High risk categories and risk pooling in health care costs

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Key Points

- Removing six highly volatile categories of cost leads to a three-fold reduction in the year-to-year volatility (and hence financial risk) associated with total health care costs.
- Minimum risk in the core CCG budget is likely to be achieved when the risk associated with the most volatile 15% of the NHS budget is covered by larger regional risk pools.
- These regional risk pools should share risk between themselves rather than with their own respective CCGs.
- However, even in the absence of such high risk activities it is still likely that location-specific volatility in costs will remain a problematic area, which up to the present has been assumed to arise from 'ineffective' local management.

Abstract

In England the totality of health care costs are aggregated at local area using 23 Programme Budgeting cost categories. These 23 categories have been analysed to determine the extent of year-to-year volatility in costs for each local area. After adjustment to bring all categories and locations to the same size the 23 categories are ranked according to volatility in costs. Six high volatility categories were identified and excluding these from the base budget resulted in a 3-times reduction in volatility (financial risk). Strategies around risk pooling are discussed.

Introduction

Volatility in costs is a poorly understood but intrinsic part of financial risk in healthcare and resource allocation (Jones 2004, 2006, 2012b-e). This risk can be mitigated by the use of risk pools (Jones 2008a-c). The aim of risk sharing in health care commissioning is to protect the participants from undue exposure to volatility in costs so that they can concentrate on the (controllable) core issues rather than reacting to (uncontrollable) high volatility peripheral events. An earlier study using computer simulation of inpatient costs suggested that excluding any health care event or person costing more than £5,000 (equivalent to around 25% of inpatient costs) was one route to this goal (Jones 2008a).

In the USA such high cost persons account for just 1% of the population but consume 22% of total health care costs while the top 5% account for 50% of costs and persons most likely to be in this group are elderly females (Cohen & Yu 2012). In Taiwan the top 0.5%, 1% and 5% of the population account for 21%, 30% and 50% of health care costs respectively (Chang et al 2010). It is the author's experience that in English PCTs there is a group who represent 1.5% of the population but have had 6 or more non-elective admissions (average 8.5) in the last 6 years costing around 16.5% of non-elective costs. This represents a sub-set of the wider group of high cost individuals and confirms the observation made in Taiwan that historic cost is strongly related to current cost (Chang et al 2010).

An example of this type of thinking is seen in the regional Specialised Commissioning groups which cover three to seven million head. These groups commission for a range of 15 low-volume but high-cost services such as blood and marrow transplantation, spinal cord injury, deep brain stimulation for Parkinson's disease, sterotactic radiosurgery and therapy, specialised burn care services, etc. From 2013 these services plus a few others will be the responsibility of the NHS Commissioning Board (see http://www.commissioningboard.nhs.uk/files/2012/07/fs-ccg-respon.pdf) and will effectively become a national risk pool for these particular services.

A previous article in this series suggested that cancer costs may be a possible source of high risk, however, such a proposal requires a knowledge of the relative volatility associated with other categories of care (Jones 2012d). In England, the total cost of health care is allocated into 23 Programme Budget categories which broadly correspond to a range of diseases or body systems, i.e. cancers, dental, social care (see http://www.dh.gov.uk/en/Managingyourorganisation/Financeandplanning/Programmebudgeting/index.htm).

In this study the year-to-year volatility in costs associated with PCT level expenditure for these 23 categories during an eight year period will be evaluated to determine which categories are most volatile and to what extent overall cost volatility could be reduced if high volatility categories were moved into regional risk pools.

Methods

Data sources and methods are as per earlier articles (Jones 2012a,b). Results for each cost category were calculated and a plot similar to Figure 2 was then used to identify PCTs containing gross data errors (usually transposition, omission of digits and other input errors). The year in which the error occurred was identified and a suitable correction applied. In general around 0.5% of the data appears to contain such gross errors which would appear to indicate that while some PCTs may be incorrectly calculating the costs in particular categories they are applying such bias in a consistent manner and hence the calculated volatility remains a valid measure. These issues are covered in more detail in the discussion section. During the first four years of the data series there was considerable uncertainty surrounding the NHS Dental contract and the provision of dental services. This is reflected in high volatility and step-like changes in costs. Hence for the dental category omission of such boundary changes were required during the earlier part of the time series. It is therefore possible that the genuine volatility in dental costs may be lower.

