Are Maternity Services at XYZ Inefficient or are the Benchmarks Flawed?

An Overview

for

XYZ NHS Trust

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Executive Summary

1. XYZ is a very small maternity unit and has unavoidable costs due to its small size.

2. An equivalent unit delivering twice as many babies per year would have >20% lower costs per birth while a very large unit 10-times the size would have >58% lower costs per birth[1].

3. Average size for a maternity unit in England is 56 beds with a national average maternity occupancy of 64.4%

4. Use of the 'E-plus for Beds' tool shows that XYZ could be expected to have somewhere between 18 to 21 beds for 1,500 births per annum and an average LOS of 2.2 days.

5. At this size average occupancy should be around 38% to 44%

6. The current costs of the maternity unit are likely to be unavoidable as staffing levels will be set by various codes of practice with the minimum number of staff set by the small size of the unit.

7. Attempts to reduce average length of stay (LOS) are futile since it is size not average LOS which determines the cost base.

8. The maternity unit should be encouraged to continue to utilize the lower average occupancy to extend the stay of mothers who have had a difficult birth or who need additional support prior to returning home.

9. The apparent reference cost index at XYZ will be further elevated by the fact that other hospitals in NHS SHA count many more 'admission' events per birth.

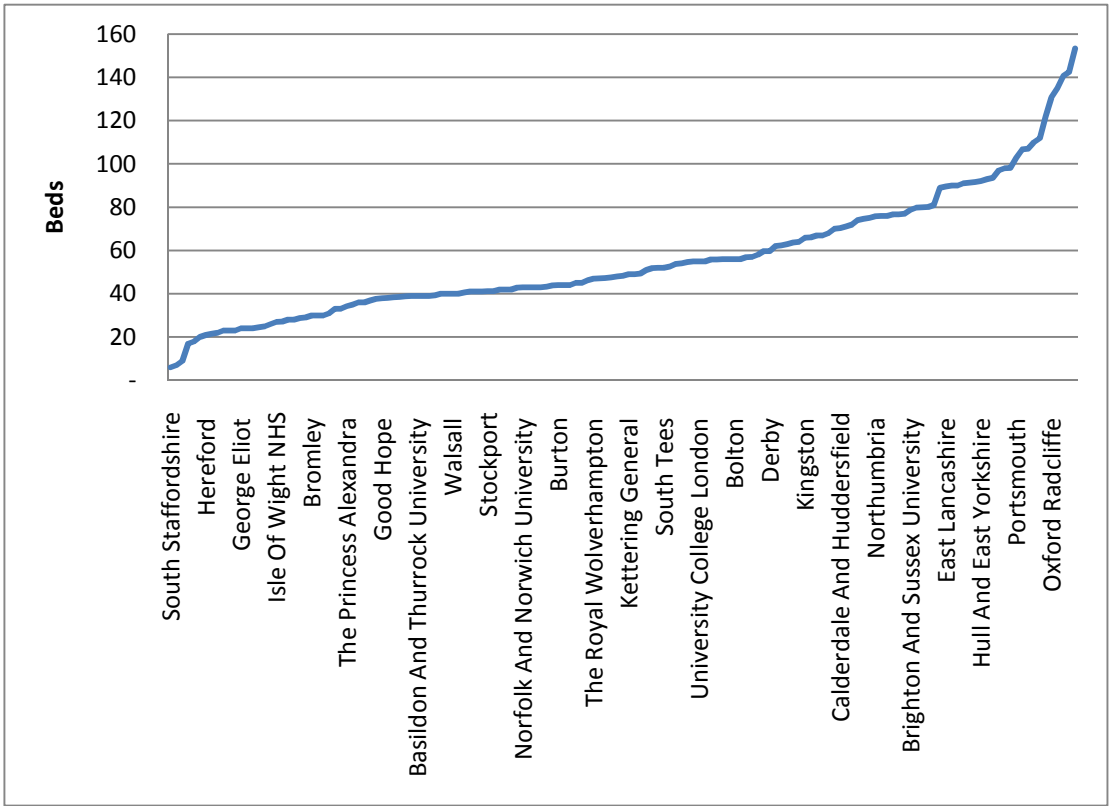
10. The maternity unit should consider advertising the fact that it delivers a very high level of personal service to mothers but that this comes at an above average cost. In this context charitable donations to the unit could be considered an appropriate public response.

