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EYE OF NEWT AND TOE OF FROG : A GOOD FORMULA FOR HEALTH?

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FIRST WITCH.	*Round about the caldron go*;
	In the poison'd entrails throw.....
SECOND WITCH.	*Cool it with a baboon's blood,*
	Then the charm is firm and good.....
HECATE.	*O, well done! I commend your pains*;
	And everyone shall share i' the gains

(Macbeth)

From HSJ to Hansard

The Health Service Journal (HSJ) is a lively forum for debate about the National Health Service — and the place to look if you want a job in that continuously reforming organization. But the Primary Care Trust (PCT) managers who lost their jobs in 2005 may be thinking that they have been deprived of their "share i' the gains" — a personal injury exacerbated by the insult that it was only by their own poor management that their PCT accounts got into the red on such a scale.

Strictly speaking, the "share" to which Shakespeare presciently referred is not a personal one but the PCT share of the 60 billions that the 303 PCTs of England got from Gordon Brown in 2005. And for the witches' forecast, we have to substitute the complex mathematical-statistical resource allocation formula devised in – yes! – Scotland by six economists and a statistician. The role of Hecate has to be played by any one of the political masters of England who commissioned the statistical study and who put it into practice with the honourable aim of allocating funds 'according to measures of need'.

In April 2003, John Hacking (research officer of the Manchester Joint Health Unit) had an article in the HSJ entitled 'Beggars belief'. His paper did not question the validity of the formula as the appropriate basis for target allocations, but analysed the consequences of the slow progress in implementing it. The promised reductions in health inequalities would take more than 20 years to achieve — during which some PCTs would be 'winners' but others would be serious 'losers'. On HSJ's 'Data briefing' page of September 2005, another John (Professor Appleby, chief economist of the King's Fund) noted that the up-to-two-fold variation in *per capita* funding of PCTs had

> ‘not met the original working party objective of resource allocation: to ensure equal opportunity of access to health care for people at equal risk.’

Other issues of HSJ echo the current crisis in PCT finances. December 2005 has Professor Drinkwater (president of the NHS Alliance) telling us that

> ‘Many are struggling with deficits. They are only doing the immediate and necessary and not thinking about the long term.’

A week earlier, Michael White came close to a question about the allocation formula itself with

> ‘Part of the pain arises from an NHS in rapid transition on all fronts. Part comes from the old Left-Right battle over funding which saw a running fight over £30M of cuts in Oxfordshire’s health economy: being deemed prosperous (which much of it is) it gets only 85 per cent of national average funding.’

Most observers of the PCT scene show little curiosity in the *per capita* formula to which the 85% refers. There are anecdotal reports of speakers at health service conferences reassuring their audiences that the formula is ‘about right’, but not about whether they were challenged to give their grounds for saying that. Are such judgements (about the slicing of a Treasury cake into 303 pieces!) any more than echoes of the ‘old Left-Right [really North-South] battle’? Or are they based on an understanding of how the formula was devised? Can we be sure that the PCT financial deficits do not stem, at least in part, from deficiencies in the formula itself?

For government, changing a funding formula has to be like launching a newly designed battleship in wartime. Steering committees and their freshly enrolled academics work on the new formula in backrooms until its shape has to be revealed on launch day. The current formula became operational in April 2003 after years of trial, error and compromise. As late as January, the following exchanges took place in the House of Commons, as recorded in Hansard[1]:

‘Mr Watts: To ask the Secretary of State for Health whether the proposed new funding system for the NHS will take into account the number of people who have private health insurance in a particular area.

Mr Hutton: The new formula used to allocate revenue resources to primary care trusts for 2003-04 to 2005-6 is concerned with health care need and not availability of private care. The research on which it is based excluded all private episodes of care on the grounds that the need for national health service resources was being modelled. The research also takes account of supply factors such as private hospitals.

David Wright: To ask the Secretary of State what work is underway to review NHS funding formulae.

Mr Hutton: The formula used to allocate National Health Service revenue resources has been reviewed by the Advisory Committee on Resource Allocation. Following the review the allocations to primary care trusts for 2003-04 to 2005-06 were based on the new formula.

