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Emergency admissions and hospital beds

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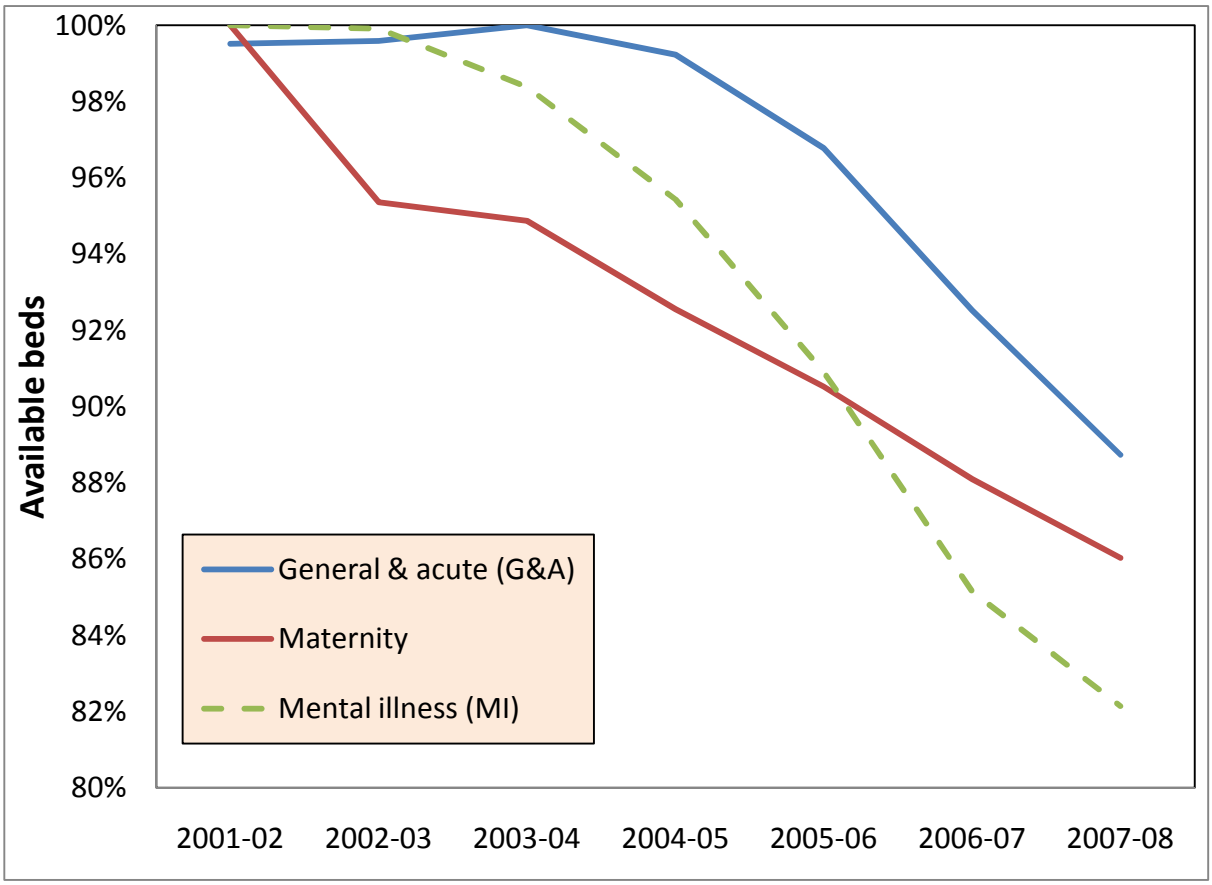
The recent acute bed crisis due to rising emergency admissions and the ongoing maternity bed crisis appear to point to the fact that there may be room to improve our understanding of how to plan to achieve an adequate number of beds.

Fig. 1 demonstrates that the number of available beds have shown a significant decline in recent years. Is it possible that the acute and maternity crises are partly self-inflicted? Is it a wise policy that allows, what are now virtually independent NHS hospitals, to close beds at will?