[1] A maternity unit 10-times the size of XYZ would be equivalent to the largest maternity unit in England, i.e. Pennine Acute Hospital with 153 maternity beds.

Overview

The relative size of maternity units in England is given in Figure One. XYZ is the 19th smallest unit with 27 'beds' reported for 2006/07 (excluding birthing rooms the unit has 22 beds).

Figure One: Relative size of maternity units in England



While most NHS personnel are aware that maternity units operate at a lower average occupancy they will not be aware that there is an exact relationship between occupancy and size. This relationship can be calculated using 'Erland for Beds'.

E-plus for Beds

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. Maternity units are sized to avoid queues of mothers waiting to give birth! This has consequences for the relationship between size and occupancy and the resulting average cost per birth.

In the Erlang equation the number of arrivals per day is assumed to follow a Poisson distribution. Figure two illustrates the dilemma faced by small units such as XYZ where an average of 2.6 per day implies that on 3% of days there will be no arrivals yet on 0.1% of days there can be 11 arrivals in a single day.

Figure 2: Range in the number of mothers arriving to be delivered each day when the annual average is 3.6 per day.

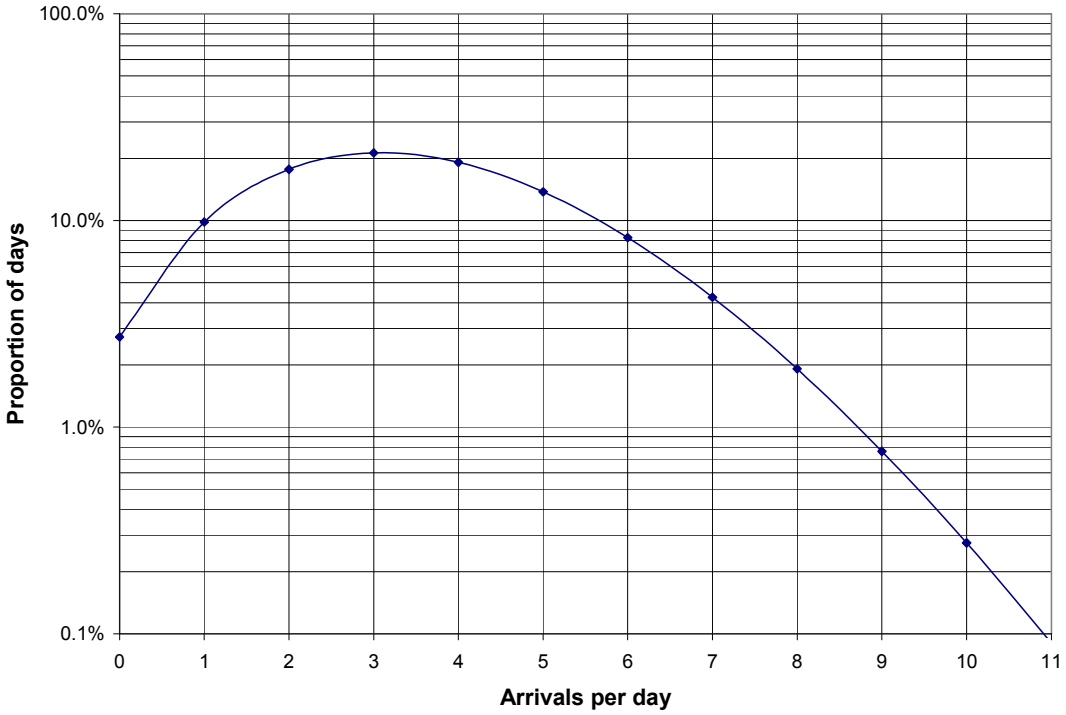
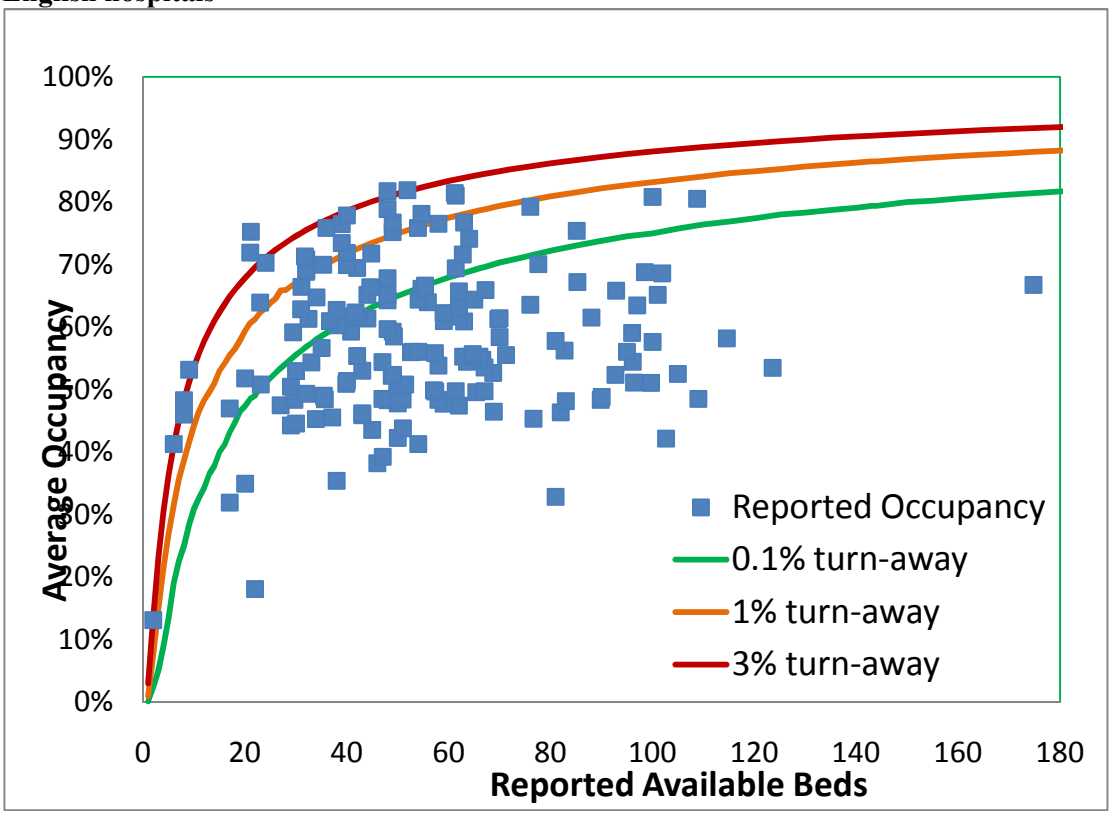