Dr Fox: To ask the Secretary of State for Health if he will publish the new formula for allocation of health spending to health authorities and trusts.

Mr Hutton: The 2003/2004 to 2005/2006 Primary Care Trust Revenue Resource Limits Exposition Book has been published. This shows how each Primary Care Trusts’s allocation has been calculated using the new formula. . . . Later this year we will publish a revised version of Resource Allocation Weighted Capitation Formulas which will describe the new formula. The team who carried out the research into the new formula have published Allocation of Resources to English Areas, a full report of their findings. It can be found at http://www.nhsis.co.uk/isd/_services/info_consult_AREAReport.htm.

Mr Watts: To ask the Secretary of State for Health if he will list primary care trust allocations for 2003-04, including (a) allocations per head and (b) a statement of the deprivation levels in each PCT area.

Mr Hutton: Primary care trusts revenue allocations for 2003-04, 2004-05 and 2005-06 were announced on 11 December 2002. Information by primary care trust on allocations, 2003-04 allocations per weighted head and unweighted head and need index in the funding formula which provides an indicator of deprivation have been placed in the Library.’

My colleague Jane Galbraith and I started our investigation of national PCT funding in 2003. I had been motivated, by some extraordinary proposals by the Director of Public Health in the Hillingdon PCT for the internal distribution of Hillingdon's allocation of £**200**M, to wonder whether all was well at the national level. The access difficulties that some MPs had in finding out about the 'new formula' were reflected in our own experiences. But, with assistance from the Department of Health's Resource Allocation team in Leeds, we were able to locate and download the three huge files[2, 3, 4] on the web that Minister John Hutton had referred to in his answer to Dr Fox. These files were then essential reading for anyone wanting to know what the new formula is and why it is what it is. Our findings have been boiled down into two technical papers[5, 6] designed to make that onerous task inessential for a readership with some knowledge of mathematical statistics.

One would have to ask Dr Fox himself what he did with the references he got from Mr Hutton. Perhaps he went for help to the Conservative Central Office's research department. What follows is written for those without statistical training and without access to a tame statistician for guidance or explanation.

What is the general shape of the formula that now generates the PCT target allocations?

To answer that question, it is best to start with the 'description' of the formula in the Weighted Capitation Formula document[3]. This is an excellent piece of work by DoH Leeds that goes beyond mere description — it is in fact a precise specification. Its only lacuna is that one has to go through 21 appendixed pages of arithmetic examples in order to pin down the exact (algebraic) shape of the formula.

The 'new formula' is the current 'weighted capitation formula' that determines the *target allocations* for each of the PCTs of England — the targets that John Hacking saw as being implemented far too slowly. Figure 1 shows how the target allocations for 2003/4 deviated from the (unacceptable) formula that would provide the same funding for every individual. For that formula, allocation would be proportional to population and all the PCTs would lie on the same line through the origin.

