

An improved routing and scheduling approach for home-based chemotherapy and infusion services with a single nurse

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Abstract: The Home Health Care Routing and Scheduling Problem focuses on designing optimal routes for care workers to visit patients at home. It has extended to the delivery of home-based infusions for chemotherapy and other diseases such as Inflammatory Bowel Disease, Multiple Sclerosis and Rheumatoid Arthritis. Planning and scheduling appointments for patients who require cyclical treatments with different rest periods between cycles, different numbers of cycles and varying treatment durations becomes increasingly complex when integrating the requirements with routing over extended periods spanning several months. The minimum planning horizon required can be determined from the least common multiple of the cycle lengths. For instance, if the group of patients require cycles of lengths four, six and eight weeks, the length of the minimum planning horizon is 24 weeks. This approach guarantees service consistency in the planning horizon while maintaining the feasibility of all patient appointments, including future visits where overlaps with patients on different cycles are possible.

This research extends the previous work in Fernando et al. (2025) with fixed treatment days for existing patients in the schedule by allowing a reset of the treatment days of existing patients to accommodate more new patients into the system. Only the existing patients in a single week are affected by a reset, and the appointment day changes are allowed only within the weeks with scheduled visits. We implemented a priority-weighted strategy to prioritise the addition of the most crucial new patients into the system, given the constrained resources in real-world settings.

We formulate this problem as a Mixed Integer Linear Program that incorporates new patients into the system with existing patients while adjusting existing patient appointments once. Due to the complexity of the resulting model, state-of-the-art solvers struggle to find even a feasible solution. Therefore, we develop a two-phase matheuristic to solve the problem in a practical timeframe. In Phase 1, existing patients are clustered into visit days based on their spatial and temporal requirements to minimise nurse travel time. In Phase 2, a filtering and decomposition based matheuristic is utilised, and the resulting sub-problems are solved using the CPLEX solver. The frequency of rerunning can be decided based on the cycle durations of patients in the system.

Our results show the potential to insert more priority-weighted new patients into the system when existing patient visit day changes are allowed, compared to the approach with fixed visit days for existing patients. Thus, adopting the second approach would help service providers to extend timely home-based chemotherapy and infusion services to a larger group of patients.

REFERENCES

Fernando V, Ozlen M and Taheri S (2025) A single nurse routing and scheduling problem for home-based chemotherapy and infusion services. *European Journal of Operational Research* (In Press).

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