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Limitations of the HRG Tariff: The National Average

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Every year NHS Trusts calculate the apparent average cost of each HRG which is then averaged again over all Trusts to give a national average cost. Apparently no regard is given to the average cost from previous years. It may be a useful exercise to determine exactly how stable these calculated national average costs are over time. To do this we must first determine how 'accurate' the average cost will be at Trust level. While there are a considerable number of perceived factors leading to variation in costs between Trusts it may be useful to focus on one factor that is often overlooked, namely, variation in the calculated average due to the sample size.

Fig. 1 presents the results of a computer simulation of the range in calculated average cost which could arise at a single Trust for a single HRG where the cost of each individual patient is unique. In the simulation each patient could stay between 12 hours and 9.6 days at £200 per day and had a diagnosis/procedure phase at the beginning of the admission lasting from 90 minutes to 6.6 hours at £300 per hour. In both cases the distributions were skewed to reflect the situation commonly seen in NHS cost data. All random variations were added together to give the cost per patient and this was then averaged over different numbers of patients admitted to our hypothetical HRG. As can be seen it takes around 1,000 patients at a single hospital for that hospital to get a tight estimate of the true average cost for a single HRG! For a sample size of less than 100 patients it can also be seen that the likelihood of high apparent averages significantly increases. Would it come as a surprise to note that the vast bulk of HRG have fewer than 10 admissions per Trust. Should we be surprised that there is very high variation in the apparent average price for each HRG submitted by different Trusts? This unavoidable source of variation is very high!

Having demonstrated that sample size is a very important source of cost variation at local level we now need to look at the national average cost. To demonstrate the uncertainty in the national average the average costs for V3.5 HRG have been followed from 2002/03 to 2005/06. Some HRG from 2002/03 (V3.1) were carried through to V3.5 and these have been incorporated into the time series.

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Figure 1: Maximum and minimum calculated average cost

