Abstract

The healthcare sector faces a growing number of patients requiring medical services at home and limited resources in the form of staff shortages and budget restrictions. These challenges put extra pressure on the industry and require service providers to optimise their operations to meet patient needs. In addition to these trends, characteristics inherent to home healthcare make constructing efficient schedules even more challenging. Staff shortages compel service providers to prioritise care worker satisfaction to retain and attract personnel. A comprehensive literature review shows the potential to increase the practical applicability of existing decision-making models. More specifically, most academic literature on home healthcare optimises short-term decisions sequentially, neglecting one or more critical home healthcare characteristics while optimising patient- or service provider-related performance metrics.

This dissertation addresses gaps in the literature and service provider needs by developing new strategies to optimise home healthcare schedules. It focuses on integrated medium-term decision-making and weekly re-planning while considering care worker satisfaction.

This thesis is structured into two main parts. The first part introduces a novel matheuristic approach that integrates *rostering*, *assignment*, *routing* and *scheduling* decisions to create a detailed four-week schedule while considering many real-life characteristics and minimising operational costs. It approximates the optimal solutions for small instances very well and can also solve large, realistic instances in acceptable computation times. The matheuristic algorithm significantly outperforms a sequential solution method used in practice, achieving substantial efficiency improvements. Additionally, there are significant benefits of patient flexibility regarding their availabilities and allowing a small amount of overtime on the efficiency of the schedule. Finally, it is proven that strict continuity of care constraints can go hand in hand with an efficient schedule if decision-making is integrated.

The second part of this thesis tackles weekly re-planning of an initial schedule after demand changes, proposing a bi-objective optimisation approach to balance cost minimisation and care worker satisfaction through roster stability. Here, the *rostering*, *assignment*, *routing* and *scheduling* decisions are re-optimised while also considering important real-life home healthcare characteristics. To handle the complexity of this problem, a heuristic algorithm is developed that can efficiently balance costs and care worker satisfaction for realistic problem sizes within practical computation times. This multi-objective solution approach effectively approximates the actual Pareto front, which can only be identified for small instances. The experimental results on large instances reveal critical trade-offs in home healthcare planning, showing that initial reductions in rostering deviations are cost-effective, but diminishing returns arise as fewer deviations remain. Relaxing continuity of care constraints and increasing patient flexibility have little effect on the Pareto front, whereas reduced patient flexibility significantly increases both costs and deviations.

In conclusion, this dissertation advances home healthcare scheduling by introducing innovative methods for integrated decision-making and re-planning while focusing on care worker satisfaction. The findings indicate considerable benefits of adopting solution algorithms that use integrated decision-making strategies instead of sequential ones. In addition, interesting insights are derived into the challenges of balancing costs and care worker satisfaction when re-planning home healthcare schedules. This dissertation paves the way for future research, including staff dimensioning, historical data integration, fairness among care workers, and patient-focused objectives.