Results

The results of the analysis of volatility are presented in Figure 1 where the average

Figure 1: Volatility associated with different cost categories
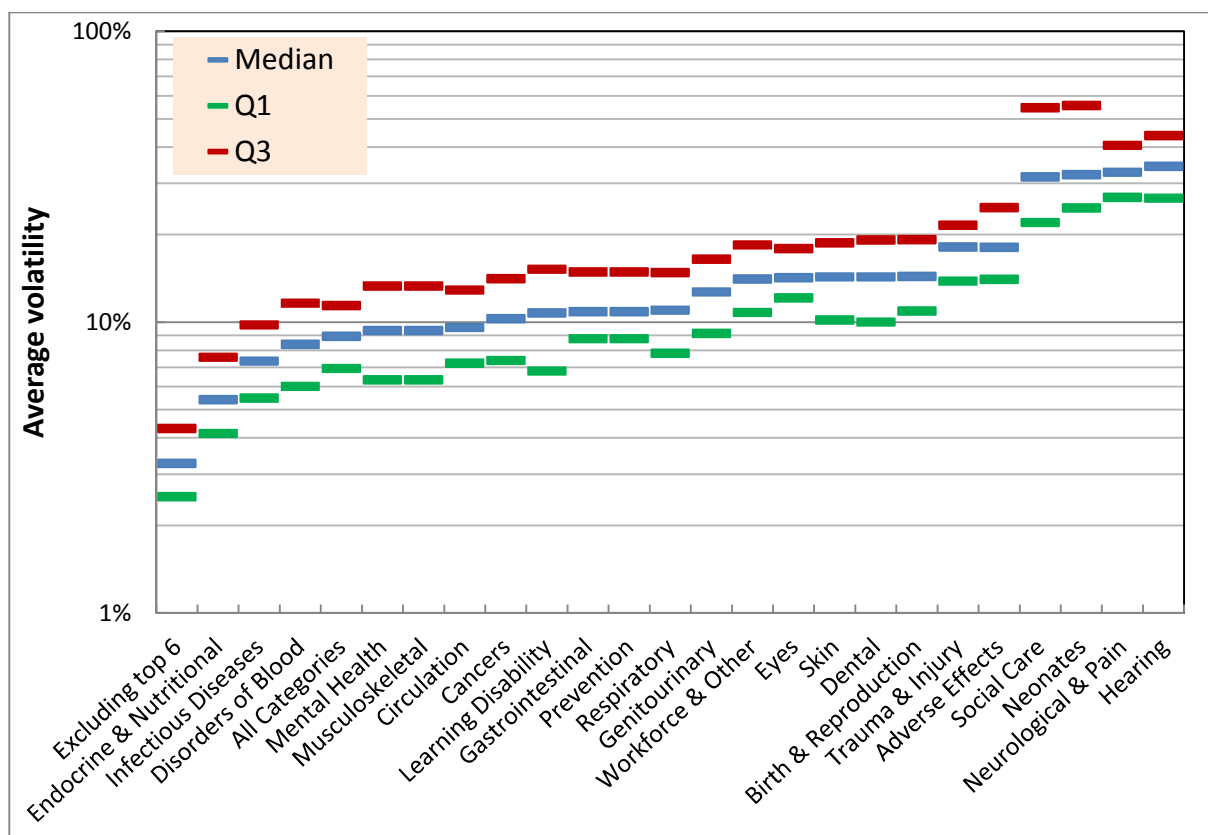

Footnote: Constituent PCT data in all groups has been adjusted to the equivalent volatility at £50 million expenditure, i.e. adjusted for size. Actual volatility x √Actual expenditure/ √£50 million. Note that the Y-axis is a logarithmic scale.

volatility for each PCT in every category has been adjusted for size to give the volatility which would apply to a £50 million budget.