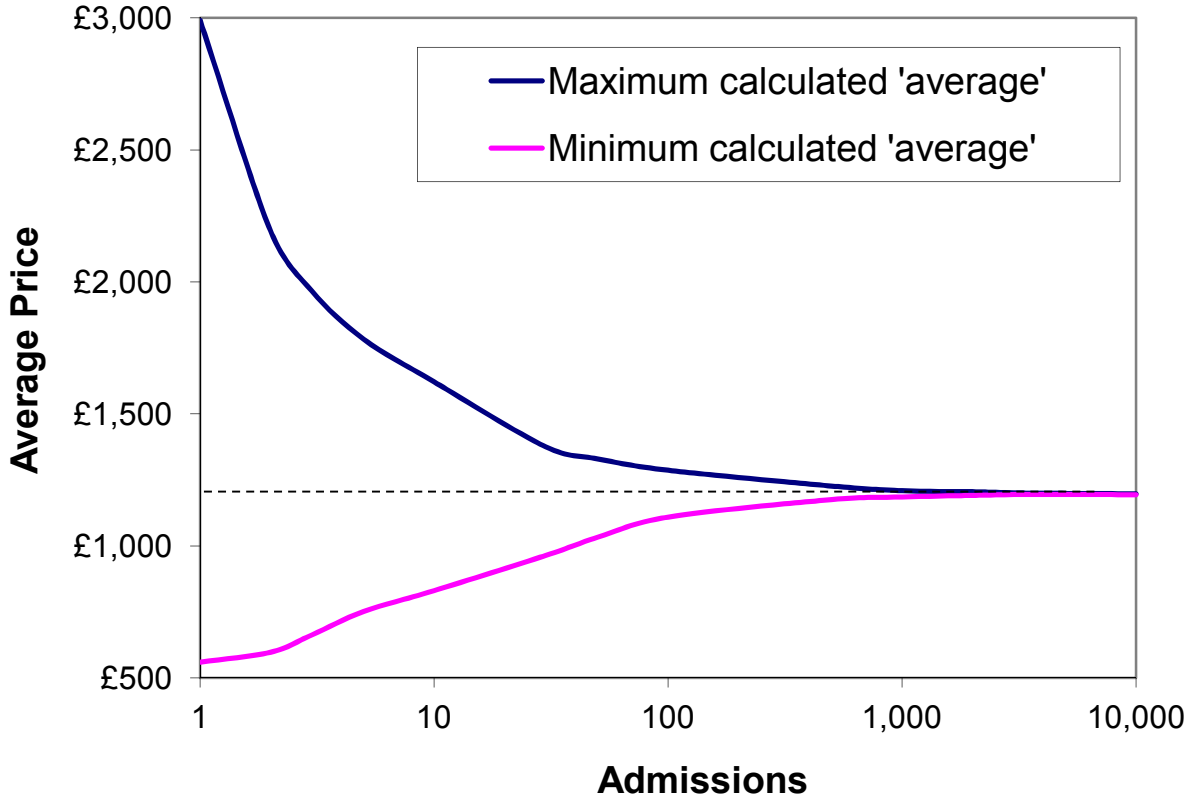
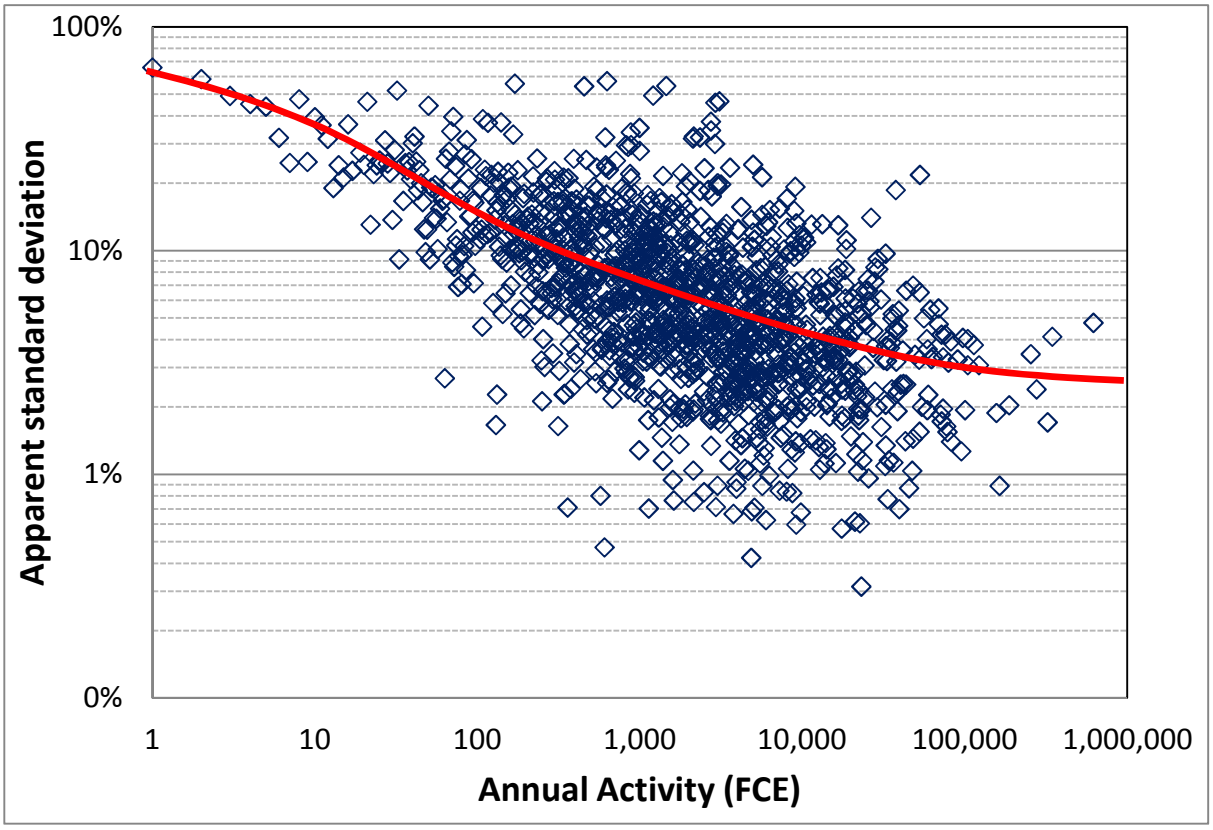


Figure 2: Standard deviation associated with the average cost for each HRG.



