Myths of ideal hospital size

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The physical capacity of a hospital should provide the environment in which patients are efficiently treated in dedicated bed pools (ie, groups of beds that meet the needs of similar patients).1,2 Recently, there has been a call for an evidence-based debate on hospital occupancy:3 Since occupancy and size are linked, we must open such debate to the wider issues of hospital size. Trends in occupied bed-days show that hospitals in England needed as many beds in 2007 as in 1998 — despite a large reduction in available beds.4 Over the same period, there was a 15% increase in occupied beds in Australia (Box 1) and an upward trend in bed demand for emergency admission in Alberta, Canada (Box 2). In the absence of new ways to improve efficiency, these trends will continue. Yet, in the United Kingdom, ageing infrastructure is being replaced with smaller hospitals.4,5 Does this process have an evidence base?

In the 1960s to the 1990s, average length of stay (LOS) was decreasing and day surgery increasing so rapidly that any attempt to forecast capacity, as long as it was lower than the existing bed allocation, was sufficient to plan the size of a hospital.2 Indeed, bed demand could have been extrapolated to zero by around 2010. Predictably, however, by the late 1990s the decline in LOS levelled out.2,6

How should we “size” a new hospital?
The accepted method for calculating the required size of a new hospital is to forecast annual numbers of admissions and average LOS, multiply the two to calculate occupied bed-days, divide by 365 for the average number of occupied beds, and apply an occupancy margin.2,7,8 Demographics of the local population are used to forecast admissions, and proposed increases in “efficiency” are used to forecast lower LOS. In the 1990s, I was involved in the planning for a new hospital. After the external demographic-based forecast of admissions at 10 years was surpassed within 2 years, I began a search to understand the real issues behind calculating a hospital size that is conducive to efficient health care.

Experience shows that demographics only give reliable forecasts of admissions for surgical procedures where the intervention rate is stable. Hence, for example, orthopaedic demand has been consistently underestimated as musculoskeletal interventions continue to evolve. Demographics have been seen to give the “right” answer simply because they underestimate future activity;2,7,8 thereby “affirming” the perceived need to reduce bed numbers.

Emergency admissions are more severely underestimated. In Scotland, demographics explain as little as 10% of the long-term increase in emergency admissions of older people.9 Long-term trends for admissions in some specialties follow cycles, while medical admissions appear to involve stepwise changes.10-16 Admissions for “injury” and “infection” exhibit unique patterns.1,16 Over 58% of emergency diagnoses are subject to a high degree of “special cause” variation.17 Special cause variation includes all weather and environmental factors (eg, viruses) influencing health, and other sources of non-linear growth, such as changes in the way hospitals count “inpatient” admissions.17-19

How do we explain such real-world patterns?

ABSTRACT

- Current methods used to calculate the required size of hospitals are underestimating the true capacity needed for operational efficiency.
- Trends in occupied bed-days (rather than admissions and length of stay) give better estimates of future bed requirements.
- Hospital occupancy rates depend on volatility in demand, not efficiency.
- Larger bed pools and hospitals can operate at higher average occupancy.
- Cost efficiency should be focusing on staffing based on the patients in the beds and not on the available beds.
- Hospitals require supporting climatological forecasts to allow for seasonal and other climate-related changes in admissions, if flexible staff deployment is to become a reality.

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The link between health and the environment is widely appreciated. Long-term cycles in human longevity, sex ratio and susceptibility to disease have been linked with the cycle in solar flare intensity.20,23 Air temperature is fundamental to health, and global warming will affect the incidence of various conditions.26 Global warming follows a series of short, medium and long-term cycles,27 and admissions for particular conditions might be expected to exhibit similar behaviour. Infectious diseases are periodic.28,29 Conditions such as appendicitis show long-term trends that are unrelated to demographics.30-32

Finally, lifetime hospital bed usage is concentrated in the last year of life, irrespective of age.33,34 Hence, demographics are only part of a complex equation where the total deaths may be the major driving force. In England, the total number of deaths peaked around 1975 and has declined since; a minimum is anticipated around 2015, followed by a steep increase.35 We are about to enter a period where death, per se, will assume an increasing contribution to the demand for beds. The real world is not behaving in the simplistic way that our demographic forecasting implies it should
— although, much like the mythical “85% occupancy” margin, no one appears to have stopped to check why we believe what we believe. 3

Average LOS is simply occupied bed-days divided by number of admissions. 2,8,36,37 LOS itself follows long-term trends that involve peaks and troughs and other behaviour expected of a complex, environment-sensitive system. 37 A method based on the trends in occupied bed-days has therefore been proposed as a better way to forecast bed demand. 3,7,9 Efficiency programs can be incorporated into such forecasts by moving blocks of bed-days out of the acute care setting. But what occupancy level needs to be applied to the annual average bed demand?

The occupancy margin

The occupancy margin depends on the volatility in admissions and occupied beds and not efficiency (Box 2 and Box 3). 10,13,18,19,38 Queuing theory and the Erlang equation anticipate that the real world is volatile and give insight into the occupancy appropriate to each bed pool. 2,3,39 Smaller bed pools (eg, paediatrics, intensive care) must operate at a lower average occupancy than larger ones. The seasonal component to medical admissions demands different numbers of available beds in summer and winter. 5,13,39 Bed-demand forecasts based on seasonal and climatic conditions are important for enabling hospitals to staff the anticipated number of occupied beds. 40,42 (Box 2 and Box 3) rather than merely staffing the available beds or attempting to use an unreliable historical seasonal average (Box 3).

Too few beds and chaotic admission into inappropriate specialty beds result in poor patient care and inefficient LOS. The real issue is not about bed numbers but flexible staffing in the face of uncertain demand. 18,19,42 In the absence of climatological forecasts, coupled with too few available beds, health services have no other option but to “staff the beds” (staff being the real cost) without basing staffing on the patients in the beds. Others therefore incorrectly conclude that “beds” are expensive.

To repeat the call already made 3 — can we please have a true evidence-based debate, or will health departments continue to insist on the use of outdated and erroneous models simply because they give the perceived right answer? Both patients and clinical staff deserve to benefit from the tools required to deliver effective and efficient health care.

Competing interests

I am a senior partner and my wife is a partner of Healthcare Analysis and Forecasting.

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References