Figure 1: Decline in available beds in England



Indeed how does a hospital determine just how many beds it needs? The accepted methodology is to forecast future admissions and average length of stay (LOS); multiply the

two and apply an occupancy level. Over six years ago I questioned the validity of this approach and concluded that it was prone to serious underestimation of true bed requirements. What is called average LOS is simply total bed days divided by total admissions, i.e. LOS is a ratio describing a frequency distribution made up from the individual LOS of every patient. Hence average LOS has upper and lower confidence intervals and more importantly can fluctuate in unexpected ways over time. An alternative approach based on trends in bed days was concluded to offer far greater certainty in the forecasting of future bed requirements (Jones 2002).

The suspicion is that very few people actually understand the forces regulating emergency bed demand. The crux of the matter lies around the predictability or otherwise of emergency admissions. Unfortunately the former Modernisation Agency may have muddied the waters considerably by insisting that poor standardisation of processes lead to variation in bed demand which was largely amenable to direct 'control' via process change (Rogers 2002). While partly true it fails to capture the fact that emergency admissions and bed demand is highly dependant on the weather (temperature, pressure, humidity, rainfall, air circulation, etc) and the level of viral and other infections (Jones 1997, Makie 2002, Rusticucci 2002, Rising 2006, Mangtani 2006, MET Office 2008, MWHF 2008). Even so-called planned (elective) admissions are subject to considerable uncontrollable variation due to seasonality in GP referral and statistical randomness (Jones 2000, 2001a,b).

Figure 2: Relative emergency bed days for a Strategic Health Authority population

