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OUTPATIENT CLINIC LAYOUT DESIGN ACCOUNTING FOR FLEXIBLE POLICIES

Vahab Vahdatzad
Jacqueline Griffin

Department of Mechanical and Industrial Engineering
Northeastern University
334 Snell Engineering
Boston, MA 02115, USA

ABSTRACT

While it is known that there is a strong relationship between form and function, often the impact of physical design on workflow can be overlooked in the design of new buildings and spaces. Correspondingly, further research is needed to examine how the efficiency of patient care is impacted by physical layout decisions. With the development of new models, relationships between physical layout designs, flexible patient flows, and operational policies are analyzed through development of a discrete event simulation approach.

1 INTRODUCTION

Among developed countries, the United States has the highest annual per-capita health expenditures, yet there are significant challenges to increase effectiveness and efficiency in the delivery of care. These challenges in improving care are a result of numerous design and operational decisions. These include long-term strategic level decisions, tactical medium-term planning decisions, and short-term operational decisions. Although these decisions are distinct and are made by different decision makers within varying time frames, the hierarchical structure and intrinsic interdependencies among these decisions impose restrictions and limitations on the success of a system. Specifically, strategic level decisions limit the variety and demarcate the scope of tactical decisions, while latter decisions influence operational actions. Very few studies, focusing on patient flow, consider integrating such decisions in one framework. Instead, researchers seek to develop policies that are limited by past decisions or assumptions of status quo policies.

Facility location, layout, and design are all examples of strategic decisions that have been studied in the healthcare sector. For example, new studies drive hospital design modernization of functionality and flexibility to evolve with technologies (Holst 2015). Hospital layout researchers aim to minimize travelling distances or associated costs of locating clinical and operational units inside hospitals (Amaral 2012; Arnolds and Nickel 2015; Helber et al. 2016). While the designs and layouts of hospitals are optimized by the minimizing the distances between units, this disregards the integration of the design with functionality such that the layouts can be flexible to implement the best tactical decisions. For this purpose, a simulation-optimization model is used to design a healthcare center layout by considering such joint decisions that not only optimize the walking distances but also seek to optimize patient flow and resource utilization.

2 LAYOUT DESIGN FOR FUTURE FACILITY

Common layouts of outpatient clinics consist of exam rooms, providers' working areas, and waiting areas. Incorporating the viewpoints and activities of all stakeholders is critical when identifying a new layout. While a patient may wish to limit the distance between the waiting area and rooms, the providers may wish to minimize distances between work rooms and exam rooms. Not only is straight line distance important, but, also, the clinic practice patterns are critical in identifying effective travel distance and time.

For example, Figure 1 represents a sub-section of two layout designs for an orthopedic outpatient clinic of a major teaching hospital. Each layout consists of an equal number of exam rooms (red), multiple physicians' working areas (yellow), and the waiting areas (blue). The first pod-based layout, distributes physician work areas equally throughout the clinic. Each working area accommodates up to two physicians

and each physician is assumed to have at most three easily accessible exam rooms. In the second, sharing-based layout, working areas are integrated and can accommodate teams of four physicians. Each physician now has access to at most nine exam rooms.

(a) Pod-based layout (b) Sharing-based layout

Figure 1: Two layouts for same outpatient clinic with different functionality

A key difference in the effectiveness of these two layouts concerns the policies implemented for allocating rooms to physicians. These policies should be designed to minimize the patient waiting time while also not increasing physician travel times excessively. Traditionally, each room or set of rooms are assigned to a specific physician for an entire session, referred to as a "dedicated" room assignment. Alternatively, all rooms can be shared among all practicing physicians and patients may be visited in any available room, referred to as a "pooled" room allocation. And a compromise approach, a "hybrid" room policy exists in which only a limited number of rooms are shared among a group of providers(Zad et al. 2016).

In many traditional layouts, such as Fig.1(a), our simulation model shows that implementation of a dynamic room allocation policy (i.e. "pooled" or "hybrid") will increase physicians' walking distances and diminish the value of higher room access to physicians. Fig.1(b), on the contrary, is designed with a joint consideration of walking distances and accessibility parameters. The number of rooms assigned to each physician may change dynamically based on physicians' schedule templates, physician team size, and patient mix to balance the average patient length of stay (LOS) and waiting time without changing physician walking distances significantly. Our simulation is utilized to quantify the impact of these features and this interplay between various decisions for identification of the best design choice.

3 CONCLUSION

It is crucial to develop a holistic framework in order to integrate the architectural aspects with the flow of patients, providers, and goods. This research integrates the layout design of outpatient clinics, a strategic decision, with the physician room assignment problem, a tactical decision, using simulation-optimization. Rather than focusing on each decision independently, this study exemplifies the importance and necessity of simultaneously considering multiple types of decisions when building new healthcare spaces.

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