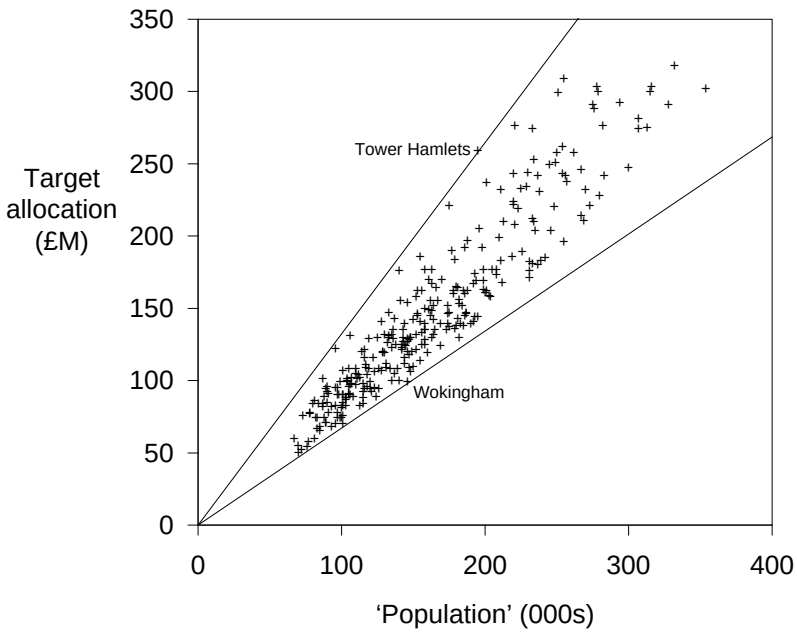

Figure 1: Target allocation for 2003/4 plotted against population for the then 304 PCTs. The straight lines are lines along which *per capita* allocation remains constant from PCT to PCT. The main reason for the divergence of the lines through Wokingham and Tower Hamlets is the allowance the formula makes for inequalities in socio-economic variables and regional costs over and above the allowance for differences between PCT age-profiles.

For 2003/4, over 93% of the total of the then 304 target allocations was for the so-called 'unified' targets. These were calculated for each PCT by the equation:

$$\textbf{Unified target population} \quad =$$

$$0.8276\times\textbf{HCHS} \;+\; 0.0067\times\textbf{HIV/AIDS} \;+\; 0.1407\times\textbf{Prescribing} \;+\; 0.0250\times\textbf{GMSCL} \qquad (1)$$

In equation (1), the numbers in bold are *notional populations*. Take **HCHS** for example. From a formula yet to be explained, each PCT gets a number **HCHS** that is a notional population adjusted to take account of its supposed need for hospital & community health services. Some adjustments go up and some go down but the total stays fixed at the population of England. Likewise for the other three terms on the right-hand side of equation (1): **HIV/AIDS**, **Prescribing** and **GMSCL** (General Medical Services Cash-Limited). These four notional populations are then combined with weights 0.8276, 0.0067, 0.1407 and 0.0250 (that add to 1.0000) to give the **Unified target population** on the left-hand side of the equation. The weights are explained in paragraph 156 of the Weighted Capitation Formula document[3] as based on estimates (from 2000/2002) of national expenditure in the four areas.

Each of the four notional populations has its own specialised provenance. To keep this piece within bounds, I will focus only on **HCHS** — the component that takes about 83% of the expenditure. This happens to be the only bit of the 'new formula' that relies for any justification on the third of John Hutton's documents — the so-called AREA Report[4]. The notional population **HCHS** is calculated by making it proportional to the PCT population adjusted up or down by no less than four indices:

$$\text{PCT population} \times \mathrm{I}_{age-profile} \times \mathrm{I}_{need} \times \mathrm{I}_{MFF} \times \mathrm{I}_{EACA} \qquad (2)$$

where MFF stands for Market Forces Factor and EACA for Emergency Ambulance Cost Adjustment. The two indices I_{MFF} and I_{EACA} were introduced by DoH Leeds and do not raise any fundamental issues (although MFF does have a major influence in formula (2)). In comparison, the indices $\mathrm{I}_{age-profile}$ and I_{need} turn out to be cans of worms. The first, $\mathrm{I}_{age-profile}$, is the ratio of the estimated *per capita* cost of the PCT's hospital & community health services (when the individuals in its population are assigned the *per capita* national HCHS cost for the age-band in which they fall) to the national *per capita* HCHS cost. The variation of $\mathrm{I}_{age-profile}$ from PCT to PCT therefore depends only on differences in the age-profile (factor 1 in Table 1 below). One cannot be certain but I think that it is the product of PCT population and

$I_{age-profile}$ (a product that is 'normalised' i.e. adjusted to keep the total equal to the national population) that John Hutton was referring to as the 'weighted head' in his last answer to Mr Watts. If so, the answer would have been clearer had it used the phrase '*age-weighted* head'.

