Home health care logistics planning: a review and framework

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Abstract

Home Health Care (HHC) is a growing industry in the medical services business, mainly in Europe and North America. These care services are provided at patients' home by a multidisciplinary team using a distribution network. In this paper, an overview of the HHC services in Portugal and Brazil is presented. Additionally, a review is also presented to identify the main logistics problems associated with HHC services such as districting, routing and inventory management and the lack of integrated approaches to address them, as well as the best practices of management in the area. A framework is proposed to represent the main elements and characteristics of HHC services and their relationships. The framework suggests the use of a Decision Support System (DSS) based on optimization models and simulation approaches to overcome some of the main challenges associated to integrated approaches to address main problems, filling the gaps in the current literature. With the development of this DSS it will be possible to assist in the logistic planning of HHC teams, especially in countries like Brazil and Portugal.

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1. Introduction

Home Health Care (HHC) services consist in attending patients in their own homes, by a multidisciplinary team. Teams are composed by workers, such as doctors, nurses, among others. Because resources for health care are limited, HHC services are nowadays viewed as a challenge in what concerns the design and the efficient operation of health care delivery systems, reducing global costs and relieving congestions in the access to hospitalization.

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The sector has high investments, mainly in developed countries, such as Denmark, which has allocated about 1.6% of its GNP (Gross National Product) in 2005 (about $4 billions) for the care of 200 thousand patients [1]. In European countries, around 1% to 5% of the public health budgets are spent on HHC services [2]. The number of people dependent on HHC services in Germany has already reached 1.6 million in 2012 and is still increasing [3]. In developing countries, HHC is more recent and its evolution is still slow due to economic problems, disorderly population growth, lack of infrastructure, security and constant illnesses (dengue fever, yellow fever, zika virus, and others). As an example, in Turkey, the public HHC system is targeted only at priority groups, namely patients bedridden with respiratory problems, muscular diseases, newborns and the terminal stage of cancer. The remaining population, which does not fall into the priority groups, need to join private HHC services [4]. In Colombia, peripheral areas of large cities with high crime rates do not receive this type of service due to lack of security as a way to preserve the physical integrity of health workers [5].

The planning effort required to manage these services is of great complexity, because it involves questions at different levels of decision, such as districting (strategic level), inventory management (tactical), routing and scheduling (tactical/operational level). In HHC literature, the largest contribution is in the area of vehicle routing and scheduling. For these types of problems, the goal is to minimize the costs of travel between patients and maximize teams scheduling to perform daily work [1]. Attention to materials’ management problems in the context of HHC has been scarce. Main topics that have been identified include suppliers’ selection, inventory policies and control [6].

Districting problem is of great importance, because aims at organizing areas, creating compactness in team’s workload and minimizing travel time. For example, in Colombia, about 50% of HHC providers face districting problems [5].

In this work, the objective is to develop a review and framework that allows understanding the main logistic problems (of different levels of decision) in the HHC context, how they relate to each other, and the possibility of solving them in an integrated mode. The framework recommends the use of a Decision Support System (DSS) based on optimization models and good practices suggested in the literature. Most relevant contributions in these areas (which can contribute to the DSS) were used to develop the framework. It will include a sequence of phases concerning the design steps of such a system, identifying the different decision levels, restrictions, resources and stakeholders.

This paper is organized as follows. Section 2 reports HHC characterization and a brief description of the Portuguese and Brazilian services; Section 3 presents the literature review; Section 4 presents a proposal of a framework; Section 5 ends the paper with the conclusions.

2. Home Health Care Characterization

Home health care services are characterized by logistical problems such as districting, routing, scheduling, and inventory management. For each type of problem, a decision level is assigned, which is directly related to the duration and impact on planning decisions, as can be seen in Fig. 1.

The decisions at strategic level consider a time horizon of over one year [5], including problems such as facility location, districting, staffing and fleet selection. The facility location aims to determine the best location for service deployment, as well as determining the location of each team’s facilities. The next planning stage will be clustering (districting) the geographical area, aiming the balance of workload among health workers. Strategic problems, such as fleet selection, staffing and supplier selection, aim to determine which ones meet the requirements at the lowest possible cost.

These processes are approached differently in each country, especially in public HHC. As an example, in Austria, HHC solutions have been proposed to reduce vehicle fleet costs, having more sustainable solutions such as the use of multimodal public transport and the division of vehicles between workers [7,8]. However, in developing countries such as Brazil and Colombia, vehicle use is extremely important due to the low quality of public transport services and the lack of safety in certain districts, making it impossible to use these solutions.

The tactical level has a time horizon of up to one year [5], and in this context problems such as fleet assignment, staff dimensioning, shift scheduling and inventory policies have to be addressed. The first problem is to define the number of vehicles to be made available by district and team. The staff dimensioning is the allocation process of workers by district, according to local demand. The shift scheduling deals with the problem of selecting, from a potentially large pool of candidates, what shifts are to be worked, together with an assignment of the number of employees to each shift, in order to meet demand [6]. Finally, the inventory policy aims to determine the number of orders or purchase of materials made in each period, aiming at minimizing costs and avoiding the lack of materials.
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