The Actuarial Basis for Financial Risk in Practice Based Commissioning and Implications to Managing Budgets.

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Poisson Statistics Explained

Poisson statistics is used to explain the chance variation around the average for a variety of 'arrival-type' situations such as telephone calls per hour at a surgery, GP referrals per week, emergency admissions per day, A&E attendances per week, i.e. anything that has a rate per unit of time. The variation seen for a Poisson distribution has a standard deviation which is equal to the square root of the average. Hence if we expect an average of 100 GP referrals per month the standard deviation will be ± 10 or ± 10%. The outcome of Poisson statistics can only be a positive integer value greater than zero, i.e. you cannot get a fraction of a patient. A Poisson distribution is skewed such that the most common values are always the average and the average less one and it has a tail of higher than expected outcomes which create havoc with healthcare budgets.

Key Messages for GPs and Commissioners

- Financial risk in healthcare is very high
- Population groups of greater than 100,000 are required to reduce the chance risk to an acceptable level
- A substantial proportion of high cost/low frequency healthcare events and high cost individuals need to be placed in to a larger risk pool which needs to cover more than 1,000,000 head to avoid the risk pool itself becoming a source of unacceptable risk
- Additional risk above that from simple chance arises from emergency admissions which typically have 2- to 3-times higher risk than simple chance variation
- The allocation of budgets is also subject to the risk of over- or under-funding relative to other groups
- The high inherent variation in healthcare implies uncertainty in the allocation of budgets and leads to large scale swapping between budgets to 'manage' chance pressures
- For 100,000 head the combined financial risk (after excluding high cost events) implied for PBC is around ± 9% (95% confidence interval)

Areas for Further Research

- Can primary care actually demonstrate statistically significant levels of 'demand management' in the face of high background variation?
- To what extent does the weather and other environmental variables cause demand to fluctuate and how could primary care be better supported via illness forecasts?
- Is the implied financial risk in healthcare compatible with Practice Based Commissioning or does PBC need to have a more defined focus?
- Should a national risk fund be used to cover the very high risk associated with high cost admissions/individuals?

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Abstract

Aim: The aim of this paper is to be both educational and thought provoking. The financial risk associated with acute budgets is an issue which affects everyone in primary care, and the calculation of the size of the financial risk is explained in an easy-to-understand way.

Background: The shift in financial responsibility toward practice based commissioning (PBC) in England opens the need for a deeper understanding of the actuarial basis of financial risk in healthcare purchasing.

Methods: A mixture of literature review and re-interpretation of various data sources are used to highlight the relevant issues.

Findings: Poisson, Negative Binomial and Extreme Value distributions lie behind the expression of overall financial risk. Low volume and hence, high risk events, tend to have a high cost and the high cost further magnifies the underlying chance risk. Particular diagnoses associated with emergency admissions have an even higher risk profile due to the influence of metrological and environmental factors. In a capitation funded environment where the budget is fixed the financial risk is higher than acceptable for populations of less then 100,000 head. A large proportion of the overall budget needs to lie within a large regional risk pool in order to allow PBC to flourish within a financially stable environment. These conclusions will also apply to health maintenance organisations (HMO) in the USA.

Introduction

The shift in financial responsibility toward practice based commissioning (PBC) opens the need for a deeper understanding of the actuarial basis of financial risk in healthcare purchasing. This paper first presents the statistical basis for this risk and then looks at the implications to the day to day running of practice budgets such as what type of reports will be needed, budgets for practices in a group and the issue of overspends.

The term 'risk' implies the chance-based variation in the total cost of healthcare for a fixed population. Hence costs in a single year may be higher or lower than the long-term average trend in costs. The first study applicable to the UK looked at the financial risk associated with elective admissions in GP fundholding (Crump 1991). The risk associated with costs (90% of outcomes) was found to be ± 27.5%, ± 15.3% and ± 5.7% for 9,000, 24,000 and 180,000 head respectively. The study of Bachmann & Bevan contained an excellent review of the early literature on financial risk in healthcare purchasing (Bachmann 1996). They then investigated catastrophic costs for 15 rare or costly conditions and concluded that an absolute minimum of 30,000 head was needed to avoid catastrophic financial loss. The essential need for risk sharing arrangements was highlighted. A study in the USA relating to Health Maintenance Organisations (HMOs); which have similarities with PBC groups, concluded that groups should merge to attain a minimum of 115,000 enrolees, i.e. head of population (Given 1996). Another study using the York Index (an early attempt at a weighted capitation formula suited to the needs of GP fundholding budgets) concluded that for 10,000 head the risk exposure (in terms of a percentage of the average budget) was in the range ± 20% and that there was a 35%

chance of budgets exceeding ±10%, ±3.2% and ± 1.6% for 10,000; 100,000 and 500,000 head respectively (Martin 1997). This was followed by a paper reviewing the organisational and risk elements relating to primary care groups which concluded that a population in the range 50,000 to 100,000 allowed the best balance between risk and the control of costs (Bojke 2001). A study on financial risk for municipal healthcare purchasers in Finland reached similar conclusions to those above and recommended that small purchasers needed to form larger purchaser risk pools (Mikkola 2003). Finally a study in Northern Island on the financial risk associated with the 'need index' which forms part of the capitation formula showed that a population base of 100,000 head was needed to reduce this part of funding risk to an acceptable level (DHSSPS 2004). Interest in the topic then declined, however, in the interval the development of the capitation formula, payment by results (PbR) and the supporting health resource group (HRG) tariff mean that a more up to date evaluation is required.

However, in summary, different methods of analysis all reach a consensus that around 100,000 head are needed to reduce the financial risk arising from chance variation in both costs and allocated budgets (funding) down to an acceptable level.