We can take it that Hutton's reference to a 'need index in the funding formula which provides an indicator of deprivation' must have been to the second index I_{need}. This index turns out to play a crucial role in determining how far PCT allocations differ from equal but unacceptable *per capita* funding. Its influence outweighs that of the age-weighted index $I_{age-profile}$. DoH Leeds created it as a weighted combination of two indices — I_1 for acute & maternity services and I_2 for mental health services with weights corresponding to the relative expenditures on these two services. They lifted I_1 and I_2 — 'lock, stock and barrel' as it were — from the AREA report[4]. The two indices are themselves weighted combinations of a number of socio-economic factors or variables: I_1 is a function of factors 2-10 in Table 1 — I_2 of factors 11-14. Factors 15-19 in the table complete the list of factors that need to be estimated for each PCT in order to calculate **HCHS** in (2) and **Unified target population** in (1).

Before taking a closer (guided) look at the complex mathematical-statistical issues in the construction of I_1 and I_2 — issues that regrettably raise the question of politically-inspired manipulation of a supposedly independent scientific study— I will present a graphical appreciation of how the 19 factors listed in Table 1 can combine to produce big differences in the unified target allocation of individual PCTs. For comparison of the PCT unified targets that determine most of any allocation, the quantity of interest has to be the *per capita* ratio of **Unified target population** to the actual population for which the PCT is responsible. Call this ratio the *target index*.
Figure 2 exploits the order in which the 19 factors are listed in Table 1. This is the order in which the factors were incorporated in DoH's illustrative calculations[3] of the unified target population. If the calculation is stopped after a number of the factors have been incorporated, a 'target index' (call it a *partial index*) can be calculated if national averages are used (instead of the PCT's own values) for the remaining factors. As each factor is incorporated, the value of the partial index changes, responding to its influence on top of the already incorporated factors. The change shows as an increment or decrement on the line of the graph. When all 19 factors have been incorporated, the partial index coincides with the target index itself.

Table 1. The factors or variables directly involved in calculating the Unified Target Population.

1	Age-profile
2	Low-education score
3	Proportion of low birthweight babies
4	Standardised mortality ratio under 75 years
5	Proportion of over 75s living alone
6	Standardised birth ratio
7	Low-income score
8	Nervous system morbidity index
9	Circulatory morbidity index
10	Musculo-skeletal morbidity index
11	Comparative mortality under 65 years
12	Proportion of over 60s claiming income support
13	Poor-housing score
14	Psycho-social morbidity index (PSMI)
15	Market Forces Factor (MFF)
16	Emergency Ambulance Cost Adjustment (EACA)
17	HIV/AIDS
18	Prescribing
19	General Medical Services Cash-Limited (GMSCL)

The four morbidity indices are themselves combinations of socio-economic factors.

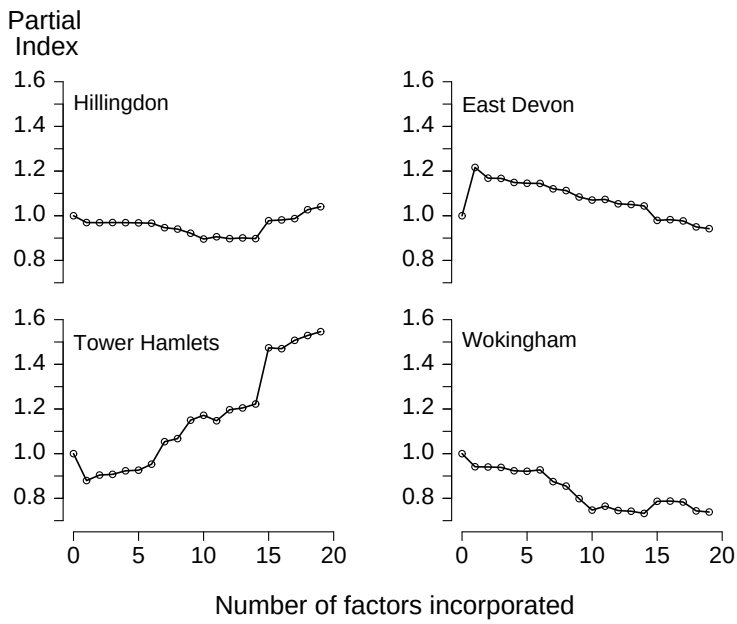

Figure 2: Comparison of four PCTs in the sequential build-up of the target index, as more and more factors are 'incorporated' (i.e. allowed to express their variation from PCT to PCT). The first point plotted is for the unacceptable model of equal *per capita* allocation. The last point is the target index for the recommended formula i.e. the partial index when all 19 factors have been incorporated (i.e. the *per capita* ratio of Unified Target Population to Population).