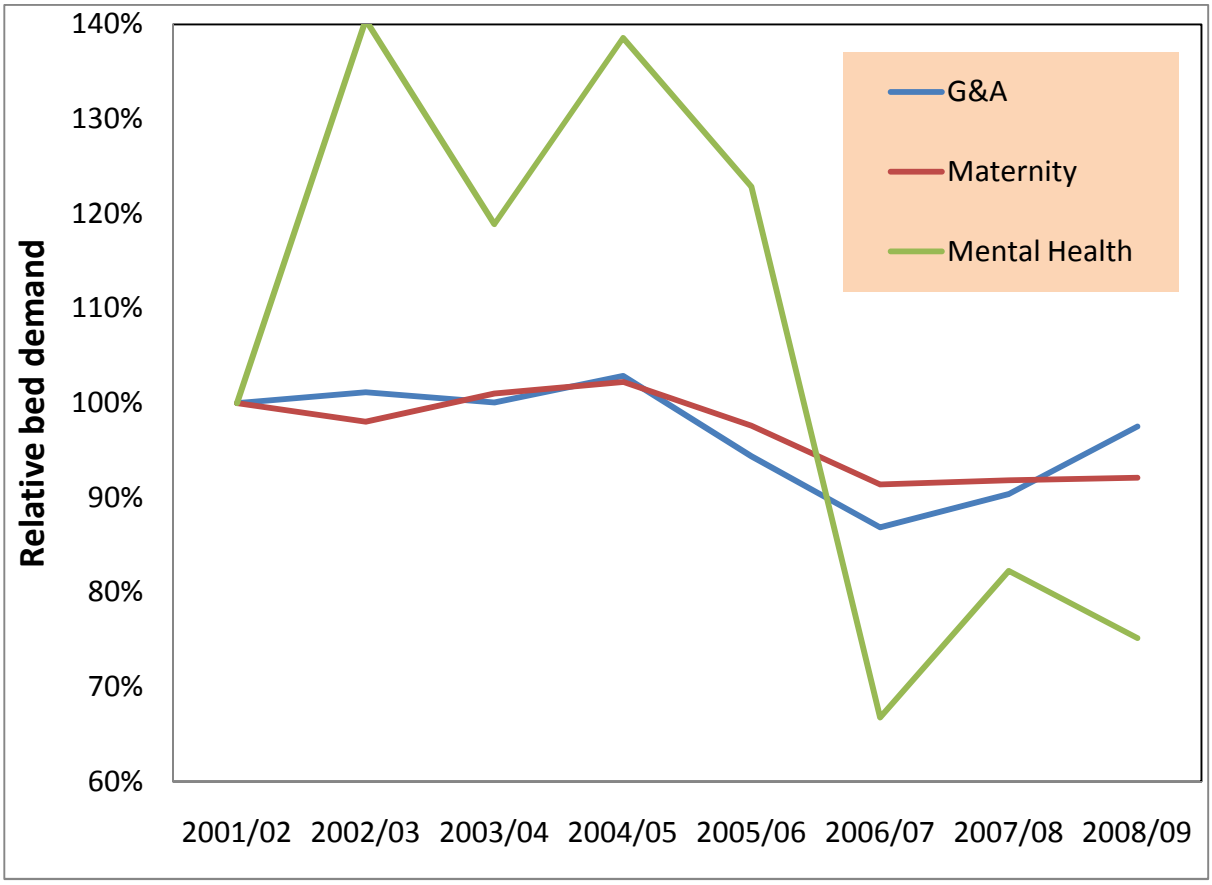


Fig. 2 illustrates this point by showing the relative total bed days for the general & acute (G&A) bed pool for the residents of a strategic health authority. Bed days are relative to 2001/02. Comparison between Fig. 1 and Fig. 2 shows the nature of the true problem.

Firstly we observe that the general situation in mental health is not a problem since bed days have fallen by 25% while available beds have only declined by 18%. However the relatively high volatility in actual demand seen in Fig. 2 implies that there may be problems in the peak years. Next we note that the G&A bed demand (as total bed days) were relatively constant over the period 2001/02 to 2004/05. This was followed by two years of relatively lower bed demand (2005/06 & 2006/07) which lulled hospitals into a false sense of security and hence bed closures were accelerated in 2006/07 and 2007/08. The resurgence in bed requirements which commenced in 2007/08 and continued in 2008/09 was not anticipated (Jones 2009a).

The particular issue related to maternity is easy to spot. Bed demand (bed days) levelled off at 8% below the 2001/02 level while available beds dropped to 14% below the former level. Given the high sensitivity of maternity to average occupancy this will have contributed significantly to the maternity bed crisis (Jones 2001, Jones 2009). The additional births to eastern European mothers only made the bed deficit more apparent.

Table 1: Diagnoses with high bed demand in 2008/09

Diagnosis or group	Beds	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Acute and unspecified renal failure	4	104%	129%	138%	138%	169%	168%	171%
Urinary tract infections	19	119%	122%	145%	153%	132%	152%	166%
Noninfectious gastroenteritis	6	106%	118%	129%	135%	115%	134%	148%
Pleurisy, pulmonary collapse, etc	5	101%	118%	130%	119%	102%	127%	146%
Pneumonia	26	113%	117%	127%	122%	110%	126%	141%
Septicemia (except in labour)	5	114%	128%	111%	137%	133%	146%	128%
Other connective tissue diseases	5	104%	106%	106%	108%	90%	96%	123%
Other circulatory disease	5	106%	119%	115%	124%	117%	113%	120%
All respiratory conditions	**83**	**106%**	**112%**	**115%**	**115%**	**101%**	**104%**	**119%**
Biliary tract disease	7	102%	103%	103%	107%	110%	109%	118%
Complications of inpatient care	7	102%	110%	123%	112%	101%	114%	116%
Spondylosis, intervertebral disc, etc	7	113%	112%	125%	116%	91%	104%	112%
Acute bronchitis	16	97%	109%	109%	107%	95%	91%	111%
Complication of device, implant or graft	10	107%	108%	114%	112%	105%	113%	110%
COPD and bronchiectasis	19	107%	121%	118%	116%	95%	97%	109%
Other fractures	10	104%	104%	106%	122%	99%	112%	107%
Fracture of neck of femur (hip)	37	111%	112%	117%	103%	93%	101%	105%
Fracture of upper limb	10	107%	111%	114%	107%	102%	101%	104%
Fracture of lower limb	18	114%	125%	121%	115%	96%	97%	102%
All trauma (fracture, injury, wounds)	**97**	**114%**	**120%**	**119%**	**113%**	**104%**	**110%**	**102%**

Beds show the approximate number of occupied beds for an average hospital in 2001/02. In all cases 2001/02 is the reference point at 100%.