Figure Three: Relationship between size and average occupancy for maternity beds in English hospitals



On a very small number of occasions (0.027%) 12 mothers can arrive in a single day. It is this huge range in the number of mothers arriving in a single day that sets the size of the maternity unit and leads to higher unavoidable costs in the smaller units.

Figure Three illustrates this relationship for maternity units in England. Superimposed on the actual data are lines of turn-away as calculated by 'E-plus for Beds'. A figure of 1% turn-away implies that 1 in 100 expectant mothers would have to wait for a short time for a bed to be found, etc.

As can be seen all maternity units in England operate at a level of turn-away below 3%. As a general guide maternity units should seek to operate at a level of 0.1% turn-away or lower, i.e. at or below the green line. Roughly 50 out of 170 maternity units operate above this level – most probably due to misplaced pressure to reduce costs!

Although the line is not shown it can be appreciated that some units will be operating at levels of turn-away below 0.01%, i.e. 1 in 10,000 mothers has to wait for a bed to be available. Levels of turn-away below 0.01% are not justified and hence a small number of beds could theoretically be closed in around 20 maternity units. In practice the number of beds in these units will be set by the physical layout.

Turn-away and 100% Occupancy

The lines of constant turn–away can also be understood in the context of 100% occupancy. Hence on the green line a unit with the appropriate number of beds & average occupancy will experience 100% bed occupancy on 0.1% of occasions, i.e. around 9 hours of 100% occupancy per annum. A maternity unit on the red line will experience 100% occupancy on 3% of occasions, i.e. around 263 hours per annum.