The mode (middle ranked value) and the upper and lower quartile were then calculated for each category of costs. As can be seen average volatility ranges from low in the Endocrine & Nutritional disorders category through to very high in the Social Care, Neonates, Neurological & Pain and Hearing categories. Also shown is the volatility applicable to the PCT total budgets (All Categories). The volatility for Mental Health is lower than may be expected and this is probably due to the fact that most mental health expenditure is covered by block contracts rather than full Payment by Results (PbR) as in many other categories.

The next step was to remove the top six high volatility categories, i.e. Trauma & Injury through to Hearing and recalculate the average volatility. This is also shown in Figure 1 where the median volatility has been reduced from 9% (all categories) down to 3.3% for a £50 million budget. This moves £13.6 billion (£2010/11 prices) or 14.8% of PCT total costs into a larger risk pool.

Figure 2: Range in risk for PCTs and larger commissioning organisations *after* excluding high risk groups
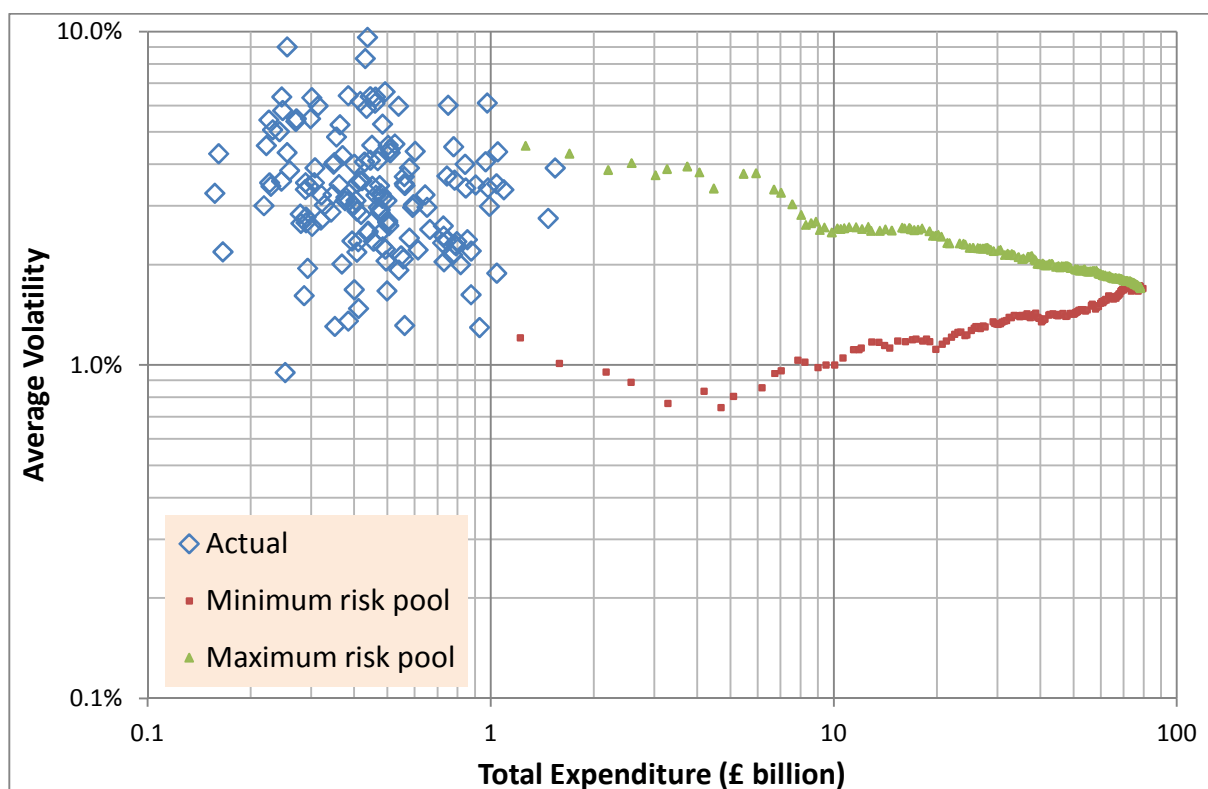
Footnote: Calculation of risk for larger commissioning groups is as per previous studies (Jones 2012a-d).