Figure 2 uses data for 2003/4 from the Resource Allocation Exposition Book[2] to compare my own PCT, Hillingdon, to three PCTs with contrasting socio-economic profiles. The target index is the last value plotted in each graph — 1.04 for Hillingdon, 0.94 for East Devon, 1.50 for Tower Hamlets and 0.74 for Wokingham. The first point in Figure 2 corresponds to the equality model in which everyone has the same *per capita* allocation with no weighting of PCT populations. The second point is the partial index in which all factors in the formula except factor 1 (age-profile) are set at their national average values. The third point then adds the education variable to the age-profile factor to show its additional influence on the target index, while factors 3-19 stay at their national values. And so on, until we get to the target index itself.

Figure 2 shows the initial dip for Tower Hamlet's youthful population in contrast to the rise for East Devon's relatively aged population. Variations in age-profile can have a major influence — but it is one that is usually outweighed by the cumulative effect of the multiplicity of factors that DoH were hoping would 'replace the age-related components of the existing formulae'[4]. The other major single influence is Market Forces (factor 15) where only East Devon does not benefit, in contrast to the three PCTs in the London area. Michael White's figure of 85% for Oxfordshire is probably an updated composite of the 2003/04 target indices 0.87, 0.78, 0.80 and 0.83 for Oxford City and the three surrounding PCTs. A partial index plot for these four PCTs would give additional insight into the build-up of their indices.

Why is the shape of the formula what it is?

John Hutton's statement that 'the team who carried out the research into the new formula have published Allocation of Resources to English Areas' may have been designed to reassure Dr Fox — but it is only half-true. And the half that is not true may well have significant consequences for PCT allocations. The AREA team *did not do any research on the 'new formula'*. What they did was to generate a goodly number of different indices each for a different purpose, of which I_1 and I_2 were the ones lifted by the DoH Leeds team from their report. DoH Leeds can be said to have been 'spoiled for choice', and they deserve sympathy for the difficulty they must have had in choosing between the different conflicting recommendations of the AREA team. In the end, they did something with the two indices they selected — in putting them together in formula (2) in the way they did — that was quite different from anything in the AREA report.

The Department of Health documents[2,3] provide the arithmetic detail (no doubt reassuring to PCT managers) of the calculation of the target allocation for each PCT — but nothing resembling a theoretical justification of the 'new formula'. What about the individual theoretical justifications of the two fish that DoH Leeds pulled out of the well-stocked AREA pool? The AREA team had a confident mission statement that excluded all doubt.

> 'The allocation of resources for health care across geographical areas in the NHS is based on the principle that individuals in equal need should have equal access to care, irrespective of where they live. To implement the principle it is necessary to measure need for health care in different areas. But those allocating resources do not have sufficient information to measure need directly. The basic assumption underlying the resource allocation procedure is that use of health services is determined by patient need and by supply. Statistical modelling of the relationship between utilisation, socio-economic variables (including measures of health) and supply factors can identify which socio-economic variables are indicators of need because of their effect on utilisation. Information on the level of such socio-economic variables across areas can then be used to allocate resources in a way that reflects need.'[4]

The separate 'statistical modelling' of existing levels of utilization of acute & maternity services (A & M) and mental health services was a huge study — and probably one that cost DoH a huge sum in consultancy fees and related overhead charges. In the end, it appears to have been little more than trial and error applications (witches' brews) of the classical statistical technique of least-squares multiple regression, applied to selected subsets of a very large number of variables — socio-economic ones lined up to act as proxies for direct measures of health need, and supply factors whose influence had to be taken into account and then discounted. This is how it was done for the hospital component of A & M:

(i) In each of over 8000 electoral wards blanketing England, the cost to the NHS was crudely estimated of the A & M hospital treatment of patients registered with GPs in the ward. An index I_{cost} was calculated for each ward as the ratio of that cost to the notional cost that would have been incurred if each of the registered population had generated costs at the level of the national average for his/her age band. (If they had done so, the index would be unity.)

