Optimizing the hospital–wide flow of elective patients

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Abstract

We consider the problem of planning the flow of elective patients in a hospital. For each patient the diagnosis related group (DRG) and the clinical pathway are given. The DRG and the length of stay determine the revenue the hospital will receive for a patient. The clinical pathway of a patient defines activities to be performed and precedence relations between them. Scarce resources such as diagnostic devices, the operating theater and beds are required by the activities within the clinical pathways. This problem is closely related to admission planning but instead of deciding on the number of patients for fixed schedules we decide for a fixed number of patients on the schedule (patient flow) of each patient.

We model the problem as a special case of the resource–constrained multi–project scheduling problem using zero–one programming. The objective is to maximize the DRG–based contribution margin taking into account the patient flow, day– and overnight–resources. We implement a rolling horizon approach in order to evaluate the influence of uncertain recovery times and non–elective patients on contribution margin.

In a computational study where we employ data from a midsize hospital we observe that solving the discrete optimization problem with standard optimization software can be done fast enough for practical applications. In an economic analysis we observe that the solutions obtained with our approach considerably improve the solutions currently employed in the hospital.

Keywords: Diagnosis related groups, Scheduling, Rolling–horizon approach