Figure 2 shows the spread in volatility associated with PCT budgets after excluding the six high risk groups. As can be seen a high degree of location-specific volatility (risk) still remains with one 'lucky' PCT managing to move below 1% average

volatility while several 'unlucky' ones remain struggling to balance the annual budget in the face of 9% average volatility. As in real estate it would appear that the old adage 'Location, Location, Location' very much applies also in healthcare. The lines for minimum and maximum risk describe the overall average volatility which would be experienced by regional sized CCGs, and the net average volatility for eight regional budgets of £10 billion would still range between 1% and 2.5% depending on the location of the region.

The resulting £13.6 billion national risk pool for the high risk categories would retain 4.1% average volatility (over an eight year period) – which suggests that attempting to exclusively retain this risk in regional risk pools may not be the best solution, i.e. these high risk categories in a £2.5 billion regional risk fund would attract somewhere around 5.5% average volatility with a spread of risk around this average depending on location (data not shown).

Discussion

Having identified a set of high volatility cost groups it is always useful to do a validity check to see if the results are as expected or are artefacts of the method. As discussed in the methods the allocation of costs into cost categories may be biased in some PCTs but the bias appears to be consistently applied, hence, calculated volatility remains a valid measure especially when the median (sometimes called the robust mean) is used. This is because the median is not unduly influenced by outlying values which may arise from data errors. The use of the upper and lower quartiles (the inter-quartile range is another 'robust' statistic) likewise only selects those 50% of values lying closest to the median. The results given in Figure 1 are therefore a robust estimate of the central range in volatility associated with each category. In this respect the two categories Neonates and Social Care have very high upper quartiles simply due to the fact that both categories will contain a substantial tail of very high cost patients.

Falls prevention is a good example of possible bias in the allocation of costs between categories discussed above. Spending on falls prevention should be allocated to Trauma & Injuries under the Prevention and Health Promotion setting - if PCT/CCGs can separately identify this spend. However, depending how these services are delivered some may not be able to separately identify this - for example if this is delivered by occupational therapists that cover a range of other services some may include this spend in the Healthy Individuals category (under prevention and health promotion). Alternatively others may include it in the Community setting if they have a block contract covering a range of services. The community part of the collection is probably the most ambiguous and many do not have suitable information to allow accurate allocation of spend to Programme Budgeting categories (although this is a small proportion of overall spend).

Using the 2010/11 Care Setting data Endocrine only has 25% in the secondary care, A&E and Ambulance settings which seems to fit with the low volatility and Hearing, Adverse Effects and Neonates are around 80% secondary care which fits with high volatility. Disorders of Blood have 85% of spend in secondary care and that has low volatility. However, a large proportion of this may be covered by specialised commissioning and hence be smoothed by risk sharing arrangements.

At this point it is worth noting that there are likely to be some aspects of care within all categories that are particularly volatile. To facilitate deeper analysis from 2010/11 onward the Programme Budgeting data has been expanded to include 13 Care Settings (elective inpatient, outpatient, health & social care, community care, etc) so that, in future, more precise identification of where the volatility is located will be possible. For example, investment in services to prevent falls should, in theory, decrease volatility of spend in other areas, e.g. A&E, non-elective inpatients.

The fact that the volatility associated with Mental Health is so low is probably more a reflection that these services have been largely run as block contracts. It goes without saying that block contracts are a very effective way of sharing risk between purchaser and provider, a fact which appears to have been overlooked in the enthusiasm to implement PbR in England and elsewhere (Jones 2004) and which necessitated the introduction of a 70% discount for emergency admissions above the 2009/10 out-turn, i.e. a form of cost and volume contract (Jones 2010).

