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Waiting for a stroke bed: Planning stroke unit capacity using queuing theory

John Boulton, Naveed Akhtar, Ashfaq Shuaib & Paula Bourke

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Abstract

Background: Access to rapidly advancing healthcare technologies is often limited due to lack of appropriate capacity. As stroke care continues to advance creating dedicated units with appropriate and effective capacity is paramount to maximizing the potential outcomes for patients. Queuing theory methodologies are widely used in industries, but infrequently in healthcare. Yet they provide the opportunity for more effective capacity planning.

Method: This paper utilizes a standard queuing model in order to effectively define stroke unit capacity with less than 1% turn-away. Data regarding admission rates, Length of stay, and current bed availability was collected from a large teaching hospital and the middle east during quarter 1, 2014. This data was then and used to develop two queuing models.

Results: The study demonstrated that the current bed capacity was considerably less than that required to provide effective care that maximizes the potential outcome for patients. Based on arrival patterns and length of stay the stroke unit requires 21 beds if the probability of a patient being turned away is to be less than 1%. This results in a bed occupancy considerably lower than the recommended 80-85%. Given the size of the unit at the time of the study (8 beds), 44.5% of patients would be turned away and managed on other units.

Conclusion: The study demonstrates the use of queuing theory to more effectively plan capacity for a stroke unit. In order to maximize outcome for patients units may need to run at lower occupancy than often recommended in the literature. Queuing theory provides an additional framework to help clinicians and managers more effectively plan in the future. Their advantage is that they are relatively straightforward to build, require no additional software other than a spreadsheet, and are relatively low on data requirements. The authors recommend that such modelling techniques should utilized more widely in healthcare planning.

Keywords:

Queuing theories | Hospital bed capacity | Stroke | Quality improvement