to: `rafael.lobao@uk-erlangen.de`
Having prior experience with Python, SQL, and statistics is advantageous.

Field of Study: Medical Engineering / Data Science

Academic advisors: Rafael Lobão M. Sc., Prof. Dr. rer. nat. Christoph Bert
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