(ii) In the year 2000/2001 for which the costing was done, the NHS in England was organised as 95 Health Authorities with an average of about 90 wards per authority. The statistical modelling was concerned only with the differences in I_{cost} between the wards within individual authorities. The modelling took no interest in the differences between the average values of I_{cost} in different health authorities. This was on the grounds that *those* differences would be confounded with differences in the overall supply factor of an authority (affecting equally all wards in the authority), and so should be discounted as not being true expressions of health need differences between wards.

(iii) A huge battery was then assembled of over 80 socio-economic factors (described as 'need' variables) supplemented a large number of measures (described as 'supply' variables) of how wards differ in their access to services. The numerical values of all these variables was then calculated for each of the more than 8000 wards from a variety of databases — the 1991 Census (the 2001 Census not then available), general practice registers, hospital episode statistics and the like.

(iv) The scene was now set for the witches' brews. The numerical values for each ward of a large number of judiciously selected variables from the battery and of the index I_{cost} are poured into the cauldron and left to boil. When done, most of the variables have been eliminated and only a few survive the boil. Each brew has an output which is an intermediate formula with the following shape (the same for all 8000-plus wards except for the mandated second term that soaks up the health authority differences):

An overall constant (estimated)
$+$ *A health authority variation (estimated)*
$+$ *Some multiple (estimated) of the first surviving supply variable*
$+$ *Some multiple (estimated) of the second surviving supply variable*
$+$ *etc.*
$+$ *Some multiple (estimated) of the first surviving socio-economic variable*
$+$ *Some multiple (estimated) of the second surviving socio-economic variable*
$+$ *etc.*

(v) The recommended index I_1 is the intermediate formula without the health authority variation and with national averages inserted as values of the supply variables, which is taken to be an effective

correction for differences in supply.

(vi) When DoH Leeds put I_1 into the 'new formula' and applied the latter to calculate the PCT target allocations, it used values of the socio-economic variables calculated for each PCT as a whole.

A historical warning.

The estimates of the overall constant and the multipliers ('coefficients') at stage (iv) were the result (in the final bit of the final brew) of a least-squares fitting of the intermediate formula to the 8000-plus values of I_{cost}. The way this is done has not changed much since the technique was invented by Karl Friedrich Gauss over 200 years ago. Gauss did apply the technique to formulae resembling the one in (iv) here i.e. expressions that are *additive* in the sense that each variable simply adds its voice to the formula without interacting with any other variable. Such simplicity was justified for Gauss because he was concerned with geodetic surveys which had such simplicity built into the mathematics of the underlying science.

A hundred years later, the English school of statistics under Karl Pearson at University College London and later with R. A. Fisher at Rothamsted developed 'multiple regression' (least squares with more than one 'explanatory' variables) as an investigative tool in the study of empirical relationships. This approach was taken up enthusiatically in sociology, especially economics, where it was seen as a way of enhancing the scientific status of those areas of study. In a now-generalised form, it is now commonplace in epidemiology and is the source of the almost daily panics that such-and-such factor has such-and-such risk when 'account has been taken' of a number of possibly confounding factors — all done with a simple additive formula that does not survive the conflicting evidence of further studies.

Statistical modesty and the DoH remit.

The AREA team did not make any presumptuous claims for their 'investigative' and 'exploratory' study. Their Summary Report does something that executive reports rarely do — it even softened an already soft sentence in the above large quotation from the Full Report[4], to read:

> Statistical modelling of the relationship between utilisation, population characteristics (including measures of health) and supply factors *can inform decisions about which population characteristics are indicators of need* [my italics].

To be merely informed about indicators is a far cry from insisting that the indices of need I_1 and I_2 can be the basis of a formula for slicing a money cake. I think that DoH should have taken this as a warning that the more positive assertions in the Full Report may have been academically playful responses to the remit given to the AREA team — a remit based on unrealistic expectations of what statistical modelling a-la-Gauss can achieve when it lacks any science to keep the modelling in touch with reality.

