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Patient-based Nurse Rostering in Home Care

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Abstract

The monthly nurse rostering is one of the most time consuming planning tasks of our project partner, a leading German home care provider. The planning is currently done manually by experienced senior nurses. However, the planning setup is very complex due to requirements such as legal working time restrictions, availabilities of full and part time nurses, and patient requests with differing requirements on qualification and frequency. The objective is to assign as few different nurses as possible to each patient. Although this continuity is important for quality of care, it is hardly addressed in literature. In this paper, we elaborate a mid-term home care rostering problem (HCR) that fits the requirements our partner. It implies the assignment of nurses to weekly recurring patient-visit-tours under consideration of the aforementioned continuity of care. We propose different measures of continuity, which are used in five novel MIP formulations, each incorporating all hard planning constraints. We evaluate the models by means of 45 generated instances with realistic features. Further experiments on a real-world instance show that the approach improves continuity of care considerably compared to the manual solution.

Keywords: mid-term home care planning, continuity of care, mixed integer programming

1. Introduction

The demographic change – not only in Germany – calls for solutions for the increasing amount of people in need of care (see Fendrich and Hoffmann [1]). Home care by mobile nursing services provides both: a desirable situation for elderly people who can stay in their familiar environment and a relatively inexpensive solution for nursing care insurances. Accordingly, home care is an increasing service sector. However, a market study showed that there are only few automated planning tools available, each addressing only parts of the process. Hence, even for major service providers most of the planning is done manually by experienced senior nurses. The complexity of this task results from the combination of the underlying routing and rostering problems. Complex legal working time regulations, availabilities of full and part time nurses, and complex patient requests with differing requirements on qualification and frequency have to be considered. Studies have shown that continuity of care – meaning i.a., that the number of nurses treating one patient is minimal – clearly improves the quality of care (see Cabana and Jee [2]). This goal is hard to respect in such a manual planning process.

Together with our project partner, a leading German home care provider, we worked out the requirements for an automatic planning tool for one of the most time demanding planning steps: the mid-term rostering which considers the assignment of nurses to weekly recurring patient-visit-tours. We focus on this monthly planning task since it has the greatest impact on continuity of care.

A more detailed description of the requirements and restrictions our partner faces is given in

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