A simple guide to a complex problem – maternity bed occupancy

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Abstract

The average occupancy applicable to different sized maternity units is shown to be calculated by Erlang's equation. This equation has been used with great confidence for nearly 100 years to calculate the resources required to meet the incoming demand in a huge variety of service situations ranging from the capacity of telecommunications satellites to bed occupancy in hospitals. Larger maternity units can operate at higher average occupancy and as such smaller units face greater cost pressures due to their inherent inability to avoid the lower occupancy (and hence higher unit costs) that is associated with smaller size. The implications to the operation and design of maternity units are discussed.

Key Points

- The average occupancy in maternity units depends on their size with larger units being able to operate at higher average occupancy, i.e. they gain economy of scale
- However even in the largest maternity units (>120 beds) a maximum average occupancy of no greater than 75% should apply.
- Utilisation of both physical and staff assets are subject to the same rules
- For these reasons smaller units have higher (unavoidable) costs
- The HRG tariff does not reflect the economy of scale in relation to maternity costs and penalises smaller units
- In a time when costs need to be reduced there is a discussion to be had regarding the minimum acceptable size of maternity units

Introduction

Recent consternation over 'unexpected' increases in the number of births and consequent overcrowding in maternity units raises questions regarding the planning, forecasting and the calculation of adequate size for these units. The issues are in many ways not new and in 1979 Mr Walter Jonhson the member for Derby South raised questions in the Commons regarding the closure of the Nightingale Maternity unit and disputed arguments by the health authority that occupancy was too low (http://hansard.millbanksystems.com/commons/1979/jun/13/nightingale-maternity-home-derby).

The relative size of maternity departments for NHS Trusts in England in 2011 is given in Figure One. For some of the larger Trusts the department may be split over multiple sites, however, on the whole single site units typically have less than 80 beds and the average size per unique site is probably around 45 beds. The key question is – which of these departments have too few beds and how do we calculate how many they should have?

Research by the Maternity Care Coalition (2011) in the USA indicates that the industry accepted standard for average bed occupancy in maternity units ranges from 70% to 80% although, as is often the case in health care, the reasoning behind these recommendations can be obscure. Hence while most NHS personnel are aware that maternity units operate at a lower average occupancy than the corresponding general and acute bed pools they may not be aware that there is an exact relationship between occupancy and size. This relationship and the resulting performance characteristics can be calculated using a mathematical formula known as the Erlang equation (Jones 2009, 2011a,b).

The Erlang Equation

The Erlang equation has been used with great confidence for many years to calculate the number of service points (beds, tills, telecoms capacity, etc) and the likely queues if capacity is constrained. This equation uses the average length of stay and the

average arrival rate to calculate various measures of interest to correct planning of both staff and physical capacity (Jones 2011a,b). While the Erlang equation does contain particular assumptions the good news is that midwifery with its genuine 24/7 pattern of demand fits very well with the assumptions contained in the equation and hence is directly applicable in the real world of operational departments (de Bruin et al 2008).

Article continues …………………..

Measuring Occupancy

Counting Beds

Size & Economy of Scale

Erlang and Staffing Ratios

Seasonal & Circadian Patterns

Length of Stay

Conclusions

Conflict of Interest

Table 1: Maternity units which may need more beds

Figure One: Relative size of maternity departments in England (2011)

Figure Two: Range in births per day at 4,250 per annum.

Figure Three: Size and average occupancy in English maternity departments

Figure Four: Maximum range in arrivals per day for different sized maternity units

Figure Five: Seasonal patterns in maternity bed demand

References

de Bruin A, Bekker R, van Zanten L, Koole G (2008) Dimensioning hospital wards using the Erland loss model. PICA Patient Flow Improvement Centre, Amsterdam. http://www.math.vu.nl/~koole/articles/2010aor/art.pdf

Jones R (1996) Estimation of annual activity and the use of activity multipliers. Health Informatics 2, 71-77.

Jones R (2000) Outpatient appointments: Feeling a bit peaky. HSJ 110(5732) 28-31

Jones R (2006) Financial and operational risk in health care provision and commissioning. Healthcare Analysis & Forecasting, Camberley, UK. http://www.hcaf.biz/Capacity%20Management/Microsoft%20Word%20-%20Variation%20in%20healthcare.pdf

Jones R (2009) Emergency admissions and hospital beds. British Journal of Healthcare Management 15(6): 289-296.

Jones R (2010) Emergency assessment tariff: lessons learned. British Journal of Healthcare Management 16(12): 574-583.

Jones R (2011a) Hospital bed occupancy demystified and why hospitals of different size and complexity must operate at different average occupancy. British Journal of Healthcare Management 17(6): 242-248.

Jones R (2011b) A&E performance and inpatient bed occupancy. British Journal of Healthcare Management 17(6): 256-257

Maternity Care Coalition (2011) The childbirth crisis: Closing maternity units. http://www.momobile.org/ObstetricsAccess1.html#Capacity

Millar K, Gloor J, Wellington N, Joubert G (2000) Early neonatal presentations to the pediatric emergency department. Pediatr Emerg Care 16(3): 145-150.

Sandall J, Homer C, Sadler E, Rudisill C, Bourgeault I, Bewley S et al (2011) Staffing in maternity units: Getting the right people in the right place at the right time. The Kings Fund, London, UK http://www.kingsfund.org.uk/publications/maternity_unit_staff.html