DRONE for Medical Application

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ABSTRACT

Unmanned aircraft vehicles (UAVs) have had a rapid escalation in manageability and affordability, which can be exploited in healthcare. We conducted a systematic review examining the use of drones for health-related purposes. This paper addresses the drone-aided delivery and pickup planning of medication and test kits for patients with chronic diseases who are required to visit clinics for routine health examinations and refill medicine in rural areas. For routine healthcare services, the work proposes two models: the first model is to find the optimal number of drone center locations using the set covering approach, and the second model is the multi-depot vehicle routing problem with pickup and delivery requests minimizing the operating cost of drones in which drones deliver medicine to patients and pick up exam kits on the way back such as blood and urine samples. In order to improve computational performance of the proposed models, a preprocessing algorithm, a Partition method, and a Lagrangian Relaxation (LR) method are developed as solution approaches.

Keywords: Drone · Healthcare · Delivery · Chronic disease · Rural health

INTRODUCTION

According to the Centers for Disease Control

and Prevention (CDC), chronic diseases are a major concern in terms of their economic and social aspects among the government and patients [1]. The cost of chronic diseases is an overwhelming component of overall healthcare expenses. As per the World Health Organization, non-communicable diseases or chronic diseases, such as cancer, heart ailments, respiratory diseases and diabetes, kill 38 million people globally every year. Over 20 Per Cent of Indians Suffer from Chronic Diseases and more than 10 percent of the people have more than one. In India in 2014, 98.16 lakhs deaths were estimated. Patients with chronic diseases are required to visit medical institutions for routine checkups or medicine refills. These periodic visits incur out-of-pocket expenses and medical costs that can be several times higher compared to patients without chronic diseases.

DESCRIPTION

Patients with a chronic disease spend almost 2.5 times more than those without chronic diseases due to regular clinic visits. Rural areas have distinct barriers to accessing healthcare such as transportation to/from medical facilities and general availability of medical facilities

Figure 1: DRONE Delivery

The lack of transportation is one of factors for the failure of medication adherence. Finally, in order to implement these programs widely and continuously, the participation of many providers is required. The population of rural residents is smaller than urban populations, and rural residents are more likely to be uninsured than urban residents. As a result, the providers often hesitate to invest in projects like this because returns on investment from rural areas are estimated to be smaller when compared to urban areas. Even if the providers are willing to invest in such healthcare projects, it is often difficult to find, recruit and retain caregivers due to the geographical conditions. Moreover, according to report on Association of Retired Persons, 89% of Indians over the age of 50 want to receive healthcare service in their own

homes. As they get older and face increased problems with mobility, they may have difficulty visiting medical clinics and prefer to be seen in a more comfortable place such as their own home.

This paper aims to determine ways to overcome the above-mentioned problems with drone-aided healthcare delivery and pickup services to rural areas. Drone can deliver routine test kits, refill drugs and pick up patients' exam kits such as blood and urine samples. Drones reduce the travel time and workload of a caregiver sharing simple care tasks. Compared to other transportation modes such as a postman and commercial courier services, drones can be a competitive alternative for delivery and pickup of time-sensitive items, regardless of the ground level road conditions. We note, however, that drones may not be dispatched in severe weather conditions. In our proposed work drones are utilized to deliver and pick up exam kits and medicine for patients located in rural areas while caregivers visit with patients who need in-person hands-on care. Therefore, the patients who need to obtain test kits or medicine do not need to drive, hence a saving on transportation expenses. Since the workload of the already limited available caregivers is reduced, they can concentrate on in-person hands-on care; thereby improving the quality of a caregiver's service.

Figure 2: DRONE based Network

CONCLUSION

In this paper, a new approach for healthcare delivery service was introduced to alleviate healthcare disparities in rural areas using an aerial delivery and pickup method. This new model was used for reducing the out-of-pocket expenses of patients with chronic diseases, thus enhancing the healthcare environments of rural areas, improving the quality of healthcare service, and reducing the burden of limited caregivers. To achieve these purposes, two planning methods were presented: first, the SP determined the location and number of centers that covered all patients and also eliminating redundant and infeasible candidate sites. Second, the OP found the optimal number of drones in each center, considering all schedules in a given area. The cost-benefit analysis method was introduced as a decision-making criterion for stakeholders. It was implemented using different cost and benefit values as the criteria for deciding this project. Finally, the computational analysis was conducted to compare the performance of the problem using the Partition method and LR algorithm which produced better performance than the model without these components. An extension of this work may include variable flight times that are associated with a different battery consumption rate according to the loaded amounts and travel distances. Priority can be assigned to the model in delivery routing and scheduling.

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