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Earlier years have been adjusted for inflation and other costing changes and the 'long term' average cost for each HRG has been calculated along with the standard deviation associated with that average cost. The calculated standard deviation has been divided by the average price to give a measure of variation as a proportion (%) of the price and this is plotted in Fig. 2 as a function of the national activity (FCE) for each HRG.

Emergency, elective overnight and day case are all shown together as there appears to be no intrinsic difference between the different admission types.
The scatter around the trend line is mainly due to the magnitude of the cost and the number of Trusts submitting a cost for each HRG. The trend line (in red) describing the standard deviation (%) associated with the national average price for a HRG can be estimated as:

$$\% \text{ Standard deviation} = \text{Price}^{-0.06} \times \text{FCE}^{-0.08} \times \text{Number of Trusts}^{-0.32}$$

Hence the % standard deviation gets smaller as price, national total FCE or number of Trusts increases. This equation is important because it allows us to estimate the incremental effect of moving from HRG V3.5 to V4 where the average number of admissions per HRG has been cut in half by virtue of doubling the number of HRG. For example, A HRG with 36,900 total admissions from 207 Trusts costing around £1,400 will now have a standard deviation of 5.4% of cost compared to 5.1% previously. Less ubiquitous HRGs will experience a greater shift; however, the point is that the average cost has become less certain as per Fig 1.

Returning to Fig. 2 we see that prior to HRG V4 the standard deviation associated with the national average price was already very high for all but the minority of HRG with high annual activity. Some 25% of the national activity is associated with HRG which have a standard deviation which is higher than 5% of the long-term average price. Any HRG with a national volume of less than 100 FCE is guaranteed to have a standard deviation of greater than 10% of the long-term average price, i.e. something with a price of £1,000 will have a standard deviation of greater than £100 and a 100% confidence interval of ± £300.

There are four key messages from Fig.2, namely, the HRG tariff is <u>not</u> calculated from the long-term average cost but from single year values. In any single year the national tariff for each HRG could therefore be a maximum of three standard deviations away from the 'true' long-term average and the year-on-year difference in the price can be up to 4.5 standard deviations. This partly explains the year-on-year variation in the reference cost index (RCI) (Jones 2009).

The second message is to do with local activity compared to national. Hence if at national level any HRG with less than 100 FCE is guaranteed to have greater than a 10% standard deviation what will the impact be on the local price submitted as part of the RCI calculation?

Thirdly, when we realize that the average for hospitals is only 33 FCE, 11 FCE and 18 FCE per HRG per specialty (day case, elective overnight and emergency FCE respectively) the possibility of an unstable RCI becomes a reality! Those who have done any statistical studies will recognize this as an outworking of what is known as sampling error, i.e. a small sample from a larger population will have a different average to the larger population from which it was taken. Indeed how can we be sure that the smaller V4 HRGs are themselves 'iso-resource' and not just statistical artifacts?

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Lastly, even after adjusting for the effect of size there are quite a few HRG which have an intrinsically high standard deviation associated with the national average price. Indeed 37% of HRG have a standard deviation higher than 10% of the average price.

What are the implications of the above to everyday life in Trust finances and the HRG tariff?

1. The HRG tariff should be calculated using averages which include all possible years' data. Difficult to do if one chooses to update the HRGs every three years!
2. The assertion that the RCI measures 'genuine' efficiency should be rejected.
3. There are only a handful of HRG at each Trust which have sufficiently high activity to enable any form of genuine 'efficiency' comparisons, i.e. around 1,000 admissions per annum.
4. Recognition needs to be given to the fact that there is a high level of statistically unavoidable risk associated with PbR. This is reflected in the high natural variation in the RCI (Jones 2009).
5. Alternative funding mechanisms, such as those pursued in Scotland, need to be given greater recognition.
6. There may be room to reduce the number of V4 HRG by stipulating that HRG with less than 100 FCE at a national level are open to a locally calculated price per patient

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