While the choice of high volatility categories will always be arbitrary the first higher risk category of Trauma & Injury (as per Figure 1) is marked by a step increase over the previous five categories. It is also logical in that trauma and injury are already known to exhibit high volatility due to their well established relationship with the weather (Mirchandani et al 2005, Rising et al 2006, Stomp et al 2009, Cashman et al 2011, Parsons et al 2011). Likewise adverse events (poisoning, violence, adverse effects of treatment, etc) is known to show long term cycles presumably due to a linkage with infectious outbreaks and also contains elements sensitive to the weather (Jones 2012a, Jacob et al 2004). Neonates are an obvious low volume-high cost category and are already part of the Specialised Services umbrella. This category has been proposed to be affected by the long term cycle in costs (Jones 2010b) as do admissions for children under the age of one year (Jones 2012f). The Social Care category is expected to be volatile given some dependence on end of life care costs (Jones 2012e) and the hearing & balance category contains neurological elements know to be low volume-high cost with other elements affected by long term cycles (Jones 2012f).

Whatever the cause(s), the partition of high risk elements into a larger risk pool is a basic step in the process of creating both a stable core budget and a stable risk pool (Jones 2008a-c). It would seem that the dual requirement of stability in the residual CCG budget and in the larger risk pool imply that somewhere up to 15% of total NHS expenditure will need to be placed into larger risk pools to ensure the greatest

chance of success for GP commissioning. It is important to point out that the larger risk pools should share risk between themselves rather than with their respective CCG members. This need arises out of the highly location-specific nature of volatility and risk (Jones 2102b-e). Given the figures on the proportion of health care costs consumed by high cost individuals in the USA and Taiwan discussed earlier a figure of 15% is probably a conservative estimate of the proportion of total costs needing to be covered by risk pools.

It would appear that the new NHS Commissioning Board may need to evaluate which conditions (in addition to those regarded as specialised and highly specialised) should be excluded from the direct CCG budgets, e.g. the high risk 'other' group of cancers identified in the previous article (Jones 2012d), etc. A minimum case scenario regarding acute costs would be the 160 diagnoses (10% of diagnoses) where there are fewer than 9 admissions per year across the whole of England, i.e. less than 1 admission per year for each of 9 risk pools. This could be extended up to the 345 diagnoses where there would be an average of 9 or fewer admissions per year per risk pool - note that an average of 9 admissions has a range of 0 to 19 in any one year (Jones 2009a). In theory these higher risk areas could also become part of the specialised services remit provided by the NHS commissioning board or they could act as broker to transfer risk equalisation debits/credits between CCGs.

However as Figure 2 clearly shows the residual CCG budgets will still show a high degree of unavoidable location-based risk and it is this area that requires far greater research. It may well emerge that non-person based factors such as population density (affording critical mass for infectious spread), unstable local weather patterns (Baldi et al 2009) or unfavourable inversion layers may be far more important than previously acknowledged.

Conclusions

Statistical randomness, high cost individuals and undulations in the 'average' for particular environment-sensitive conditions all contribute to the high 'real world' financial risk in health care. The population size covered by CCGs still remains an outstanding issue and as at May 2012 population ranges from 68,000 (Corby) to 901,000 (Devon) – lower quartile 170,000; median 226,000; upper quartile 300,000 and 40% are below 200,000 population. Given the very high 'real world' volatility identified in this series of articles (Jones 2012a-e) it is highly unlikely, even with 15% of the budget in larger risk pools, that less than 300,000 head provides a sufficiently large cost base to ensure long term stability. Paradoxically it is only within the financial stability offered by large populations that localism can flourish – although establishing the long-term benefits of particular schemes may take five or more years, i.e. the length of the cycles which appear to regulate the natural rise and fall in health care expenditure over time (Jones 2010a-b, 2009b, 2012a). Expect to see continuing developments in this area.

