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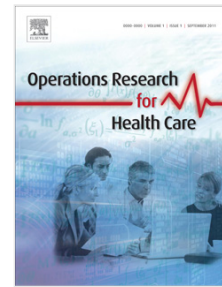
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A MATHEMATICAL OPTIMIZATION MODEL FOR EFFICIENT MANAGEMENT OF NURSES' QUARTERS IN A TEACHING AND REFERRAL HOSPITAL IN HONG KONG

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Objective

Effective use of available resources is critical in the healthcare industry. Space in the Nurses' Quarters in an acute regional and teaching hospital in Hong Kong is under pressure and effective use of such scarce resources is warranted. We present an application of mathematical optimization to ensure rooms are optimally assigned for users, in which the least number of rooms need to be opened while entertaining the most number of user requests, while at the same time satisfying the various business rules of quarter management.

Methods

Extensive consultation was embarked at the start of the project to gather requirements from quarter management and frontline users. Utilization statistics were also gathered and analyzed. A web-based booking system was designed and implemented to streamline the booking workflow for users, while a mixed integer programming model was implemented to automate the room assignment process for quarter management.

Findings

More than 70% of bookings are now booked through the automated system. Unlike the old workflow where users need to travel to the quarter for reservation of rooms, they can now access the online system using any computer workstation that is connected to the hospital intranet. This greatly simplifies the booking workflow for users and decreased the amount of no-shows. In addition, workflow wastage in the then-manual room assignment process was minimized through the use of the room assignment model. Instead of utilizing two man-hours to complete the room assignment exercise each day, optimized room assignment is now automatically generated with a click of a button. Defects and rework that arise from the manual process was eliminated through the implementation of the mathematical model. The implementation of such a fair and transparent assignment methodology also minimized the amount of disputes and complaints from users.

Conclusion

The use of operations research methodologies is useful in enhancing workflow efficiency and resource utilization in healthcare. Through the employment of a data-driven and evidence-based methodology, buy-in from important stakeholders could be obtained so that a new and enhanced workflow could be successfully implemented.

Keywords: Nurses' Quarters, mixed-integer programming, resource allocation, bed assignment

Introduction

How to efficiently and effectively utilize scarce resources has always been a focus of research in healthcare management. In most parts of the world, healthcare capacity is heavily constrained compared to the growing demand. In Hong Kong, healthcare capacity shortage stems from a variety of reasons, including but not limited to the insufficient or unmatched funding, shortage of healthcare care practitioners, and the shortage of physical space. In a crowded environment like Hong Kong, the efficient use of space is of particular importance.

Due to the geographically-remote nature of a lot of hospitals in Hong Kong, staff quarters are set up in these sites for medical, nursing, and healthcare assistants so that they don't need to travel back and forth between their residence and the hospitals. These facilities are for on-call purposes for medical staff, and also serve as temporary short stay dormitory units (for 8 to 10 hours) for nursing and healthcare assistant colleagues. These staff quarters are not only there for staff retention purposes, but also they serve a critical role in ensuring around the clock clinical service could be provided.

Efficient management of staff quarters is very important in ensuring precious quarters space is utilized effectively. In addition, it is vital for staff quarters to devise a convenient workflow for staff to reserve, revise, and delete their reservations. In this paper, we discuss an application of web/database programming and mathematical modeling to enhance the management of Nurses' Quarters in Queen Mary Hospital (QMH), a tertiary/quaternary referral and teaching hospital, in Hong Kong.

QMH is one of the largest acute regional hospitals in Hong Kong with more than 1,400 inpatient beds. It is located in the Pokfulam district, about 20 minutes of transportation via public transit from the Hong Kong city centre, mainly serving the acute care needs for the Central and Western District. Apart from offering secondary

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