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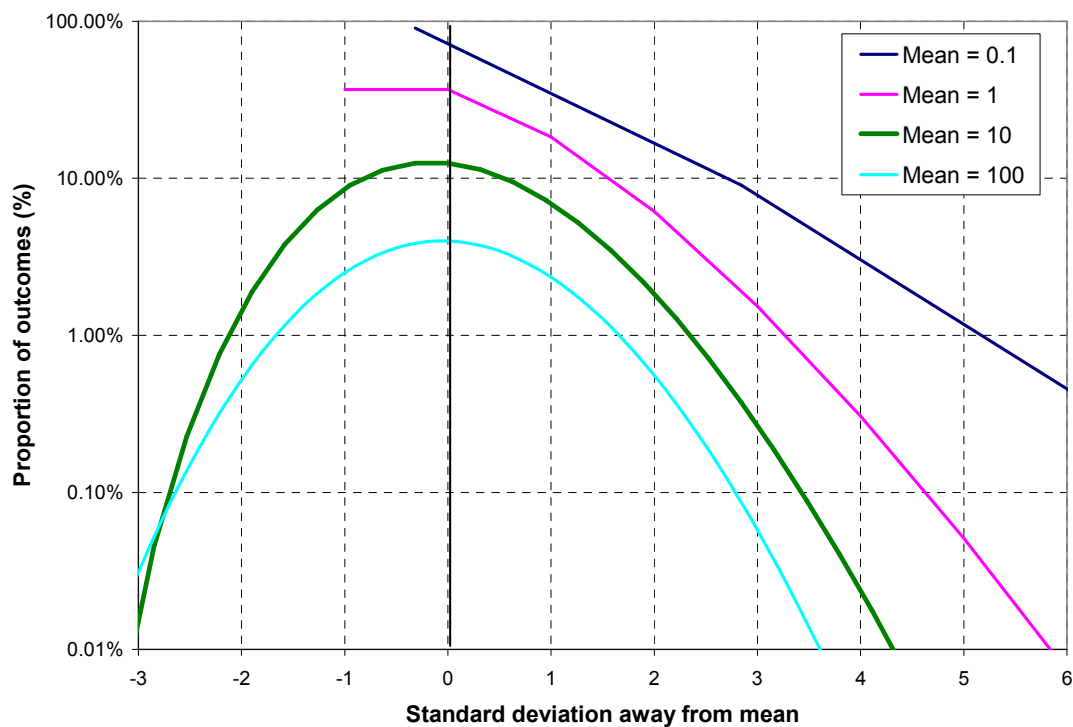**Statement of Competing Interests:**

None

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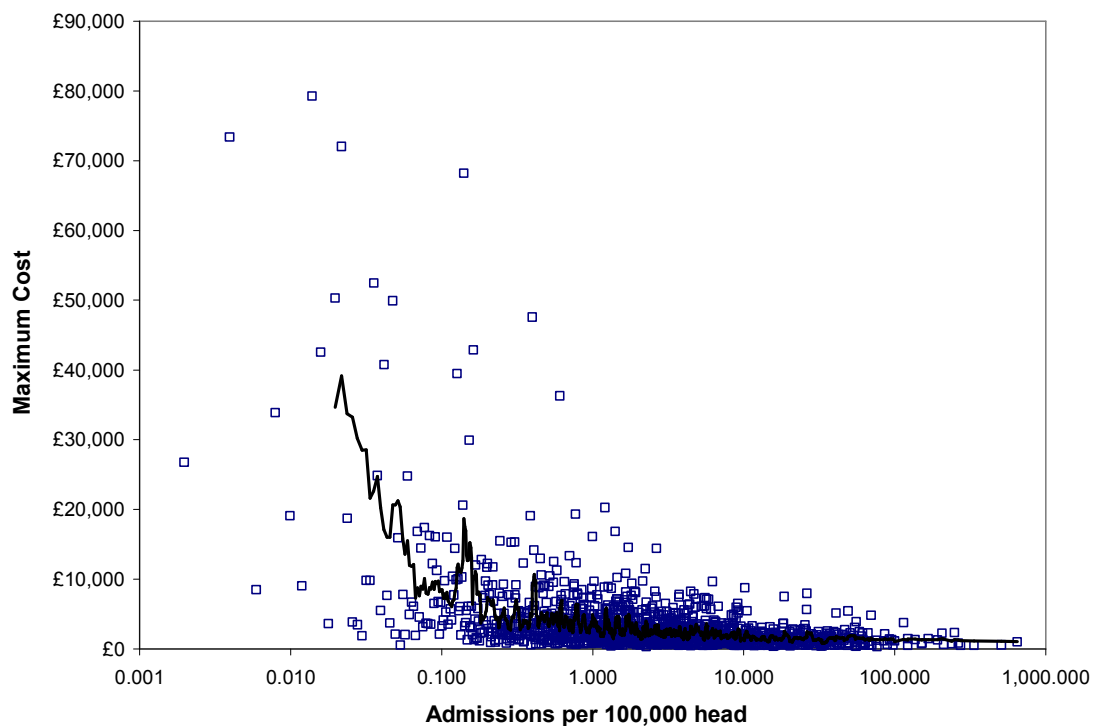
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Figure 1: Variation around the average for the number of persons with a disease or condition seen in a group of people such as a practice list, PBC group or PCT.

Note to editor: can you remove the decimal places form 1.00%, 10.00% and 100.00%

Figure 2: Maximum cost for version 4 HRG with different number of admissions per annum (converted to admissions per 100,000 head)

Footnote to Fig 2: The solid line is a running average of the previous 10 data points.

Note to Editor – can you remove the decimal places for the x-axis where the number is 1, 10, 100 or 1,000