Seasonal & Circadian Patterns

In the SE of England births do exhibit slight seasonality and are roughly 4% to 6% higher than the annual average in the months April to June. The pattern of births is also highly circadian with up to 45% higher births at the peak time in the hours after midnight and a minimum in the afternoon. While the circadian cycle affects the workload during the day it does not alter the average arrivals per day and so the calculations in this report refer to the general average of arrivals per day.

Calculations for XYZ Maternity Unit

Births per annum at XYZ range between 1,000 and 1,300 with an average LOS of 2.2 days, i.e. an average of 3.6 births per day. Using this information bed pool size can be calculated for XYZ and units which are 2-times and 10-times larger. This information is given in Table One. The higher figure of 1,300 births per annum has been used as the basis for calculations.

If the information on births per annum and LOS is correct then the reported bed pool size of 22 beds is at the optimum size. Changing the average LOS to 2.3 days gives 23 beds rather than 21 beds for 0.01% turn-away.

In conclusion, the unit appears to be appropriately sized given the low volume of births per annum.

If we assume that the bed pool is fully staffed then we can use Table One to calculate the effective cost saving for units larger than XYZ. For a unit 2-times the size of XYZ (2,600 births per annum) the unit could be expected to be between 20% to 31% more cost efficient while for a unit 10-times larger that apparent cost efficiency is 58% to 89% lower cost per birth.

Table One: Calculated beds, turn-away and occupancy for XYZ, a unit twice the size and a unit 10-times the size

Births per day	Beds	Turn-away	Occupancy
3.6	15	1.00%	52.4%
	18	0.10%	44.0%
	21	0.01%	37.7%
7.2	25	1.00%	62.8%
	29	0.10%	54.6%
	32	0.01%	49.5%
36.0	95	1.00%	82.6%
	104	0.10%	76.1%
	111	0.01%	71.3%

We are therefore left with the conclusion that the so-called target cost saving of £2M is a theoretical figure based on the average size of a maternity unit in England, i.e. 56 beds. This would equate to a unit 4.6-times the size of XYZ where costs would be expected to be around 47% lower per birth than at XYZ. This calculation is roughly in proportion to the size of the 'target' cost saving.

The so-called cost saving is therefore largely the artefact of misplaced belief in a flawed benchmark.

Counting and Reference Costs at XYZ

The effect of size is not the only factor which may contribute to perceived cost inefficiency at XYZ. There is significant counting abuse of the HRG's N02, N03 and N12, i.e. some hospitals count almost every baby as having 'one minor diagnosis' (HRG N02) while other hospitals count as an 'emergency' admission every woman presenting for a minor bleed, etc during the course of pregnancy (HRG N12). These counting manoeuvres shift costs in such a way to lower the apparent reference cost index of the maternity unit.

This information is given in Tables Two and Three for maternity units in the NHS SHA.

Table Two gives the number of 'admissions' for neonates and as can be seen the ABC PCT is roughly at around the average. It is not known how Milton Keynes General Hospital (MKGH) achieves the remarkable feat of 159% of births having one minor diagnosis. Presumably every time a baby coughs they are admitted!

ABC is possibly slightly high in terms of the recording of one minor diagnosis however the generally average position implies no opportunities to artificially lower the apparent reference cost index.

Table Two: Percentage of births with neonates coded to a diagnosis (Dx)

Acute Trust	N01 Died	N02 Multiple Minor Dx	N03 One Minor Dx	N04 Multiple Major Dx	N05 One Major Dx
Basingstoke	0.3%	16%	78%	1%	8%
Buckinghamshire	0.4%	16%	76%	2%	6%
HWWP	0.7%	6%	85%	5%	8%
ABC PCT	0.5%	17%	73%	4%	6%
MKGH	1.1%	7%	**159%**	5%	6%
ORH	0.5%	26%	60%	2%	7%
Portsmouth	0.4%	8%	59%	3%	**10%**
RBH	0.1%	5%	15%	2%	5%
SUH	0.6%	10%	65%	7%	5%
Winchester	0.1%	**42%**	45%	5%	6%
SCHA Avg	0.5%	15%	63%	4%	7%

Table Three gives the count of total 'admitted' events per birth. As can be seen MKGH counts very high in both antenatal admissions and the high count of neonates with one minor diagnosis combines to give them 4.14 admissions per birth. This will lead to a considerably lower apparent reference cost index for maternity at this hospital.

