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New Multi-Objective Approach for the Home Care Service Problem Based on Scheduling Algorithms and Variable Neighborhood Descent

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Abstract

We address a home care service problem, and propose a three-phase metaheuristic based on Variable Neighborhood Decent algorithm and Longest Processing Time algorithm. In the first phase, we resolve the assignment problem using a scheduling algorithm which is the Longest Processing Time algorithm. In the second one, for each nurse, we resolve the routing problem in order to improve the travelled distances using the Variable Neighborhood Decent algorithm. The third phase, is devoted to refine the second phase in terms of maximizing patient's satisfaction regarding services rendered using an efficient heuristic that performs replacements of patients not satisfied between nurses if possible while taking into consideration the distances found in the second phase. The numerical results show the efficiency of the proposed three-phase approach.

Keywords: Static problem of home care services, Metaheuristic, Mathematical Modelling, Variable neighbourhood descent, Longest processing time, Shortest processing time.

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1 Introduction

The home care service problem (HCSP) is an NP-hard problem [5]. The management of the care of patients at home in the structures of home care service (HCS) has been the subject of several researches. These works are focused on issues which are either "strategic and tactical" by offering approaches that decompose the space covering of the HCS and assigns the necessary caregivers (paramedics or social affairs employees) to these "districts" [7]; or "Tactical-operational" by dealing mutually with the problem of the assignment of the personnel to the patients and the caregivers tours; or "Operational" by facing only the issues of the personnel covering tours by inserting a set of constraints of continuity of care and temporal dependencies. In Table 1 below, there is a summary covering the recent researches works that has contributed to resolve the HCSP.

Table 1
Examples of researches works

	same disease	≠ disease	exact method	meta-heuristic	patient's satisfaction	dynamic context	static context
[9],[10]	√		√				√
[4]	√		√				√
[5]		√		√			√
[2]		√	√	√			√
[3]	√		√				√
[1]		√	√	√			√
[12]		√	√	√		√	
[6]	√		√				√
[11]		√	√	√	√	√	√

The HCSP represents a mix of classic problems linked to graph G = (ND, A), in which 'ND' represents the set of nodes (the patients to visit), and 'A' is the set of arcs (routes). The latter crosses with the problems associated with Traveling Salesman Problem (TSP) (in terms of determining the shortest path for nurses) ; it also resembles the Dial a Ride Problem (DaRP)(in terms of compliance with time windows of patients) ; and starts the Knapsack problem (KP)(in terms of determining the appropriate order to serve patients). In addition, it addresses a new problem, which is actually, has a major impact on the quality of service (QoS) of HCS, which is patient satisfaction compared to the services offered. Moreover, we are faced to another problem called unfair

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