To understand how bed demand could so quickly bounce back we need to understand the nature of the diagnoses that are showing a fundamental increase over time and the nature of variation in those that are not. Table 1 presents the annual average beds occupied for a variety of diagnoses where bed demand is higher in 2008/09 than in 2001/02. Hence the average

hospital in 2001/02 had 4 beds dedicated to renal failure growing to 7 in 2008/09 and 19 beds dedicated to urinary tract infection in 2001/02 growing to 31 in 2008/09, etc. The next point to note is that the variation for each condition is quite large, hence for all trauma admissions it would appear that bed demand can fluctuate from 100% to 120% (range 20%) of the 2001/02 base figure. Likewise acute bronchitis can fluctuate between 91% to 111% (range 20%) of the 2001/02 figure and 2008/09 just happens to be at the top of this range.

The probability of two low years in a row is 1 in 4 and hence the predisposition to negative skew in a 'good' year appears to have fooled hospitals into closing beds while the longer term cycle in admissions then led to a bed shortage in late 2008 (Jones 2009a).

While various years may be higher or lower than others there is also considerable seasonal variation in bed demand which adds additional bed demand into the system. This is illustrated in Table 2 where the seasonal demand in each of the four quarters of a financial year is given for a variety of diagnoses. As can be seen there is considerable variation around the annual average and a range of conditions peak in the last quarter of the financial year leafing to a general 5% increase in bed demand during the last quarter. It should be appreciated that monthly bed demand shows even greater seasonal peaks and troughs. Of passing interest is the increase in miscellaneous and poorly coded admissions during the last quarter – a possible by product of the general chaos created when there are too few beds (Jones 1996).

Table 2: Relative bed demand in the four quarters of the financial year.

Diagnosis	April to June	July to September	October to December	January to March
Miscellaneous groups & poorly coded	70%	86%	110%	**134%**
Septicemia (except in labour)	91%	105%	97%	**108%**
Urinary tract infections	92%	96%	102%	**110%**
Chronic ulcer of skin	93%	96%	**112%**	99%
Pneumonia	93%	78%	95%	**134%**
Other gastrointestinal disorders	94%	**106%**	**106%**	94%
Complication of device, implant or graft	94%	101%	**109%**	96%
Fracture of lower limb	95%	101%	**106%**	98%
Other fractures	95%	104%	95%	**107%**
Acute bronchitis	95%	71%	94%	**139%**
General & Acute	**96%**	**98%**	**101%**	**105%**
Acute and unspecified renal failure	96%	97%	96%	**111%**
Chronic obstructive pulmonary disease	98%	82%	92%	**127%**
Fracture of upper limb	98%	**107%**	101%	94%
Syncope	99%	92%	103%	**105%**
Other nervous system disorders	99%	99%	**106%**	95%
Acute myocardial infarction	103%	93%	98%	**106%**
Paralysis	106%	**108%**	94%	92%
Nonspecific chest pain	**106%**	99%	95%	100%
Nonhypertensive congestive heart failure	**110%**	97%	93%	100%