The remit had a number of jobs for the AREA team to attend to. DoH wanted a single index of need to replace the two that had been invented by the previous consultancy team at the University of York in 1993 and had been in use for nearly a decade. But AREA was unaccommodating about that and it was left to DoH Leeds to provide the single index I_{need} that allowed John Hutton to keep things simple in his answer to Mr Watts. Another task was to investigate 'alternative methodologies to replace the age-related components of the existing formulae'[4] — which would mean doing away with the index I_{age} in formula (2). A PCT's age-profile was to be the only influential socio-economic factor that would be ruled out as a proxy for health need! Again, to its credit, AREA was unaccommodating.

But AREA was willing to play along with DoH's request that it *propose* (not, be it noted, merely investigate) 'a methodology to adjust for unmet need' — a supposed deficit in I_{cost} arising from some section of the population. This is what AREA did about 'unmet need' for mental health services to 'ethnic minorities'. The relevant variable is the 'Proportion from ethnic minority groups' calculated for each ward from 1991 Census data — a better description of which is 'Proportion of non-whites' (PNW). This was a repeated input to the multiple regression brews that tried to fit intermediate formulae to the I_{cost} for mental health services. In the first brew reported by AREA, the multiplier (coefficient) of PNW did not reach a high enough level of statistical significance to be included in what AREA called its basic model for inpatient mental services — which could have been recommended as generator of I_2 if PNW had not been favoured for further attention above all the other non-significant variables.

The idea was that PNW's non-significance may be due to the mutual cancellation of two factors — an unmet need for the average non-white ethnic individual (age-adjusted *per capita* utilization measure I_{cost} goes down as PNW goes up) cancelled by the effect of a positive correlation between PNW and some morbidity measure not yet thought of (PNW acts as proxy for the omitted morbidity measure and, according to the formula, I_{cost} would go up with PNW). So AREA went fishing for the missing measure

that would do the job — and found it in the shape of a psycho-social morbidity index (PSMI). When both PNW and PSMI were added to the next brew, both variables passed the statistical significance test — PSMI with a positive and PNW with a negative multiplier (-0.034). Here, then, was the methodology that would adjust for unmet need. By keeping PSMI in the formula for I_2 but dropping PNW, the formula would go some way to compensate PCTs with high PNWs — by interpreting the $0.034 \times$PNW as a measure of the unmet need that has to be added to the intermediate formula to put things right. I like to think that AREA was being tongue-in-cheek in recommending such compensation.

Statisticians will widely question the validity of a heavily selected formula whose need variables explain at most 36% of the variation in a least-squares multiple regression. They will also notice, if they cut PSMI open, that it has PNW as a major component, and that the formula puts great trust in the age-profile adjustment when age-profile is strongly correlated with PNW. They will conclude that AREA's unmet need methodology is almost certainly a chimerical artefact.

The gap between formulae and truth

The AREA team should not have let their natural wish to fulfil the contract override the good sense they must have had about how far their formulae are likely to be from a direct and true measure of health need. No-one can really quarrel with a formula, based on a moderate number of explanatory variables, that is a close fit to a large number of 'observations' (unless those variables have been selected as the best-fitting subset of a large number of variables) — the achievement of a close fit gives assurance that the thinking behind the formula has some basis in reality. The intermediate formulae for both I_1 and I_2 are not in that league. By the conventional measure of closeness of fit, I_1 achieves only 76% and I_2 only 36% of the 100% that would represent a perfect fit to the relevant I_{cost} — and those percentages include what is achieved by the health authority and all the other supply variables. On top of that, I_2 fails to pass the only statistical test that AREA uses to judge whether the formula is 'well-specified'. In both cases, the simple additive formulae may be far from providing a valid measure of health need. That matters because it is the gap between existing allocation and target allocation (based on the formulae) that is to be closed — more quickly than it is, if Mr Hacking had his way.

What next?

I suppose the Department of Health likes to see its current formula as the culmination of evidence-based improvements over three decades — ever since Crossman authorised the first formula in the late Sixties. In those less sophisticated days, regional inequalities were addressed by adjusting the regional population by a very simple wheeze — add *half* the annual number of 'bed-years' in the region and *quarter* the annual number of 'cases', and make the allocations proportional to the resulting notional populations. Those were the days when the simplest of fractions would serve as coefficients.