Table Three: Total count of 'admitted' events per birth

Acute Trust	N12 Antenatal Admissions not Related to Delivery Event	Grand Total
Apple	0.20	2.23
Banana	0.92	2.92
Humous	0.91	2.96
ABC	**0.18**	**2.18**
Melon	**1.35**	**4.14**
Orange	0.80	2.75
Pear	0.56	2.35
Radish	**1.41**	2.68
Spinach	0.58	2.45
Water melon	1.05	3.03
SHA Avg	0.82	2.71

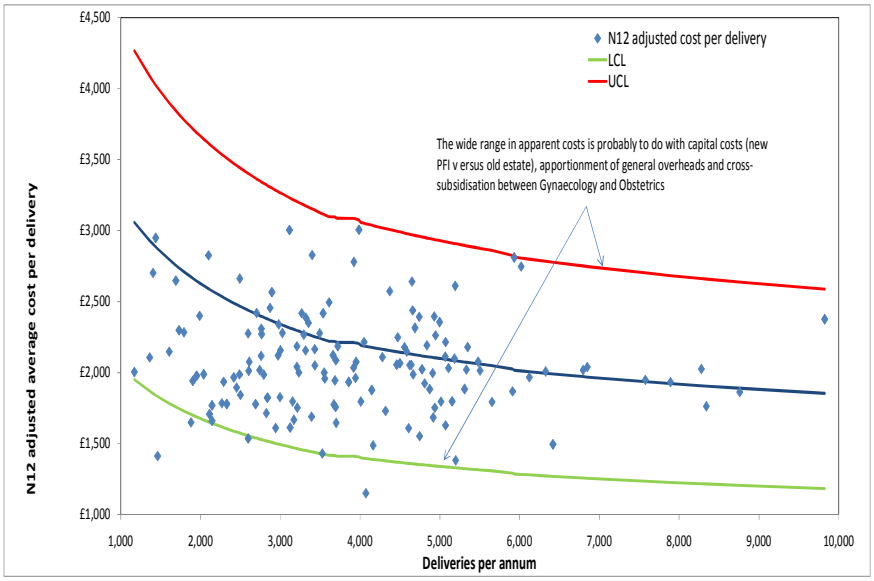
Of direct interest to ABC is the fact that ABC has the lowest number of 'admissions' per birth in NHS SHA. This will lead to XYZ have a high apparent reference cost index relative to other maternity units in NHS SHA.

Economy of Scale & Reference Costs

The NHS reference costs should reflect the economy of scale available to the larger maternity units. At face value the reference costs do not appear to show economy of scale, however, the issue has been greatly complicated by the cost shifting introduced by HRG N12.

Figure Four shows the effect of scale on reference costs (as average cost per delivery) after adjusting for the confounding effect of N12.

Figure Four: Economy of scale and maternity costs after adjusting for the effect of N12. The lines give the economy of scale predicted by the Erlang equation.



As can be seen the cost per delivery in maternity units does indeed appear to conform to the economy of scale predicted by the Erlang equation. However there appears to be very wide variation between the lower and upper limits.

There are a number of reasons for this variation:

- Different capital costs incurred by newer PFI units and older estate
- The method of apportionment of general hospital overheads, i.e. are general overheads apportioned based on costs or volume
- Cross-subsidisation between Obstetric and Gynaecology costs
- The impact of gross errors in costing elsewhere in the total hospital costs

It should be noted that the N12 adjusted cost for XYZ is £2,250 per delivery. This places the unit very close to the lower limit of costs, i.e. excluding the impact of the four points above there is the implication of an efficient unit.

Conclusions

Both relative size and how events are counted will lead to the unfounded appearance of cost inefficiency at the XYZ maternity unit.

There is no basis for believing that the unit costs any more than a similar sized maternity unit should cost and it is possible that the unit lies at the lower range of cost per delivery.

Massive cost savings are not required and the ongoing process of continuous improvement should be encouraged as evidence of a commitment to excellence.