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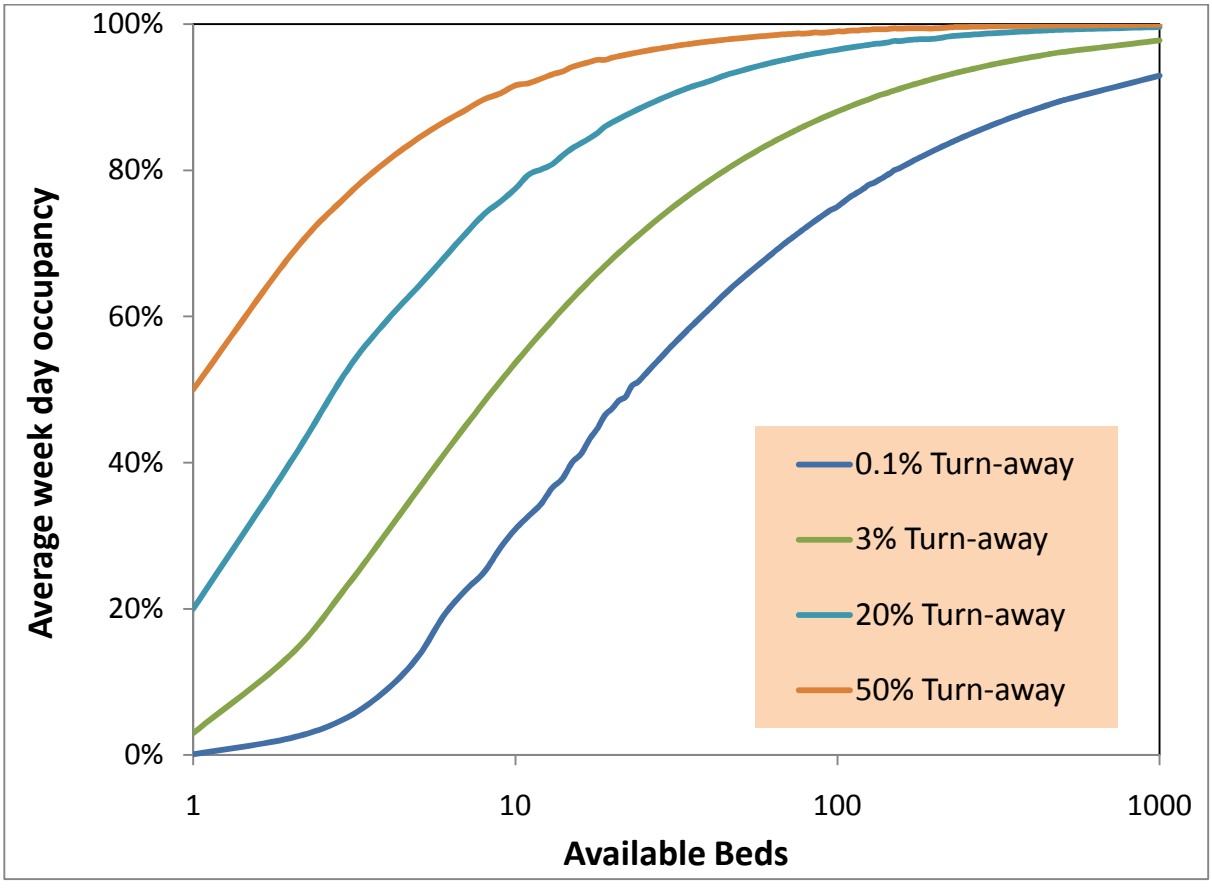
Hence the current bed crisis is none other than too few beds going into a year when bed demand has reverted back to the longer term cyclical demand trend. What remedies can be applied to avoid a repeat of this situation?

Firstly a framework needs to be applied to ensure that adequate beds are maintained in the system. Many will remember the National Beds Inquiry back in the late 1990's – it would seem that the lessons learned have been quickly forgotten or ignored (DH 2000). While 82% average occupancy was recommended the 'Erlang for Beds' methodology demonstrates that bed pools of different sizes have different optimum average occupancy levels (see Fig. 3) and that too high an occupancy leads to undesirable 'turn-away', i.e. ambulances diverted elsewhere, patients on trolleys, cancelled operations, etc. (Baghurst 1999, Jones 2009). A figure of 50% turn-away implies that at the point of arrival 50% of patients will experience undesirable consequences. Maternity, intensive care, paediatric, etc should in theory have sufficient beds to operate on the 0.1% turn-away line while G&A beds can safely operate at around 3% turn-away. Hence a G&A bed pool with 300 beds can operate at 95% average occupancy. Most hospitals are operating well above this figure during the winter months.

Figure 3: Average occupancy and undesirable 'turn-away'



In conclusion, a mechanism needs to be established to ensure that hospitals maintain sufficient beds to cope with winter demand peaks and the vagaries of emergency admissions in general.

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