References

Baldi M, Salinger J, Dirks K and McGregor G (2009). Winter hospital admissions and weather types in the Auckland region. Australian Government Bureau of Metrology. http://www.bom.gov.au/events/9ichsmo/manuscripts/M1415_Baldi.pdf

Cashman J, Green C, McEllistrem B, Masterson B, Condon F (2011) The effect of inclement weather on trauma orthopaedic workload. Irish Journal of Medical Science180(3), 679-682,

Chang H-Y, Lee W-C, Weiner J (2010) Comparison of alternative risk adjustment measures for predictive modelling: high risk patient case finding using Taiwan's National Health Insurance claims. BMC Health Services Research 10:343 doi: 10.1186/1472-6963-10-343

Cohen S, Yu W (2012) The Concentration and Persistence in the Level of Health Expenditures over Time: Estimates for the U.S. Population, 2008-2009. Statistical Brief No. 354, January 10, 2012, Rockville (MD): Agency for Healthcare Research and Quality http://meps.ahrq.gov/mepsweb/data_stats/Pub_ProdResults_Details.jsp?pt=Statistical+Brief&opt=2&id=1036

Jacob B, Lefgren L, Moretti E (2004) The dynamics of criminal behaviour: Evidence from weather shocks. Working Paper 10739, National Bureau of Economic Research, Cambridge, MA.http://www.nber.org/papers/w10739.pdf

Jones R (2004) Financial risk in health care provision and contracts. Proceedings of the 2004 Crystal Ball User Conference, Denver, USA. http://www.hcaf.biz/Financial%20Risk/CBUC_Paper.pdf

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

Jones R (2008a) Financial risk in practice based commissioning. BJHCM 14(5): 199-204.

Jones R (2008b) Financial risk in health purchasing: risk pools. BJHCM 14(6): 240-245.

Jones R (2008c) Financial risk at the PCT/PBC Interface. British Journal of Healthcare Management 14(7): 288-293.

Jones R (2009a) The actuarial basis for financial risk in practice-based commissioning and implications to managing budgets. Primary Health Care Research & Development 10(3): 245-253.

Jones R (2009b) Emergency admissions and financial risk. British Journal of Healthcare Management 15(7): 344-350.

Jones R (2010a) Emergency preparedness. British Journal of Healthcare Management 16(2): 94-95.

Jones R (2010b) Trends in programme budget expenditure. British Journal of Healthcare Management 16(11): 518-526.

Jones R (2012a) Time to re-evaluate financial risk in GP commissioning. British Journal of Healthcare Management 18(1): 39-48.

Jones R (2012b) Why is the 'real world' financial risk in commissioning so high? British Journal of Healthcare Management 18(4): 216-217.

Jones R (2012c) Volatile inpatient costs: implications to CCG financial stability. British Journal of Healthcare Management 18(5): 251-258.

Jones R (2012d) Financial risk in commissioning: cancer costs. British Journal of Healthcare Management 18(6): 315-324.

Jones R (2012e) End of life and financial risk in GP commissioning. British Journal of Healthcare Management 18(7): 374-381.

Jones R (2012f) Could cytomegalovirus be causing widespread outbreaks of chronic poor health. Hypotheses in Clinical Medicine, Chapter 4, Eds M. Shoja et al. New York: Nova Science Publishers Inc

Mirchandani S, Aharonoff G, Hiebert R, Capla E et al (2005) The effects of weather and seasonality on hip fracture incidence in older adults. Orthopedics 28(2): 149-155.

Parsons N, Odumenya M, Edwards A, Lecky F, Pattison G (2011) Modelling the effects of the weather on admissions to UK trauma units: A cross sectional study. Emergency Medicine Journal 28: 851-855.
Rising W, O'Daniel J, Roberts C (2006) Correlating weather and trauma admissions at a level 1 trauma center. J Trauma-Injury Infection & Critical Care 60(5): 1006-1100.
Stomp W, Fidler V, ten Duis H-J, Nijsten M (2009) Relation of the weather and lunar cycle with the incidence of trauma in the Groningen region. J Trauma 67(5): 1103-1108.