The same preference for simplicity was the superficial justification when, in the late Eighties, DoH used 'half' to overrule the finely-tuned power of 0.44 in the proposed regional health authority formula

$$\text{Allocation} \quad \propto \quad \text{Population} \times \text{I}_{\,age-profile} \times (\text{SMR75})^{0.44}$$

where SMR75 is the Standardised Mortality Ratio of the under-75s. Or so it seemed. The real reason may have been political: 0.44 would have been a little too drastic in returning to the South some of the resources that had been moved North by an earlier development of the Crossman formula.

Others see DoH's 'improvements' in a different light. Professor Alan Maynard has made the general comment:

> The government's propensity to produce endless evidence-free wheezes that 're-disorganise' the NHS's structure and perverse incentives is accompanied by 'spin' that gives the illusion of integration of initiatives, when none exists. Sadly, this approach fails to tackle basic issues such as indefensible variations in practice in every part of the NHS[7].

As far as formulae are concerned, I am not the only one who sees the three decades of formula-mongering not as a path to improvement but as a road littered with discarded wrecks. Criticisms[5] voiced by statisticians in recent years include:

(i) "…modelling techniques cannot deal adequately with a system where demand, utilization and supply are so inextricably intertwined…The use of the formulae gives too much importance to

variables which only account for some of the variation. . . The fundamentally political nature of the construction of an allocation policy and the choice of indicators of need must be acknowledged."

(ii) ". . . the search for an empirically based resource allocation formula of high precision in the name of promotion of equity is largely fruitless. . . Attention should increasingly be focused on how resources are used — the effectiveness and appropriateness of health service interventions. . . weighting in the dark [is] an industry which is abstracted from research into, and the management and delivery of, health services."

(iii) "We have become besotted with the production of ever more refined empirically based formulas."

(iv) ". . . a professional consensus should be developed regarding the major methodological issues in this field. If this cannot be provided, it implies either an arrogance among statisticians or the absence of a robust methodological core to the work of the profession, neither of which I believe to be the casewonder whether there is a role for the [Royal Statistical] Society in encouraging and endorsing transparency in this area."

(v) "My third concern is with the existence of the large amounts of unexplained variation in the author's models."

(vi) ". . . however sophisticated the methods, estimating needs weights is essentially contested, that is to say a concept whose application is inherently a matter of dispute."

Goverment departments have a problem when experts disagree. But it cannot be right to pretend that they do not, to use confidential contractual procedures to move from one group of experts to another and to implement the latest formula as if it were an evidence-based, scientifically validated way of dispensing huge sums of public money.

The inconsistency at the heart of things is that a government department that admits its incompetence to resolve a technical problem neverthelss claims to have the competence to choose which of several submitted tenders is the one to engage. Using confidential internal steering committees and additional experts to review that choice is no substitute for the kind of open academic argument about the way DoH interpreted and deployed bits of the AREA work that might inspire new thinking about radical

alternatives (such as the *direct* assessment of health needs in random samples of GP-registered individuals).

There should also be better access to the AREA documents. The key document[4] for the 'new formula' is no longer accessible at the web address that John Hutton gave Dr Fox. Right now (January 2006), if you enter "Allocation Resources English Areas" in Google you will get to the ISD Scotland website which offers, for downloading, both the Full Report[4] (AREA or RARP26) and the Summary Report. It does not tell you that both have been withdrawn and that you have to apply personally for a copy.

I accidentally deleted my old copy of AREA, but I was able to replace it with one from Joan Davis, chairman of Hillingdon's Community Voice, who has been equally interested in Hillingdon PCT's allocation and who got her copy from ISD Scotland by personal application. That is now on my 'homepage' at UCL and can be inspected by simply entering "RARP26" in Google. (I trust that that will not be regarded as a breach of Crown Copyright.) The second AREA publication[8] is no substitute. It does not deal with the indices I_1 and I_2 at the heart of John Hutton's 'new formula'.

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